

**Shifting Interfaces:
art research at the intersections of live
performance and technology**

by

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A thesis submitted to the University of Plymouth in partial fulfilment of
the degree of

DOCTOR OF PHILOSOPHY

by Staff Candidature on the basis of Published Works

Dartington College of Arts

May 2010

Abstract

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This collection of published works is an outcome of my practice-led inter-disciplinary collaborative artistic research into deepening understanding of creative process in the field of contemporary dance. It comprises thirty written works published from 1999 to 2007 in various formats and platforms. This collection is framed by a methodological discussion that provides insight into how this research has intersected over time with diverse fields of practice including contemporary dance, digital and new media arts and non-art domains such as cognitive and social science. Fields are understood in the context of this research to be largely constituted out of the expert practices of individual collaborators.

This research starts from an interest in the impact of new media technologies on dance making/ choreography. The collection of works show evidence, established in the first two publications, of an evolving engagement with two concepts related to this interest: (1) the 'algorithm' as a process-level connection or bridge between dance composition and computation; (2) the empirical study of movement embedded as a 'knowledge base' in the practices of both computer animation and dance and thus forming a special correspondence between them.

This collection provides evidence of this research through a period of community-building amongst artists using new media technologies in performance, and culminates in the identification of an emerging 'community of practice' coming together around the formation of a unique body of knowledge pertaining to dance.

The late 1990s New Media Art movement provided a supportive context for important peer-to-peer encounters with creators and users of software tools and platforms in the context of inter-disciplinary art-making. A growing interest in software programming as a creative practice opened up fresh perspectives on possible connections with dance making. It became clear that software's utility alone, including artistic uses of software, was a limited conception.

This was the background thinking that informed the first major shift in the research towards the design of software that might augment the creative process of expert choreographers and dancers. This shift from software use to its design, framed by a focus on the development of tools to support dance creation, also provided strong rationale to deepen the research into dance making processes. In the second major phase of the research presented here, scientific study is brought collaboratively to bear on questions related to choreographic practice. This led to a better understanding of ways in which dancers and choreographers, as 'thinking bodies', interact with their design tools and each other in the context of creation work.

In addition to this collection, outcomes of this research are traceable to other published papers and art works it has given rise to. Less easily measureable, but just as valuable, are the sustained relations between individuals and groups behind the 'community of practice' now recognised for its development of unique formats for bringing choreographic ideas and processes into contact, now and in the future, with both general audiences and other specialist practices.

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'Virtual Ephemerality: the art of digital dancing'

This is the pre-translation version. The published version

appeared as: 'virtualna efemernost: emetnost digitalnega plesa'

in Maska: Užitek avtomata, May 1999, pp. 45-49.

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and Software for Making Dances'.

This is the pre-translation version. The published version appeared

as: 'Coreografie in Bit e Byte: Motion Capture, Animazione e

Software per la Danza' in *La scena digitale: Nuovi media per la*

danza. eds. A. Menicacci & E. Quinz. Milano: Giangiacomo

Feltrinelli Editore. 2001, pp. 83-100. (See Appenix pp. 377-398)

- No. 3 p. 77
- 'Hot Wired Live Art: observations, reflections and interviews' in
3T: Norwegian Theatre Journal. Spring 2000, pp. 6-17.
- No. 4 p. 91
- 'Virtual Reality and Performance' in Performing Arts Journal. 24:1.
 2002, pp. 105-114.
- No. 5 p. 103
- 'Ballet Moves from Dance Bar to the Smart Dance Studio' in
METATAG, ed. L. Haskel, Amsterdam: BIS. June 2001, pp. 79-81.
- No. 6 p. 107
- 'Armando Menicacci and Emanuele Quinz: interview with Scott
 deLahunta' in *Anomalie digital_arts #2: Digital Performance*. ed.
 E.Quinz. Paris: Anomalie. January 2002, pp. 83-84 (a selection
 Of two pages only).
- No. 7 p. 113
- 'Software for Dancers: Coding Forms' in On Translations:
Performance Research. 7:2 2002, pp. 96-102.
- No. 8 p. 123
- 'Periodic Convergences: Dance and Computers' in *Tanz und Neue
 Medien: Dance and New Media*. eds. Dr. S. Dinkla & Dr. M.
 Leeker. Berlin: Alexander Verlag. 2002, pp. 66-84.

No. 9 p. 135

'Open Source Choreography?' in *Code: The Language of Our Time*. Katalog zur Ars Electronica 2003. Ostfildern-Ruit: Hatje Cantz. 2003, pp. 304-310.

No. 10 p. 145

'The Finished Middle: a Hot Wired Live Art conversation about collaboration, prototypes, tools as art and rules of engagement' in *A Guide to Good Practice in Collaborative Working Methods and New Media Tools Creation*. eds. L. Goodman & K. Milton. London: Office for Humanities Communication Publication 18. October 2005, pp. 105-113.

No. 11 p. 157

'Permuting Connections: Software for Dancers' in *Sound Unbound - an anthology on Sound Art, Digital Media and new Compositional Strategy*. ed. P. D. Miller. Cambridge: MIT Press. 2008, pp. 265-272.

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'Isadora: an interview with artist/ programmer Mark Coniglio' in *International Journal of Performance and Digital Media*. 1:1. 2005, pp. 31-46.

No. 13 p. 185

'The Dimensions of Data Space' in *Anomalie digital_arts #3: Interfaces:Theories & Applications*. ed. E. Quinz. Paris: Anomalie. February 2003, pp. 72-79.

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'Sightseeing on digital pathways' in Pulse: South Asian Dance in the UK. Spring 2003, pp. 6-9.

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p. 201

'Choreography and Cognition: A joint research project' in *Art and Science: Proceedings of the XVIII Congress of the International Association of Empirical Aesthetics*. eds. J. P. Fróis, P. Andrade & J. F. Marques. Lisbon: IAEA2004. 2004, pp. 169-173.

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'Transactables' (co-authors Wayne McGregor & Alan Blackwell).
in On The Page: Performance Research. 9:2. 2004, pp. 67-72.

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'Separate Spaces: some cognitive dimensions of movement'.
This is the pre-translation version. The published version
appeared as: 'Espaces distincts: quelques dimensions
cognitives du mouvement' in Scientifiquement danse:
Quand la danse puise aux sciences et réciproquement:
Nouvelles de Danse. Bruxelles: Contredanse, No.53. 2006,
pp. 150-162. (See Appendix pp 399-412)

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p. 233

'The Human Walking Apparatus: a technological episteme'.
This is the pre-translation version. The published version
appeared as: 'L'Appareil de Locomotion: une Épistémé

Technologique' in Interagir: avec les technologies numériques:
Nouvelles de Danse. Bruxelles: Contredanse. No. 52. 2004,
pp. 36-49. (See Appendix pp. 413-426)

No. 19 p. 245

'Blurring the Boundaries: interactions between choreography,
dance and new media technologies' in *Interface Cultures: Artistic
Aspects on Interaction.* eds. C. Sommerer, L. Mignonneau, D.
Gestrich. Bielefeld: transcript. 2008, pp. 225-235.

No. 20 p. 259

'What's in a Phrase?' (co-author Phil Barnard) in *Tanz im Kopf /
Dance and Cognition.* eds. J. Birringer & J. Fenger. Jahrbuch der
Gesellschaft für Tanzforschung 15. Münster: LIT Verlag. 2005, pp.
253-66.

No. 21 p. 275

'Densities of Agreement' (co-authors Phil Barnard, Ian Nimmo-
Smith, Jennifer Potts & Cristina Ramponi) in Dance Theatre
Journal. 21:3. 2006, pp. 17-23.

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'Moving Ideas: questions for the dancing mind' in ballettanz.
October 2005, pp. 20-23.

No. 23 p. 291

'Willing conversations: the process of being between' in Leonardo.
39:5. 2006, pp. 479-481.

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'Sharing Questions of Movement' in *De theatermaker als onderzoeker: Theater Topics II*. eds. M. Bleeker, L. Heeteren, C. Kattenbelt & K. Vuyk. Amsterdam University Press. 2006, pp. 182-186.

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p. 305

'Sharing Descriptions of Movement' (co-author Frédéric Bevilacqua) in International Journal of Performance and Digital Media. 3:1. 2007, pp. 3-16.

No. 26

p. 321

'Dance (in the presence and absence of) Technology'.
This is the pre-translation version. The published version appeared as: 'Danza y Tecnología' in En moviment. Barcelona: Theatre Institute Mercat de les Flors. October 2006, pp. 16-17.
(See Appendix pp. 427-428)

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p. 331

'Constructing Memory: creation of the choreographic resource' (co-author Norah Zuniga Shaw). in Digital Resources: Performance Research. 11:4. 2007, pp. 53-62.

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'Day of the Figurines with Blast Theory' in Digital Resources: Performance Research. 11:4. 2007, pp. 148-151.

No. 29 p. 349

'Choreographing Cycling Anims' in *SwanQuake. The User Manual*.

ed. S. deLahunta. Plymouth: Liquid Press/i-DAT. 2008, pp. 17-26.

No. 30 p. 361

'Introduction: The Body has to be Clear and the Words have to be

Right'. in *Capturing Intention: documentation, analysis and*

notation research based on the work of Emio Greco | PC. ed. S.

deLahunta. Amsterdam: Emio Greco | PC and Amsterdam School

of the Arts. October 2007. pp. 4-9.

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Non - English Publications p. 371

Acknowledgements

For their support and friendship during the years of research that have gone into the writing in this thesis I would like to thank:

From Dartington College of Arts:

John Hall, Ric Allsopp, David Williams, Josie Sutcliffe, Edward Cowie and Antonia Payne.

From the Amsterdam School of the Arts:

Henk Borgdorff, Marijke Hoogenboom, Bertha Bermudez and Jeroen Fabius

From other places and various times during the research period:

Toni Cots, Mark Coniglio, Daniel Aschwanden, Philippe Baudelot, Bronac Ferran, Jennifer McLachlan, Torunn Kjølner, Armando Menicacci, Emanuele Quinz, Frédéric Bevilacqua, Nik Haffner, Norah Zuniga Shaw, Sarah Whatley, Johannes Birringer, Wayne McGregor, Philip Barnard, James Leach, Bruno Martelli and Ruth Gibson, Matt Adams and Ju Row Farr, Eva-Maria Hoerster, Alexander and Patricia deLahunta.

And especially for assistance on this thesis:

John Hall and Anna Karolina Andersson

Author's Declaration

Scott deLahunta

At no time during the registration for the PhD by Staff Candidature have I been registered for any other University award.

The research put forward in this thesis began in 1996, with the first publication in 1999. That was the year I was first employed by Dartington College of Arts (DCA) as a part-time lecturer for theatre and advisor on digital media and education. In 2000, I became a part-time Associate Research Fellow supported by DCA to continue my research into the intersections between choreography, live performance, new media art and art practices related to digital technology. That contract was renewed annually and continuously through September 2009.

It was understood that as a Research Fellow I would be working remotely, enabling me to remain engaged with the latest developments in the field of professional practice. I maintained a residence in the Netherlands, and the projects I organised and/ or facilitated internationally as part of my research were supported by various institutes of higher education, cultural organisations and festivals. With the support of DCA, I was able to start pursuing this work full- time. The college provided an essential higher education affiliation and the intellectual "home base" for contextualising and furthering my research. I made frequent visits of varying lengths, produced annual research reports for the college, and participated in two RAE exercises. The focus of my research was significantly enhanced by having this home research environment with a stable group of peers, many of whom were themselves senior researchers engaged in arts practice-based research.

I declare that the published works submitted here are substantially my own with two exceptions detailed below. The co-authored works included in this thesis submission reflect the intensely collaborative nature of the projects, but all were initiated by me at the invitation of the respective publications.

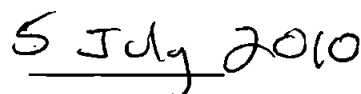
In articles No. 3 and No. 10 the interviews and conversations were set up and conducted by me, and I was the final editor of the published version. These two works communicate an essential dimension of my research methods. This is similar for the two artist interviews in articles No. 12 and No. 28, which I initiated, conducted and edited for publication. Article No. 25 is co-authored with Frédéric Bevilacqua with whom I co-organised the conference on which the article is based. I declare that this article is substantially my own work except the section on the gesture follower, which is based on Bevilacqua's research work.

Co-authorship in the form of collaborative writing was critical to the research that was done with non-arts specialists. This is especially the case for articles No. 20 and No. 21, both co-authored with scientists. Article No. 16 was co-authored with an artist and scientist, but written as separate sections. These works again were entirely initiated and submitted by me to the respective journals and books in which they are published. Finally, I declare that article No. 27, co-authored with Norah Zuniga Shaw, is substantially my own work except the William Forsythe section, which is based on Shaw's research work.

Signature:



Date:



Critical Appraisal

Shifting Interfaces: art research at the intersections of live performance and technology

This collection of published works is an outcome of my practice-led inter-disciplinary collaborative artistic research into deepening understanding of creative process in the field of contemporary dance. My research has not followed the trajectory of traditional doctoral studies, and framing it as having a set of clear a priori specified aims and objectives would be artificial. One of the benefits of submitting this collection is the opportunity to conduct a post-hoc analysis that draws the reader's attention to the overall coherence and singularity of the seven year study represented here, and offers me the chance to reflect upon those patterns myself. These can only appear within a context of theoretical assumptions or held beliefs, normally articulated at the start and then tested in the context of the research. In my case, I can retrospectively list four theoretical assumptions related to both the form of my distinct contribution and the modes of its formation which I believe my research has effectively tested and shown to be robust enough to stand for further development.

First, that though there is something irreducibly complex about the creative process in contemporary dance, it can nevertheless be made available to reflexive study. Second, creative process in dance, as a topic of 'mutual interest', can make itself manifoldly available to different disciplinary perspectives which can participate collaboratively in this study. Third, what qualifies as knowledge that might emerge from this inter-disciplinary study is largely constituted and governed by social relations: its value is in these relationships as much if not more than in something separate from them. Fourth, that a practice-led artistic research into the creative

process in contemporary dance does not have to result in either the production of texts or art works to be engaged in materializing research outcomes.

In this Critical Appraisal, I will frame and demonstrate the progressive development and overall coherence of my research to be found in the published works submitted in this thesis. I have organised them chronologically according to date of the writing rather than of publication. I have inserted a title and context page before each, with information about the circumstances (invitation or proposal) informing the writing. The rationale for inclusion of this corpus of thirty published works, written between 1999 and 2007 inclusive, will be supported by weaving references into the Critical Appraisal to specific pages in the collection. These will be bracketed, e.g. [p 321], to distinguish them from other references and help the reader recognise and trace the form and content of the research. This system of referencing will also point to the contemporary relevance of the different publishing formats and platforms.

In the following sections I firstly outline the way in which my research has intersected with diverse fields of practice. I then provide my assessment of the most important consistent lines of enquiry and where evidence of these can be found in the published works. This is followed by details about the contexts and forms of my contribution outside of the published work. I close with a discussion of the contribution to knowledge I believe I have made and thoughts about where the research is going next.

FIELDS/ EXPERTISE

In my writing, the concepts of domain and discipline both stand in occasionally for that of a field. Integrated with use of these concepts is the notion of expertise: something existing inside the frame of any field, domain or discipline that is recognised as such. Expertise corresponds to levels of competency particularly

when related to using computer-based hardware/ software. Expertise also has connections to legibility – when language is used in a specialised or expert discursive register it can be highly enabling within the context of that particular field, while disabling attempts to communicate between disciplines.¹ Expertise corresponds to practice-based mastery, a result of extensive training and study – “advanced material knowledge” (Carter p 179), “signature practices and singularity” and the “expert-intuitive” (Melrose 2009 p 29) – as well as ways of seeing and writing. Expertise also has an important social dimension in the frameworks that are set up in any domain or field for valuing (as in recognising, evaluating and promoting) a particular arena of specialist practice. In other words, expertise is seen to be constitutive of the field itself.²

By the mid-1990s, I was an established practitioner in the contemporary dance field, having worked professionally for over a decade as a performer and choreographer, first in North America and later in Europe, where I taught classes in dance theory and composition and mentored student choreographers at the School for New Dance Development, Amsterdam School of the Arts.³ My first encounter as a dance specialist with digital technology, in the context of an international symposium I organised in 1996, was a precursor to my research.⁴ This encounter did not configure a distinct field or discipline out of technology, though it began to structure a number of conceptual, practical and personal relationships that I would later build into my inter-disciplinary research. This took place partly through the community-building work I did following the symposium, when I collaborated with media-

¹ Legibility is usually associated with ‘readability’, but I am referring to an expanding notion of a literacy which includes understandings of non-language forms of expression. This opens up the challenge to be one of comprehension.

² The overlaps between disciplinary knowledge, expertise, techne, craft and how these overlaps apply to thinking about practice-led research are thoroughly explored in the writings of Paul Carter and Susan Melrose, both making reference to the “pertinence of a pre-Aristotelian entwining of ‘techne’ and ‘episteme’” (Melrose & Hunt 2005 p 71).

³ SNDD is a school for the “independent dance artist/choreographer”. <http://www.english.theaterschool.nl/> (accessed 7 May 2010).

⁴ ‘Connecting Bodies: an international symposium on the connections between the discourses and practices of dance and technology focussing specifically on the impact of new media technologies on dance making/ choreography’, Amsterdam, June 1996. <http://www.sdela.dds.nl/boi/sympos.htm> (accessed 7 May 2010)

performance artist Mark Coniglio on re-launching an email list and setting up a website as a resource for artists who use new media technologies in performance, and partly through speaking and consulting engagements on the topic of new media in arts education.⁵

There was a tendency amongst the community Coniglio and I were addressing with the website and discussion list toward melding an emerging field out of Dance and Technology, something I comment on critically in 'Dance (in the presence and absence of) Technology' [pp 323-329].⁶ In 2001, I contrasted the notion of something field-like appearing by describing the relation between dance and computers as 'episodic' in 'Periodic Convergences: Dance and Computers' [p 125]. In retrospect, there was no distinct other field in place at the start of my research. Early encounters with computer scientists and engineers mainly forecasted interdisciplinary collaborative research to come. My first two published works establish two critical lines of enquiry, which I will discuss next, from inside the field borders of contemporary dance.

By 2000, I was developing a wider network of relationships within the growing movement of digital and New Media Art which stood for a recognisable collection of artists and art works, increasing "institutional embrace" (Tribe p 21), including collection and preservation efforts, and an abundance of theoretical discourse, some of which was important for me such as Lev Manovich's 'principles of new media' because of its focus on materiality (Manovich 1999).⁷ This wider network provided me opportunities in the context of 'interdisciplinary research labs' to position myself as a researcher outside of the discipline of contemporary dance [pp 79-90, pp 147-

⁵ Major consulting commissions from Laban London and Amsterdam School of the Arts. See <http://www.sdela.dds.nl/labani/> and <http://www.sdela.dds.nl/ahkrepor/> (accessed 7 May 2010).

⁶ The dance-tech discussion list reached its peak number of messages exchanged in 1998. The website (<http://www.art.net/~dtz>) received no further updates from Coniglio or myself after mid-1998.

⁷ The principles Manovich describes in his 1999 text—discrete representation on different scales, numerical representation, automation, variability – offered insight into how to understand making in the context of digital and media art.

155], or as an organiser and facilitator of creative exchanges between dance and new media artists [pp 187-194]. Both situations were fruitful for my research, but 'Software for Dancers' (2001) provided a primary critical impetus for my practice-led collaborative research into the creative process in dance [p 120 note 1].⁸

At the same time my research frame was beginning to extend beyond the arts to the domain of science. This was supported by a commission to undertake a survey of extant UK based collaborations involving performing artists and scientists for the Collaborative Arts Unit, Arts Council England. This brought me into contact for the first time with the working methods and environments of non-art expert practitioners, for example cognitive-neuroscientists and social scientists.⁹

There is no exact moment when one phase ended and another began, but seen in retrospect, from 1999 through 2002 I was building an important network of relationships, developing conceptual frameworks and gaining vital experience for what was to follow. By the end of 2003 or early 2004, I was leaving behind the wider community-building and consulting work to pursue a more independent and focused enquiry. As part of this change, the contact I established with scientists through the work for the Collaborative Arts Unit developed into 'Choreography and Cognition' (2003-2004), the second major critical impetus for my research [pp 203-207].¹⁰

'Choreography and Cognition' took me into close contact with non-art disciplines, but similar rules regarding expertise apply. The structuring of the space for interdisciplinary communication is the same with heightened attention to legibility. Susan Melrose and Nick Rose refer to "mixed-mode practice which must be articulable in

⁸ See documentation website: <http://www.sdela.dds.nl/sfd> (accessed 7 May 2010).

⁹ See Ground Work report on line <http://www.sdela.dds.nl/gw/> (accessed 7 May 2010). I was influenced by Michael Century's 'Pathways to Innovation in Digital Culture', commissioned by the Rockefeller Foundation and published in 1999. In this report, Century analyzes the studio-laboratory as the context for a "transdisciplinary knowledge production" involving the arts as a major constitutive force for innovation outside of the boundaries of its own field. <http://www.nextcentury.ca/PI/PI.html> (accessed 7 May 2010).

¹⁰ See documentation website: <http://www.choreocog.net> (accessed 7 May 2010).

an agreed disciplinary-specific set of multi-faceted codes" (Melrose & Rose 2005 p 75). The challenge is not to let this agreement override mastery but to maintain disciplinary-specificity as much as possible. This is one of the reasons some of the submitted works from this project are co-authored. They share the responsibility of making expert thinking legible across fields.

There might be concern that fields and expertise appear to be fixed-stable entities. This is no more the case than if one were to assume a craft skill is in some way fixed because of its association with tradition. Paul Carter writes, "Craft is associated with a gift for ambiguity. It is a skill in loosening positions that have been fixed." (p 179) The same follows with expertise. With expertise in place fields are shifting centres of gravity under constant adaptation as ideas of all descriptions get pulled into their orbits. Expertise in the context of a field or discipline also stands for the type of "personal commitment" often underemphasised in discussions of practice (Polanyi p 61). My collaborators bring themselves as individuals with expertise to the research process. They know and are prepared to explore the limits and stretching places of their field or discipline within which they have an established professional practice.¹¹

In summary, the questions I am formulating regarding creative process are coming from inside the dance field, and I am engaging practitioners from outside the dance field to approach these questions from their own diverse expert perspectives. That is why I describe my work as inter-disciplinary collaborative artistic research; it effects connections or relationships through individuals to other fields and disciplines, but relies on the individual to channel the connection with the particular domain. They are colleagues and my guides to diverse modes of thinking.

¹¹ See in this collection my 'Willing Conversations: the process of being between' for a discussion of inter-profession dynamics [p 293].

LINES OF ENQUIRY

Two fundamental concepts are established in the first two published works in the collection. Firstly, I draw attention to the 'algorithm' as a process-level connection or bridge between dance composition and computation [pp 40-43]. Then I explore how biomechanics, as the empirical study of movement, might be embedded as a 'knowledge base' in the practices of both computer animation and dance and thus form a special correspondence between them [pp 56-60, pp 67-69].¹² In the following paragraphs, I provide a partial roadmap for indexing into the evolution of these two ideas as lines of enquiry throughout the published works to follow.

These two concepts convert into the following research questions:

- 1) When does it make sense to bring computation (coding the digital) as creative process and dance-making (composing the analog) into the same frame?
- 2) Do adequate descriptions of movement exist that can bridge the space between dance and mathematics, binding together in some shared space of understanding dancing (corporeal), algorithmic and biomechanical bodies?

In exploring question one I began to study software programming as both a work activity and the material products it gives rise to. My objects of study for this were selected software tools and their use in art making contexts in the field of new media art practice in the context of the 'interdisciplinary research labs' mentioned earlier. Projects like 'Hot Wired Live Art' (2000, 2001) provided critical opportunities to observe and interact with artists with varying levels of expertise (both competency and mastery) with software and get a feeling for what digital technologies bring to

¹² My interest in computer animation constituted a sub-theme for a period, stimulated by the procedural human figure animation research of Michael Girard and Susan Amkraut, which I write about in the context of the collaboration with Paul Kaiser, Shelley Eshkar and Merce Cunningham [pp 67-69, pp 163-164].

the creative process [pp 79-90, pp 147-155]. In keeping with both my research interest and my role as discussion facilitator I drew on emerging media theory for conceptual frames [pp 82-83], probed collaborative creative process and posed specific questions about programming. I also conducted interviews with software tool makers and users, for example, with Mark Coniglio about his 'Isadora' software [pp 169-184].¹³

The 'Software for Dancers' project (2001) marked a shift for me away from studying software tools used in the labs to researching the design of new software tools to augment the creative practice of expert choreographers and dancers. I discuss this shift briefly in a published interview [pp 110-111]. 'Software for Dancers' prompted a refocusing of my question about bringing computation and dance making into the same frame and was the inspiration for me to write about software as a language, tool and material [pp 115-121]. It also brought me in direct contact with four established choreographers who made it clear that what they gained most from the experience was the focused opportunity to question their own making practice in the context of other expert makers. At the same time, inspired by exposure to debates about Open Source software with its emphasis on collective creativity, I published an important piece that stepped away from software as a material to rigorously explore cultural similarities and differences between choreographic methods and computer code [pp 137-143].¹⁴

As I found myself refocusing on the concerns of choreographers and reflecting on their creative process in the context of exploring ideas related to digital media, my research frame was opening to the domain of science. The invitation to write for *Performing Arts Journal (PAJ)* in October 2000 coincided with the Arts Council

¹³ I conducted several interviews and dialogues that are unpublished, for example the 'Barriedale Operahouse Dialogue' and the 'Monaco Software Discussion' can be found here: <http://www.sdela.dds.nl/sfd/> (accessed 7 May 2010).

¹⁴ Some of the historical touchstones in my writing involved 'computers and dance' projects in the 1960s and 70s [pp 125-128, pp 159-161, p 115]; and includes a quotation from Merce Cunningham circa 1968 about the future possibilities of computers and notation [p 74].

England commission to investigate collaborations involving performing artists and scientists. This provided an opportunity to reflect on the work of Blast Theory whose collaboration with computer scientists and engineers was an inspiration for my understanding of rich inter-disciplinary collaborative practice [pp 96-99], and the group appears frequently in this published collection.¹⁵ The PAJ article also explored the limits and possibilities of choreography in virtual 3-D spaces [pp 93-101], something I return to seven years later in 'Choreographing Cycling Anims' [pp 351-360].¹⁶

Another inspiration has been the work of kinesiologist Hubert Godard who inspired me to recognise the "labor of dance" in my writing [p 100]. My perspective on the constitution of mastery in the contemporary dance field continues to be informed by this expert prowess acquired through dance training.¹⁷ In one of Godard's few published interviews in which he discusses dance, he characterizes the dancing body as an "accumulation of corporeities" (p 15) eloquently challenging me to rethink the attraction to biomechanical descriptions of movement.¹⁸ In trying to 'flesh out' my own writing about dancing bodies, I refer to the dancers working for William Forsythe and explore imagined scenarios bringing the concept of dance training and interactive installations together [pp 105-106]. The idea that dance training and practice (repetition) offered an interesting challenge and contrast to the concept of the "bodies as interface" and the "tendency to simplify" what constitutes experience in the discourse about interactive systems appears in other locations in the written material [pp 129-131, p 162].

¹⁵ Artists and artist groups often feature in my writing as exemplars, particularly when I was invited to provide some overview of the possibilities lying at the intersection of dance and digital technology. Published works No 1, No 14 and No 19 do this most explicitly.

¹⁶ 'Choreographing cycling anims' was anticipated in 'Sightseeing on digital pathways' in the paragraph about *Topologies L'Instant* [p 198].

¹⁷ Susan Melrose frequently discusses the "highly trained dancer" in the context of her discourses on performance practice (2009 p 25). See publications list and on-line material here: <http://www.sfmelrose.org.uk/> (accessed 7 May 2010).

¹⁸ Hubert Godard participated in a project I co-organised to research the potential an interactive system might have for dance training, titled 'Extending Perception', during the Monaco Dance Festival December 2004. See: Menicacci, A, Quinz, E, 2006, 'Étendre la perception? Biofeedback et transfert intermodaux en danse' in *Scientifiquement Danse: Nouvelles de Danse*, 53, pp. 76-95.

The concept of descriptions that bridge dance and mathematics as "the relation between real bodies and data bodies" reappears in the research report 'The Dimensions of Data Space' [pp 187-194]. In the report, I draw a frame around "representations, classifications, algorithms, notations and code" as potentially "co-meaningful" [p 192], a concept elaborated on in the future [p 300, p 278, pp 307-320]. Some of the origins of movement science is explored in 'The Human Walking Apparatus' [pp 235-244], but that essay closed that particular sub-theme. My commitment to the study of choreographic creation in an interdisciplinary collaborative research context, combined with opportunities to pursue this with expert practitioners, in particular dance makers themselves keen to participate in the research, was at this point guiding my research progress.

The 'Choreography and Cognition' (2003-2004) project marked a second major research shift for me and drew together the two lines of enquiry begun in 1999. Its first iteration, funded by the pilot Arts and Science Research Fellowships, was set up in close collaboration with choreographer Wayne McGregor, also a collaborator on 'Software for Dancers', and reflected his questions about choreographic process.¹⁹ The project featured scientific research into the temporal dynamics of movement, investigation into the notational uses of choreographic notebooks as design tools and the beginnings of collaborative research into 'choreographic thinking' – the embodied mind of dance making [pp 203-207].

This new collaboratively explored theme recurs in my writing. In 'Transactables', I describe the potential of a dynamic relationship the choreographer and dancer have with their notebook, articulating a continuum that involves interaction with the page in a rational process of using structures such as triggers and stimuli to help do

¹⁹ The Arts and Science Research Fellowships were jointly funded by the Arts Council England and the Arts and Humanities Research Board. I was engaged as a research consultant by the Collaborative Arts Unit in spring 2002 to develop the assessment criteria for the scheme which had only two cycles.

creative work in the studio [pp 211-212].²⁰ From this perspective notebooks provide a possible way of accounting for and learning from the ephemeral via the inspection of marks linked to movement decisions or choices.²¹ In a short essay titled 'Moving Ideas: questions for the dancing mind' written two years later, I build on this link between dance drawing and making as continuous internal and external processes in the context of historical linkages to the notion of the "thinking body" [pp 287-289].

'Choreography and Cognition' was a complex project with multiple layers. At its core was the organisation of a two day schedule that established the working conditions for the project [pp 220-228]. The first publication to materialise as a concrete result of the project was a work of co-authorship at the end of a long period of analysis and interpretation of one of the experiments [pp 261-274]. This work, 'What's in a Phrase?', makes a bridge between two field/ expertise areas, nesting and making legible expert observation based on specialist knowledge from the domain of cognitive psychology within a contextual framework based on knowledge of contemporary dance practice. It draws attention to how tools or instruments can be used to provide support for non-verbal study and the possibilities and limits of art and science collaborative research [pp 272-273]. It also lays the groundwork for an applied theory of choreographic thinking, and moves in the direction of what might constitute a choreographic resource in the collection of data. In a follow up article, notational properties of visual representations and ideas about augmenting the choreographic process are developed alongside further analysis of the experiment [pp 277-283].²²

²⁰ This process could be seen as a computational one, using the notebook to look for and discover solutions. This is discussed in David Kirsh's section on 'thinking with things' in *The Cambridge Handbook of Situated Cognition* (Kirsh 2009). Kirsh is a key collaborator with whom we researching distributed choreographic cognition. See: http://www.randomdance.org/r_research/current_projects1 (accessed 7 May 2010).

²¹ Such inspection might lead to augmenting or intensifying creative practice through a refinement of the basic tools known to be used. One such refinement, *RotoSketch*, a software programme supporting video annotation is an outcome of the 'Software for Dancers' project developed in collaboration with Zachary Lieberman. A alpha version can be downloaded here: <http://thesystemis.com/rotosketch/> (accessed 7 May 2010).

²² These two publications signal the start of one of my important long-standing collaborations with cognitive psychologist Phil Barnard.

Picking up the theme of collaborative modes of working, something I address more fully in the next section, I take 'Choreography and Cognition' as a case study for exploring some important social mechanisms supporting interdisciplinary (art-science) research [pp 293-295]. Shortly thereafter, in 'Sharing Questions of Movement', I add layers to earlier observations about the potential for interdisciplinary collaborative research while giving some examples of how dance might maintain the integrity of its own questions [pp 299-303]. This work also picks up and extends the concept of co-descriptions developed earlier, an idea which is thoroughly tested in the next published work in the sequence 'Sharing Descriptions of Movement'. This publication explores in great depth and detail the relationship between computation and dance-making by focusing on and reporting the evolved research of selected artists [pp 307-320]. It gives examples of how thinking about danced movement from an analytic perspective has evolved and integrates my independent research developments with that of other colleagues in the field.

Although not the final publication in the sequence, 'Constructing Memory: creation of the choreographic resource' could be read as a summation of the research presented here as well as an indication for the future. Here, the collaborative research projects of four established choreographers are described in the same context which affords productive comparison. These projects, which I am either leading or advising on, are making the creative work of these dance makers available for self- and shared study [pp 333-342]. The concept of choreographic resources, making its first appearance in this publication, points toward a wider dissemination of my research work, and the work of the involved research teams. The final publication in the sequence is my introduction to the book *Capturing Intention* (2007) [pp 363-368]. Like this Critical Appraisal it links the reader into other written material, but it does so in a framework which also encapsulates and

reiterates in a condensed way just how far my first two ideas have travelled in seven years.

OTHER CONTEXTS AND FORMS

It should be clear from the previous sections how transformations in both my field relationships and lines of enquiry are connected and co-inform each other. It is also important to recognise that the published collection here has been shaped in response to two basic circumstances: (1) invitations from someone else to write on a theme and/ or report on the content of a research project; or (2) proposals from me (sometimes with co-author) to write on a theme and/ or report on the content of a research project. Some specific details of these are provided in the title/ context pages before each published work.

In this third section, I will address some of the specifics of conditions lying outside of the published work in the context of research projects which include the 'interdisciplinary research labs' as well as the two major projects 'Software for Dancers' and 'Choreography and Cognition'. These projects were all fundamentally concerned with supporting reflection on creative process in art making – in the context of making. They have been the primary sites of my engagement with my own practice-led inter-disciplinary collaborative artistic research. I will briefly describe my roles in the various research projects.

My practice-led research is underpinned by two capacities. One is as a writer, which is partially in evidence here in this submission of collected works. The other is my ability to organise and subsequently facilitate a stable arrangement of social conditions for interpersonal relations to enact themselves in ways that can be individually valued within a certain agreed framework. That value is not extractable as such because it happens in the experience of moment to moment relations that

unfold in the context of the project where learning, teaching, transmission of understanding, development of ideas, trajectories of thought, action and making of movements and objects all come together. In one published work, 'Willing Conversations' [pp 293-295], I reflect on these aspects of my practice (writing and facilitation) in relation to the 'Choreography and Cognition' project.

In 1998, I began accepting invitations to participate in short intensive sessions, interdisciplinary research labs, aimed at supporting a small group of artists coming from different practices to explore collaborative creative work together. I was invited, not as an artist, but as a researcher and facilitator. My role was, in addition to documentation of the project, to support individuals and groups in their own creative work. For this, I provided reference points and other resources such as structures for discussing their making process. I have already mentioned using these projects as opportunities to study software tools in use, but I also advanced my understanding of creative process and its reflexive study through helping other artist practitioners articulate their process-based research questions, aims and objectives. After a couple of years, I became more instrumental in setting up and directing such projects, continuing to use some of the same methods for extracting (accessing, probing for) important information from them, even as the field/ expertise frame expanded to include non-art domains. At the same time, as I had built up a community around me, I effectively had established relations with a group of researchers who could be drafted in for particular projects.²³

It has been a challenge to continuously conduct my own research while actively contributing to the conditions of research for others. One way I have done that is to maintain a certain perspective on collaboration. When I say my research has been collaborative, I don't mean that the outcomes of the projects I have organised have

²³ For example, Inside Movement Knowledge which I currently co-direct has 24 individual researchers comprising five research groups and an International Associates Network. One-third of these were involved in previous research projects. <http://insidemovementknowledge.net/> (accessed 7 May 2010).

been collaborative. In these projects outcomes themselves are not necessarily shared, but they are multiple and can be represented as emerging from a set of shared conditions (which include peer to peer feedback, ideas exchange and support), where participants get to keep their "starting point" [pp 149-150] as well as generate individual outcomes. They may also generate collaborative outcomes, but what is always shared is the social space of relations.²⁴ As I have steadily moved into the position to set up and direct my own projects, I have been able to develop these to correspond more closely to my research questions and lines of enquiry, but the principle of multiple individual outcomes in different domains remains the same.

CONTRIBUTION TO KNOWLEDGE/ AND THE FUTURE

I will return to my four assumptions laid out at the start of this Critical Appraisal. My first assumption was that the creative process despite its complexity can be made available to reflective study and this is supported by the lines of enquiry I have articulated and traced through the published writings (for example: the link between dance drawing-making as continuous internal and external processes and the notion of the "thinking body" tracked through recent history). It should be clear how some aspects of my research are not possible to separate from that of my collaborators since our research spaces are mutually informing. The fact that creative process in contemporary dance has provided the topic of mutual interest supports my second theoretical assumption regarding inter-disciplinary collaborative research. My third assumption holds because working closely and productively with individuals and groups from diverse fields and practices, has made it clear to me that what qualifies as knowledge is at least in part dependent on what is emergent at the interface of shifting social relations. And publications Nos. 27 and 30 firmly demonstrate that a

²⁴ I acknowledge here the major influence on my discourse about inter-disciplinary collaboration of James Leach, currently Senior Lecturer in Social Anthropology and Head of Department at the University of Aberdeen. Leach was a close collaborator on 'Choreography and Cognition' and more recently the 'Choreographic Objects' project:
<http://projects.beyondtext.ac.uk/choreographicobjects/index.php> (accessed 7 May 2010).

practice-led artistic research into the creative process of contemporary dance does not have to result in the production of texts or works of art to be engaged in materializing research outcomes. The four choreographic resources projects cited in No. 27 involve the creation of unique formats for bringing choreographic ideas and processes into productive new relations with both general audiences and other specialist practices.

Looking to the future, the resources described in that article have since materialized into valuable 'boundary objects', now engendering inter-disciplinary collaborative exchange in a variety of research contexts.²⁵ One of these research contexts, 'Choreographic Objects: traces and artefacts of physical intelligence', involved a series of workshops centring on the variety of resources the research teams are developing with the four choreographers.²⁶ The workshops drew attention to the teams' work as an emerging "community of practice" (Wenger & Snyder) and began to contextualize and frame what may begin to constitute a unique body of knowledge pertaining to contemporary dance.²⁷ This research will continue as new partnerships and opportunities come into view.²⁸

²⁵ 'Boundary objects' in sociological studies are seen to be constructs that support working relations between different groups. They are "adaptable to different viewpoints and robust enough to maintain identity across them" (Star & Griesemer p 387)

²⁶ These include on-line interactive scores (<http://synchronousojects.osu.edu/>) and archives (<http://www.siohandaviesreplay.com/>), interactive training installations (<http://insidemovementknowledge.net/context/background/capturing-intention>) and unique notation instruments (http://www.randomdance.org/r_research/current_projects1) (all accessed 7 May 2010)

²⁷ This 2008-2009 project brought the four projects together in the same investigative context with social scientists specialising in object making. It was funded by Beyond Text, a strategic programme created by the Arts and Humanities Research Council, UK, to generate new understandings of, and research into, the impact and significance of the way we communicate. Final report on-line at: <http://projects.beyondtext.ac.uk/choreographicobjects/index.php> (accessed 7 May 2010)

²⁸ For example, funding has been obtained in Germany from both the Volkswagen Foundation and the Federal Cultural Foundation for a four year project which I currently co-direct to continue the development of 'choreographic resources' in an international context.

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'Virtual Ephemerality: the art of digital dancing'

This is the pre-translation version. The published version appeared as:

'virtualna efemernost: emetnost digitalnega plesa' in Maska: Užitek avtomata, May 1999, pp. 45-49. (See Appendix pp 371-375)

In January 1999, I received an invitation from philosopher and dramaturge Bojana Kunst, who was editing an issue for MASKA on the theme of the automaton and cyborg bodies. She gave me a very open invitation to write "something on dance and new technologies, how the technological development influenced the dance field, are there some new art forms and what is their future, what are the new possibilities of choreography in connection with technology, what is happening with dancing body (or is it something happening at all)."¹ At the time, I was Visiting Professor with the Institute for Dramaturgy Aarhus University working on the 'Digital Theatre: an Experimentarium' project.² I had given public talks in Paris (Dec. 1998) and Aarhus (Feb-Mar 1999) in which I presented many of the ideas I then wrote about in the article.

MASKA is a performing arts journal based in Ljubljana, Slovenia, published four times a year since 1920, according to its website. Each issue is dedicated to a specific theme and covers local and international contexts. Source:

http://www.maska.si/en/publications/maska_performing_arts_journal_from_year_1999_on/ (accessed 7 May 2010).

¹ Email to the author, 14 Jan 1999.

² Documentation website: <http://www.daimi.au.dk/~sdela/dte/> (accessed 7 May 2010).

Virtual Ephemerality: the art of digital dancing

(This is the pre-translation English version as submitted for publication in March 1999. The referencing system of the published Slovenian version is used.)

Background

Like all contemporary art fields, dance has several overlapping historical trajectories. One of these is a tradition of choreography, dance training and performing which can be traced to the influences in particular of Merce Cunningham (in collaboration with John Cage) and then Robert Dunn whose composition classes in the early 60s in NYC (influenced by Cage) laid the groundwork for the Judson Church experimentalists which included Trisha Brown, Steve Paxton, Simone Forti, Yvonne Rainer, Douglas Dunn, David Gordon, etc.

This list of names from the Judson Church has been canonized by writers and scholars such as Sally Banes who wrote about several of them in *Terpsichore in Sneakers: Post-modern Dance* in 1980.¹ What happened at Judson Church could be seen as a manifestation of the revolutions of the 60s, especially in the sense that the Judson experimentalists made manifest one of the tropes of the decade by bringing 'anything goes' into the praxis of dance making. However, this could be seen not as a rebellion against constraints, but as a continuation of a tradition of artistic insurrection as represented by the innovations of Merce Cunningham who had already been explicit about his desire to break with the artistic ideas of the earlier modern dance 'pioneers'. Early modern dance (Duncan, Humphrey, Graham, etc.) celebrated the expressive potential of a dancing body; Cunningham celebrated the emancipation of this dancing body from the need for expression or interpretation. As compared to the first pioneers of 'modern' dance, Cunningham was the first dance 'modernist'... who was emphatic about his dances being 'movement which is only about movement'.

Whether or not Judson Church was an extension of this modernist practice which some see in the further stripping down of movement to its 'essential' features (as in the use of pedestrian movement) or, as Banes saw it, a period of post-modern practices in the mixing and matching of forms is a hotly debated topic in the field of dance theory and scholarship. I do not intend to pick up this debate here, but to point out it is well recorded that the Judson experimentalists took their own type of rebellion as far as it could be taken – even removing dance as a necessity for dances. For them, anything could be dance – found and pedestrian movement, task dances, rule-based choreography, written dances, dances performed outside the theatre, dances performed by people who didn't know they were being watched, and the list goes on. A strong democratic ideology persisted throughout knocking 'high art' off its pedestal and making dance a non-specialist pursuit. Anyone and everyone could be a performer or a dance maker. The boundaries between audience and dancer, between dance maker and store clerk temporarily disappeared.

It is important to see that without this particular trajectory, from Cunningham through Judson Church – it would not be possible for me to speculate on some of the following relationships between dance and technology which depend on three KEY ideas related to this trajectory: one – the meaning of a dance can reside in the movement of the dancer alone; two – that dances can be performed by anyone and; three – ways of making and framing dances can be many.

Software for Dancers

In 1984, Pauline Oliveros published a book entitled "Software for People".² Oliveros is a composer who works with live electronics, computers, improvisation, and new modes of ensemble interaction. The book includes articles on new music, women as composers, sonic meditation, attention and awareness... and it also includes

algorithms for creating sound performances.

The most common usage of 'algorithm' is as a mathematical or computational term, and in Foldoc, the "Free On-Line Dictionary of Computing", its basic description is "A detailed sequence of actions to perform to accomplish some task", cited as being named after an Iranian mathematician, Al- Khawarizmi.³

A slightly more elaborate description, also culled from the 'internet'⁴, names four special characteristics of an algorithm as:

1. It is complete; all the steps are there, in the right order.
2. It is correct, it always gets the right answer.
3. It is finite; there is a stated way to know when it's done.
4. It is executable; all of the instructions can actually be carried out.

I have mentioned already that the Judson Church experimentalists worked with rule-based structures for making dances. Many of these structures could be seen as fitting these four special characteristics. Perhaps the best known choreographer basing her work on algorithmic procedures was Trisha Brown. Two such works were *Accumulation* and *Locus* – both made in the 1970s, and the 'algorithms' for these dances can be found in several sources, including *Contemporary Dance* edited by Anne Livet.⁵

The algorithm for *Accumulation* is as follows:

"The accumulation is an additive procedure where movement 1 is presented; start over. Movement 1; 2 is added and start over. 1,2; 3 is added and start over, etc., until the dance ends. Primary Accumulation accumulates thirty movements in eighteen minutes. The 29th and 30th movements each cause the figure to revolve 45 degrees, making a 90-degree turn with each completion of the sequence. Therefore, a 360-degree revolution occurs in the last two minutes of the dance, giving the audience three alternate views of the dance before finally stopping."⁶

The point is that this dance precisely fits the definition of an *algorithm* as stated above: it is complete; it is correct; it is finite; it is executable.

Algorithms are like recipes, and their usage as a dance making strategy during the 60s and 70s was also part and parcel of the prevalent democratic arts ideology of the time. Brown and others worked with these dance making devices in part so that they could be performed by anyone. The dance algorithm allows a 'non-dance specialist' to create and make a dance – one does not require any training in order to make and perform 'accumulation'. The usage of rule structures for dance making is also an extension on the chance procedures employed by Cage and Cunningham – chance procedures also 'always get the right answer'.

I would like to make a link to the work of William Forsythe, choreographer for the Frankfurt Ballet. Paul Kaiser, co-director of Riverbed, a multimedia company which has collaborated with Robert Wilson, Merce Cunningham and Bill T. Jones on 'virtual performance' projects, has interviewed Forsythe about his process of making dances.⁷ Part of the discussion focussed on the making of the piece *Alien Action*, and Kaiser says that Forsythe's comments remind him of recursive algorithms, where "procedures call themselves, modify the results, call themselves again, and so on". Forsythe responds:

"In fact, *Alien Action* was the first time that I actually began to produce movement based on recursive algorithms. However, they were fixed variations that we created through a long, painstaking process, not unlike that of computer programming, where every step has to be repeated ad infinitum."

On some level, Forsythe is carrying on the tradition of dance artists taking on metaphors which are cross-disciplinary – the method of montage as it might be drawn from filmmaking comes to mind. In other interviews, Forsythe refers to his 'database' of movement vocabulary and 'cutting and pasting' as an editing strategy. But the algorithm is much more a process than a metaphor... and represents the

region where ways of constructing things in the field of mathematics and computer science overlap with dance making.

Migratory Bodies

In the south of France, Nicole and Norbert Corsino have a dance company, but they make dances for the screen and other media spaces, not for the 'real' stage. At a recent Paris conference on 'dance and technology' Norbert Corsino referred to the dancing body as a 'migratory' body – as opposed to a 'nomadic' body.⁸ This dancing body doesn't carry its home with it wherever it goes, but makes whatever place it lands in its own.

This is a particularly appropriate metaphor for dance – a 'migratory body' – especially used in relationship to the screen. It suggests that the dancing body is at home there, and I believe this to be the case. The relationship between dance and the screen originates most potently in 1945 with "A Study in Choreography for Camera" one of the dance films made by avant-garde filmmaker Maya Deren. Though she made only seven films, Deren is often credited as being the first dance filmmaker... in other words to make dance specifically for the space of the screen. In her own program notes about the film she writes: "This is, in a sense, a duet between space and a dancer—a duet in which the camera is not merely an observant sensitive eye, but is itself creatively responsible for the performance."⁹

This work by Deren stands at the beginning of what mushroomed in the last two decades into its own genre as evidenced by the growing number of festivals, competitions and events specifically set up for 'videodanse', 'dance for the camera', 'dance and screen', etc. In an issue of *Tanz Aktuell/ Ballet International*, Elisa Vaccarino cautiously suggests that the name 'videodanse' might have been coined in 1988 for a showcase at the Centre Pompidou.¹⁰ Dance made it to television in the 1980s in Britain with Michael Kustows' series on Channel 4 and the United States

on PBS [Public Broadcasting Service]. Commissions and grants became available for these works, which stood in their own separate category.

This history is well documented and it is only my intention here to point towards the solidity of this relationship between dance and screen. Dance is very comfortable on the screen. Merce Cunningham has been exploring the relationship for years with video and filmmakers such as Charles Atlas and Elliot Caplan. The question to ask in the context of this article is what the potential is now that the screen is evolving from the fixed classical space of the cinema to the more interactive possibilities of the computer interface.

In 1996, Lev Manovich published an essay entitled "An Archaeology of the Computer Screen".¹¹ His starting point – the 'classical screen' – is the painting in its most general sense. Something which is framed, flat and rectangular and functions as a 'window into another space'. This is followed in his genealogy by the 'dynamic screen' – the cinema or video screen.

Next in Manovich's order is the screen of 'real time' – which, he writes, first emerges during WW2 with the invention of the radar. This is a radically different screen because it is constantly updating in relationship to an outside referent. A short time later this 'real time' screen becomes used for the input of data (as well as output) and evolves into what we now know as the computer screen.

There are some dance artists exploring the possibilities of making dances for this interactive screen. Three projects have originated in the United Kingdom in the context of Digital Dancing, an annual event organised by Terry Braun of Illuminations Interactive.¹² Mark Baldwin and Richard Lord are choreographers involved in two of these projects. Lord has made interactive dances for the web which can be found on his site <http://www.bigroom.co.uk>. The other project comes

from the collaboration between digital artist and choreographer, Bruno Martelli and Ruth Gibson.¹³ They have recently completed a CD-ROM entitled "WindowsNinetyEight" where there are many opportunities for the user/ viewer to interact with the dancing taking place on the screen. One sequence in particular uses 'sprites' which are small looping video clips of a short dance phrase performed by Gibson. These 'sprites' appear between 12-16 times in several different locations on the screen repeating the same looping phrase. With the mouse, one can click on them and move them into different spatial relationships with each other. Clicking on them also causes the timing of the loop to be slightly interrupted and within a short time the 'user' is able to create intricate choreographic patterns on the screen. Thus, bringing the viewer into the position of choreographer – to paraphrase Maya Deren — themselves creatively responsible for the performance.

Choreographic Gardens and Exquisite Corpses

In an attempt to indicate a relationship between technological/ computer and dance making processes, I have mentioned earlier is work of Trisha Brown and William Forsythe. There is a more direct relationship with dance making to be found in the choreographic tool called 'LifeForms'.¹⁴ LifeForms was developed starting in the late 1980s in collaboration with Merce Cunningham who had, as early as 1968 expressed an interest in seeing if the computer could assist him in making dances.¹⁵ Merce has always been explicit about how he sees the impact of technology on his work – it has given him new ways of seeing, thinking about and making up movement.

"... it presents possibilities which were always there, as with photos which catch a figure in a shape our eye had never seen. On the computer the timing can be changed to see in slow motion how the body changes from one shape to another. Obviously it can produce shapes and transitions that are not available to humans, but as happened with the rhythmic structure, then with the use of chance operations, followed by the use of the camera on film and video, and now with the dance computer, I am aware once more of new possibilities with which to work."¹⁶

By implying that “technology shapes us as we shape technology”, Cunningham invokes the patron saint of our digital age, Marshall McLuhan, who was of course following in the footsteps of a host of cultural theorists like Walter Benjamin who writes about how our perceptions of art and art related processes are radically altered by technological invention.^{17 18}

Arguably, LifeForms is really the 'only' software of its kind for choreographers, but it is not used very much by dance makers. Besides the matter of computer access and the time and effort it takes to learn to use the program, LifeForms 'embodies', if one could say that, the dancing aesthetic of Cunningham. The program easily represents limbs moving oddly out of coordination with each other combined with rather impossible shapes and difficult movement transitions. It allows the instant replication of a single dancer as many times as desired anywhere on the representation of a 3-Dimensional stage which can be rotated for viewing from absolutely ANY angle, from the bird's eye view to the subterranean. Perfect for Cunningham, but of limited use to choreographers whose movement vocabulary and aesthetic is directed along another line. The most extreme example might be something like Butoh, where the surface of the skin and movement of internal body organs are more important to the choreographic strategy than where an arm or leg is in space at any given moment.

But this partly assumes that LifeForms is only a tool for the choreographer to help him or her in their physical studio based work. But LifeForms is a piece of software. As such it is comprised of digital material, and this opens up a range of possible applications. I will mention two here.

One)

In the summer of 1998, digital artist Guy Hilton sent out a call for participation in a project he called “interference: a performance experiment in Internet Choreography”

which would be performed in Manchester, UK as part of the Digital Summer programme, "with a simultaneous webcast embracing a global audience. It is a dance trio created electronically by forty choreographers worldwide."¹⁹

Hilton based his project on the "Exquisite Corpse" a Surrealist Game which involved players who complete a sentence without seeing what has been done already. The following are some of the instructions for Hilton's project:

"You will receive by e-mail a Life Forms file containing a single starting keyframe. You are invited to devise a movement sequence of between 30 seconds and one minute's duration, commencing from the supplied keyframe. Your sequence is then returned by e-mail, and the final frame of your sequence forwarded as a start position to the next participant. Together, the 40 phrases created in this way will form a sequence ('cadavre exquis' style) which will be interpreted for performance by live dancers. You may devise any movement you see fit, and may choose not to observe gravity or the limitations of the human body if you wish."

When completed Hilton's project comprised a dance piece lasting approximately 30 minutes long with over 50 contributions from Europe, North America, Australia and Hong Kong. The opening and closing fragments were contributions courtesy of Merce Cunningham. As planned, live performers attempted to learn the choreography, a great challenge because several of the contributors created material which was physically impossible to replicate precisely on the stage.

Two)

The following two paragraphs quote extensively from the websites related to this project:

At the University of Colorado Computing Science Department, Elizabeth Bradley is leading a team of investigators asking the question: "Can Computers Learn to Dance".²⁰ They are interested in redefining the computer's role in dance which, they state,

"The computer has, to date, been primarily external: as a tool for representation (e.g., using Life Forms to render a dance as an animated sequence) or embellishment (e.g., hooking a dancer's heartbeat to a synthesizer). We are interested in a wholly different type of computer tool: one that plays an active role in the creation of dance sequences".

Bradley's team is working on the implementation of two computer programs that get "inside" the dance – one that operates as a "shuffler" of movement phraseology in a manner akin to certain postmodern choreographic strategies, and the other that "learns" from a corpus of dance phrases (and here a library of LifeForms phrases might be used) to create completely original movement sequences that retain the stylistic stamp of the given material. The first program, called Chaographer, uses the mathematics of chaos to first divide an animated movement sequence into sub-sequences and then shuffle them. The results of this approach, they write, "are reminiscent of some of Cunningham's aleatory processes". The second program, MotionMind, uses machine learning algorithms to capture the stylistic rules implicit in a given body of dance phrases. MotionMind then uses that knowledge to automatically generate innovative and stylistically consonant movement sequences between arbitrary starting and ending postures.²¹

While it is, of course, not likely that MotionMind will replace the choreographer – in my opinion, and as in evidence from their statements, these practices within the Computer Science field are a direct extension of Cunningham and some of the Judson Church experiments. Informed as it is by these choreographers, Bradley's work, or work like it, will in turn have an influence on the dance making of the future.

Motion Capture: where animation and choreography converge

One could say that the history of motion capture stems back to the 19th century with such mechanical inventions as the apparatus constructed by scientist/ engineer Etienne-Jules Marey to measure the trajectory of the bird's wing in free flight. In his own words, Marey built a device which "could transmit to a distance any movement

whatever, and register it on a plane surface".²² These early registrations of movement were designed with the advancement of scientific knowledge in mind and resulted in a registration which was more information than likeness, more measurement than representation.

Following developments in digital technologies, motion capture has been transformed into a mechanism whereby one's movements can be captured and transmitted to the computer for a process of analysis similar to, but much more complex than that mentioned above. This provides quantifiable research benefits to the medical, sports and military establishments. But digital technologies and motion capture have also grown rapidly in the area of special animation effects utilized by the entertainment (movies and computer games) and advertising industries. In this area of development special computer graphics software is able to import the movement data into a 3-D virtual space where objects and figures of any imaginable type may be animated by this motion.²³

This is where two major 20th century art forms – animation and choreography – overlap. But digital motion capture was rarely used in a more purely artistic context because the costs were prohibitive and outcomes unclear for artists. However, in the last few years, we see more performance and digital artists working together on a regular basis with these technologies (e.g. Susan Kozel and Kirk Woolford, Sally Jane Norman, Richard Lord and Christian Hogue, Paul Kaiser and Merce Cunningham/ Bill T. Jones, Bruno Martelli and Ruth Gibson, Yvonne Fontijn and Karin Post, etc.). They represent an evolved 'critical mass' of work... whereby this technology is steadily becoming more integrated into the dance field.

Paul Kaiser and Riverbed have been mentioned earlier and their motion capture projects with Merce Cunningham and dance artist Bill T. Jones have received strong critical acclaim. But rather than write about these works which can be investigated in

much more details via the Riverbed website <http://www.riverbed.com>, I would like to describe here the work of Dutch artist Yvonne Fontijn for whom currently one will not find a website, nor much international press coverage.

Fontijn and Dutch choreographer Karin Post have been collaborating on motion capture and animation projects for a few years now. Fontijn works as an animation artist for Motek, an Amsterdam based commercial motion capture house.²⁴ This affords her unique access to the technologies necessary to for her projects and gives her the opportunity to experiment and explore over a longer period of time. Approximately one and a half years ago, they did a motion capture session in which the movement of the torso and arms was captured from one dancer (Karin Post) and the movement of the pelvis and legs from a tap dancer.

This data sat stored in the computer for several months before Fontijn decided to use it in creating an animation for the "Traces of Science in Art" exhibition at Het Trippenhuis in Amsterdam in late Spring 1998. In order to get as far away from the representation of a human figure as possible while still retaining the special movement quality of motion capture... she superimposed the upper torso from Post directly on top of the lower half from the tap dancer.

What you see in the animation is a series of abstract figures, which are animated with human movement. Once you are informed that it has been motion captured, it is possible to identify in the shifting forms the occasional and recognisable rhythm of the tap dancer's feet. If uninformed one would likely only see the film as an 'animation'. Other artists, like the Riverbed collaboration, are exploring choreography, motion capture and animation with more recognisable human forms.

Animation briefly defined is "giving motion to a thing" and choreography might be defined as the "composition of moving bodies in Cartesian space and time". Prior to

the invention of this possibility of animating with digital motion capture technologies, classical animation artists had always used the careful study of people moving in order to draw the motion of cartoon characters as accurately as possible. Master animator Virgil Ross who died in May 1996, was considered a legend in the profession. His 60 year career was honored by awards, many bestowed on him because of his amazing ability as a dance specialist. From Bugs Bunny tap-dancing down the street or cakewalked on the vaudeville circuit it was Virgil's drawing ability that created the illusion of human movement.

Now, that illusion comes more directly from the source – the dancer – and this affords us with a very large range of new possibilities in the future where we will see animation and choreography continuing to overlap.

[I have avoided providing technical details about motion capture technologies because this information is easily available from other sources, including some of the websites listed in the citations below.]

Conclusion: Dramaturgs Required

One can hardly come to a conclusion at the end of an article based on such widely scattered examples and observations on the art of digital dancing – but I would like to close with a final speculation as follows:

The dramaturgy of a dance performance which involves technology is a mathematical dramaturgy. It relies on a clear understanding of the necessity of precise calculations which will enable the artistic ideas to be realised. It requires the employment of the optical science of the Renaissance perspective, the restrictive design laws which are the legacy of the Bauhaus and sympathy towards the required reductionist thinking of a computer programmer. Some of my artist colleagues like to state that we will be getting somewhere when Dance and

Technology is no longer Dance AND Technology, but is simply 'dance', but this should not be the case. As has so often been expressed in this century, the way of the future STILL lies in the ability for artists, engineers and scientists to bridge but not erase the gaps between their respective disciplines to bring creativity to empirical, positivistic thinking and a diminishment in the mysticism which is still romanticized by the artistic enterprise.

Scott deLahunta

Aarhus, Denmark. 1999

Endnotes (accessed March 1999)

¹ Banes, Sally. *Terpsichore in Sneakers: Post-modern Dance*. Wesleyan, CT: Wesleyan University Press, 1980.

² Oliveros, Pauline. *Software For People: Collected Writings 1963-1980*. Baltimore, MD: Smith Publications, 1984.

³ <http://wombat.doc.ic.ac.uk/foldoc/foldoc.cgi?query=algorithm>

⁴ http://www2.baldwin.edu/~rmolmen/150dir/150mt_written_rev.html

⁵ . Livet, Anne, ed. *Contemporary Dance*. New York: Abbeville Press, Inc. 1978.

⁶ Trisha Brown interviewed in *The Drama Review*, Post-modern dance issue, T- 65, March 1975. p. 29.

⁷ <http://www.riverbed.com/duoframe/duoforsythe.htm> (main Riverbed Site – <http://www.riverbed.com>)

⁸ Conference on "Danse et Nouvelles Technologies". Cité de la Musique, Paris, France. 3 December 1998.

⁹ Quote comes for the cover of the widely-distributed video entitled *Maya Deren, Volume One Dances For The Camera*. The text is also on the following site –

<http://www.dla.utexas.edu/deQpts/ams/Deren/camera.html>

¹⁰ Vaccarino, Elisa. "Dance and Video", *Ballet International/ Tanz Aktuell*. Issue 8/9, August 1997. p. 59.

¹¹ Manovitch, Lev. "Archaeology of the Computer Screen" reprinted in *Cain, Abel or Cable*, ed. Thomas Elsaesser. Amsterdam and Ann Arbor: Amsterdam University Press / Michigan University Press, 1998.

¹² <http://www.illumin.co.uk/>

¹³ <http://www.shoevegas.com/windows/>

¹⁴ <http://www.credo-interactive.com/>

¹⁵ Cunningham, Merce. *Changes: Notes on Choreography*. Ed. Frances Starr. New York: Something Else Press, Inc., 1968 (no page number).

¹⁶ http://www.merce.org:80/technology_lifeforms.html

¹⁷ McLuhan, Marshall. *Understanding Media: The Extensions of Man* (new edition with Introduction by Lewis Lapham). Cambridge, MA: MIT Press. 1994.

¹⁸ Benjamin, Walter. "The Work of Art in the Age of Mechanical Reproduction". In *Illuminations*. New York: Schocken Books. 1962. pp. 217-251.

¹⁹ Hilton, Guy. (Electronic Email Posting) "INTERFERENCE calling (again)" gjhilton (orangemouth@geocities.com) Fri, 31 Jul 1998 14:15:11 +0000 (available in the Dance-Tech list archive: <http://www.art.net/Resources/dtz/archive/DanceTech98/0597.html>)

²⁰ <http://www.cs.colorado.edu/~lizb/papers/ldat99-paper.html>

²¹ <http://www.cs.colorado.edu/~lizb/chaotic-dance.html>

²² Braun, Marta. *Picturing Time; The Work Of Etienne-Jules Marey (1830-1904)*. Chicago, IL: University of Chicago Press, 1994.

²³ A selection of Motion Capture related Websites:

<http://www.qualisys.com/>

<http://www.televirtual.com/>

<http://www.riverbed.com/>

²⁴ <http://www.motek.org/>

'Choreography from Bits and Bytes: Motion Capture, Animation and Software for Making Dances'

This is the pre-translation version. The published version appeared as:

'Coreografie in Bit e Byte: Motion Capture, Animazione e Software per la Danza' in *La scena digitale: Nuovi media per la danza*, eds. A. Menicacci & E. Quinz, Milano: Giangiacomo Feltrinelli Editore, 2001, pp. 83-100. (See Appendix pp. 377-398)

In November 1999, I received an invitation from Armando Menicacci and Emanuele Quinz to write a chapter for a new book they were planning on the theme of digital technologies and dance. I had given a presentation on motion capture and dance projects for them at the 'Bolzano Dance Festival' in June 1999 coinciding with using materials collected during my work on the 'Digital Theatre: an Experimentarium' project.¹ They accepted my proposal to develop that talk into a paper, only requesting that I develop some of my "thoughts on the machine/body interface issue."² Other authors in this book include: Thecla Schiphorst, Mark Coniglio, Paul Kaiser, Stelarc, Kitsou Dubois, Susanne Kozel, Michel Bernard and Bojana Kunst.

¹ Documentation website: <http://www.daimi.au.dk/~sdela/dte/> (accessed 7 May 2010).

² Email to the author, 3 Nov 1999.

Choreographing in Bits and Bytes:

motion capture, animation and software for making dances

(This is the pre-translation English version as submitted for publication in January 2000. Illustrations in and the referencing system of the published Italian version are used.)

Abstract:

The video camera has, since the early 1980s, become a ubiquitous tool for choreographers. It is used as part of the creative process, to document and preserve dances and to record video dance that is made solely for the screen. In the last few years, dance artists have increasingly begun to make use of a new imaging technology known as Motion Capture. Motion Capture refers to the electronic hardware and computer software that makes possible the digital 3-D representation of recorded moving bodies. This article covers some of the history of Motion Capture technology as well as the work of several dance and multimedia artists who are using it in their work. It will also make some speculations about how Motion Capture, just as video before it, may in the future move into common usage by dance artists.

Introduction

Motion Capture refers to the computer hardware and software that makes possible recorded digital 3-D representation of moving bodies. Recording sessions involve the placement of markers or sensors on strategic positions on the body that provide the basic information for the computer software. The expense of these systems, which includes the cost of the equipment as well as the expertise to run it, is enormous with developments being driven primarily by those industries such as medical, military, entertainment and advertising that have the necessary capital.

These costs, combined with a basic distrust in 'technology', resulted in little interesting artistic work being done within the dance field until recently through the efforts of a small but determined artistic vanguard of dance and digital artist collaborators. This includes Paul Kaiser and Shelley Eshkar working with Merce Cunningham and Bill T. Jones (USA); Kirk Woolford with Susan Kozel (UK); Bruno Martelli with Ruth Gibson (UK), Yvonne Fontijn with Karin Post and Michael Schumacher (NL); Richard Lord with Christian Hogue (UK); Sally Jane Norman (FR); Dorte Persson (DK); etc.

Making the Invisible Visible: Scientific Progress in the 19th Century

Most accounts of the history of motion capture refer to the work of Etienne-Jules Marey and Eadweard Muybridge. Both men were late 19th century pioneers in the recording and analysis of movement, and both men are credited with having contributed greatly to the evolution of photographic techniques that led to the invention of cinema. However, as Marta Braun proposes in her book on Etienne-Jules Marey titled *Picturing Time*, the enormous differences between Marey's photographic study of locomotion and Muybridge's has not been fully appreciated.¹ Before Braun's book no full account of the impact of Marey's work had been published, and she persuasively argues for a fuller recognition of the influence his work has had in particular on the developing 19th century science of physiology.

Etienne-Jules Marey began studying medicine in Paris in 1849 at a time when the study of physiology was about to emerge as a science in its own right. According to Braun, amongst the many reasons for this was the "assimilation of physics and chemistry as explanatory models for physiological processes".²

N.B. all footnote websites cited accessible as of January 2000.

¹ Marta Braun. *Picturing Time: The Work of Etienne-Jules Marey (1830-1904)*. Chicago, IL: University of Chicago Press, 1994.

² Ibid. p. 9.

Marey's theory of physiology was that the body was an "animate machine" whose motion would be subject to the universal laws of physics that might be applied to any moving object (animate or inanimate). He set out to prove this firstly by inventing a series of graph-making instruments in the late 1850s. With these instruments he was able to monitor movements invisible to the human eye and make them visible by tracing them onto a "smoke-blackened cylinder". Marey fabricated an extensive array of mechanical recording devices which not only involved inventing the tracing mechanism, but also the creation and placement of various movement trackers and sensors.

(See **Illustration** in the published Italian version. Thesis Page 395 Figure No. 10: Illustration of Marey's bird apparatus)

Amongst these instruments was an apparatus built to register the trajectory of the wing of a bird in free flight, a device which would register the up and down and back and forth movements of the wings simultaneously. It "could transmit to a distance any movement whatever and register it on a plane surface".³ These and other studies of bird flight were important to the foundation of aviation in Europe and America.

By the late 1800s, Marey had begun to use the camera in his scientific studies of human and animal locomotion, slowly replacing his mechanical graphing instruments. Still, technological invention would continue to be an essential feature of Marey's work, and eventually he was to develop a motion picture camera (the precursor to the commercial motion pictures) to allow him to further refine his studies.

³ Etienne-Jules Marey quoted in Braun. *Picturing Time: The Work of Etienne-Jules Marey (1830-1904)*. p. 35.

Throughout the 20th century animation artists would study images of movement made by Marey and Muybridge because of the details and deconstruction of motion that could be derived from them. However, in the last two decades and this one in particular, computer animation techniques have evolved to the point of practically replacing hand drawn animation skills - in particular when it comes to creating human motion. Since the early 1980s, animators have been using software based systems capable of simulating human and animal locomotion. It is in this software that we can also discover the influence of Etienne-Jules Marey. His scientific work contributed to the discovery of the laws governing physiological processes - as expressed in mathematics. Some of these mathematical expressions are used in the underlying algorithms in today's computer animation and movement analysis software programs.

For example, take *SIMM* (Software for Interactive Musculoskeletal Modeling), a software system that allows one to create and analyze graphics-based models of the human musculoskeletal system.⁴ The software is designed to be used by biomechanic researchers, neuroscientists, kinesiologists, biologists, computer scientists, human factors engineers and animators. Embedded in its complex "knowledge based systems" (software which uses biomechanical information about how the human body behaves in motion) are mathematical equations derived from the laws of physics as they apply to human movement. Some of these equations have their origins in 19th century research of physiologists/ scientists like Marey.⁵

Motion Capture and Simulation in the 20th Century

Some early 20th century animation artists did rely on a type of 'motion capture' known as rotoscoping in which "photographed motion was used as a template for

⁴ *SIMM* (Software for Interactive Musculoskeletal Modeling) <http://www.musculographics.com/>.

⁵ For a brief description of 'knowledge based systems' see Wes Trager's online article entitled: 'A Practical Approach to Motion Capture: Acclaim's optical motion capture system' prepared for SIGGRAPH 94. http://old.cs.gsu.edu/materials/HyperGraph/animation/character_animation/motion_capture/motion_optical.htm

the artist/ animator who traced individual frames of film to create individual frames of drawn animation".⁶ One often cited example where this method was used is the Disney film *Snow White* produced in 1937. Rotoscopy was used wherever a more 'human-like' as opposed to cartoon-like rendering of human movement was desired.

In the early 1960s, Boeing Airplane designers built the first graphical digital simulation environment for trying out takeoffs and landings. They also created the first digital human to use in testing out pilot movement in the cockpit. However, it would be another twenty years before biomechanics laboratories had enough computing hardware power to build the more sophisticated software systems for simulating human movement that began to make their way into the computer graphics community. These software systems would be 'knowledge based' as mentioned above - utilizing some of the mathematical expressions of the physical laws of nature searched for by Marey. Out of these developments emerged two powerful software tools for modelling or animating human movement in computer graphics environments. These were the practice of using a skeleton to control a 3-D character and inverse kinematics. "Inverse kinematics was a great breakthrough for 3D character animation, providing a 'goal-directed' approach to animating a character. It allows the artist to control a 3D character's limbs by treating them as a mechanical linkage, or kinematic chain".⁷

In the early 1980s, the MIT Architecture Machine Group and the New York Institute of Technology Computer Graphics Lab experimented with optical tracking of the human body.⁸ Again, the limitations of computer hardware at that time prevented

⁶ Wes Trager. 'A Practical Approach to Motion Capture: Acclaim's optical motion capture system'. SIGGRAPH 94.

http://old.cs.gsu.edu/materials/HyperGraph/animation/character_animation/motion_capture/motion_optical.htm

⁷ Wes Trager. 'A Practical Approach to Motion Capture: Acclaim's optical motion capture system'. SIGGRAPH 94.

http://old.cs.gsu.edu/materials/HyperGraph/animation/character_animation/motion_capture/motion_optical.htm

⁸ David J. Sturman. 'A Brief History of Motion Capture for Computer Character Animation'. SIGGRAPH 94.

certain developments the software engineers knew would be possible eventually. Towards the end of the 1980's, Motion Capture as we think of it today began to appear: as a sophisticated means for recording the motion of objects, usually human or animal, playing back this motion in a 3-D digital space and allowing that motion to drive a variety of animated forms both human and non-human. Rotoscopy in 3-D without the laborious task of human hands tracing movement.

Over the next five to six years the rapid growth of Motion Capture technologies would be spurred on as much by the commercial entertainment industry as it had been since the 60s by medical, scientific and industry research. Today, Motion Capture is considered a viable option for computer animation production with current developments moving in the direction of more affordable animation programs and camera based capture systems which will utilize sophisticated machine and computer vision software (software which can simulate the way the human eye sees depth and movement). I will return later to make some predictions about the possible use of these cheaper, more available systems in the dance field.

Types of Motion Capture for Dance Artists

There are a range of different input devices which have been developed for recording the position of selected points on the moving body and making this information available to the computer software, e.g. prosthetic, acoustic, magnetic and optical.⁹ For the purposes of this article, I am only going to discuss magnetic and optical systems in the context of several different motion capture projects involving dance artists. I will avoid providing overly technical details, a fair amount of which is available on the internet. Comparison figures on motion capture technologies that are best for dance artists are not easy to come by. Each system

http://old.cs.gsu.edu/materials/HyperGraph/animation/character_animation/motion_capture/history1.htm

⁹ For a brief description of these systems see Wes Trager's 'A Practical Approach to Motion Capture: Acclaim's optical motion capture system'. SIGGRAPH 94.

http://old.cs.gsu.edu/materials/HyperGraph/animation/character_animation/motion_capture/motion_optical.htm

vendor will tell you their system is the best and very technical information is impossible to interpret without specialists. Those interested in beginning to experiment with some of these technologies might be advised to attempt to contact some of the dance artists I have written about here.

(See **Illustration** in the published Italian version: Thesis Page 395 Figure No. 11: magnetic motion capture system being used by a dancer)

Briefly, magnetic motion capture involves the use of a centrally located transmitter that emits a strong magnetic field and a set of sensors that are attached to various parts of the dancer's body. Each of these sensors provides a data stream that consists of 3-D positions and orientations for the sensor. Some magnetic systems have wires running from each sensor almost all the way to the computer (e.g. Polhemus Flock of Birds). Other systems are wireless and use radio transmitters and receivers to send the data to the computer (e.g. Ascension MotionStar Wireless). The wireless systems provide a greater possibility for unencumbered movement in the space - but one is still limited by the size of the magnetic capture field that may be only a few meters in diameter. Magnetic motion capture will provide a large quantity of uninterrupted motion capture data which does create the possibility of working with it in real-time in a performance context - in other words you can see the animation being driven by the dancer who is wearing the sensors (for a related artist's project see Susan Kozel's *Figments* described later).

Optical motion capture systems work with the use of directionally reflective balls or markers placed at strategic points on the dancer. These systems require at least three cameras and often use more. Optical systems can offer the dancer the most freedom of movement since they do not require any cabling. However, they have the drawback of suffering from 'occlusion', which is what happens when a reflector is lost or hidden from the viewpoint of the camera. This results in a gap in the data

stream that the software repairs using tracking algorithms that can make the interpolation across the missing section in the movement. These algorithms are extremely complex and are based on an understanding of how the human skeleton behaves - once again knowledge derived from the science of physiology.

Because of 'occlusion', optical systems tend not to provide the same real-time possibilities for using motion capture as the magnetic, but this is changing as computers become increasingly more powerful. Optical systems do have the reputation of being able to provide the most accurate motion capture data or representation of human movement through the use of a large number of reflectors. This is one of the reasons Paul Kaiser and Shelley Eshkar of Riverbed used it in their motion capture projects with Merce Cunningham and Bill T. Jones.

Before I start to elaborate on some specific projects involving dance artists and motion capture, I will just briefly mention here some of the hardware and software systems they have used. Ascension and Polhemus produce wired and wireless magnetic systems; Vicon and Qualisys build and market optical systems. Three of the industry leaders for animation software specifically engineered to work with motion capture data are Maya, Softimage and 3-D Studio Max. These names will appear again and links for these and other companies are provided in the Appendix.

Workshops and Laboratories

The dance field suffers from the difficulty of gaining access to the human and equipment facilities necessary to explore the possibilities of some of the emerging technologies. Motion Capture, being one of the most interesting for dance, is no exception as it is very expensive and requires software specialists. Because of this, the context for experimentation with technologies usually needs to be formally organized and the necessary funds obtained. I would like to mention some of the workshop/ laboratory style events that have been organized to give dance artists

access to motion capture. Out of these projects has evolved a wider basis of expertise and knowledge about the potential for these technologies as well as a commitment to explore the possibilities further.

Digital Dancing was a one to three-week workshop organized in London each autumn from 1994-1998 by Terry Braun of Illuminations.¹⁰ For some of those years, Braun was able to provide access to motion capture technologies that were explored in the workshops by Ruth Gibson and Bruno Martelli (a choreographer/multimedia artist partnership), by Richard Lord (choreographer), and Susan Kozel (choreographer and scholar).

In September 1996, the Theatre Lantaren-Venster in Rotterdam organized the *Cyberstudio* in collaboration with Motek, an Amsterdam based commercial motion capture house.¹¹ This workshop brought dance and digital animation artists together to explore the possibilities for motion capture technologies. Motek contributed both equipment and computer specialists.

Real Gestures/ Virtual Environments was a two-week laboratory organized by Sally Jane Norman in August 1998 to take place in two phases - firstly at the International Institute of Puppetry in Charleville-Mézières, France and secondly at the Zentrum für Kunst und Medientechnologie (ZKM) in Karlsruhe, Germany.¹² This project was designed to investigate interrelationships between traditional puppetry and digital animation and utilized motion capture systems.

From February to May 1999, the *Digital Theatre Experimentarium*, a project I was

¹⁰ Terry Braun, Illuminations/ Braunarts. <http://www.braunarts.com/>; Digital Dancing Websites. <http://www.braunarts.com/digidancing/>

¹¹ Future Moves/ Cyberstudio Website. <http://www.ipr.nl/~future-moves/> Motek Website. <http://www.motek.nl>

¹² The Centre for Art and Media Technology (ZKM), Karlsruhe. <http://www.zkm.de/>

involved in, took place at the University of Aarhus, Denmark.¹³ Throughout February and March several seminars and workshops were organized to explore the theatrical potential of Motion Capture, Computer Animation and Projection Technologies. Performers and digital artists Yvonne Fontijn, Susan Kozel, Paul Kaiser and Shelley Eshkar were consulted and invited to contribute to the seminars. An Ascension Motion Star Wireless system with seven sensors, on loan from the former Denmark Lego Wizard Group, was used with the Maya computer animation software program.

The research goals of the Experimentarium were:

- To experiment with what to capture and how (e.g., body parts, different kinds of movement, children, etc.)
- To take the motion capture data and experiment in the animation program with human and non-human representations
- To investigate live performance interaction with projected motion capture - both in real-time and postproduction [meaning pre-recorded]
- To use the motion capture data to work outside of the animation program to drive other effects (e.g., sound)
- To reflect on assumptions about movement, time and space - actual and software based

During the month of May, two projects were followed to completion and public presentations given. One of these was a dance piece that attempted to integrate on a single stage live performers with post-production motion capture animations. A month is only enough time to experiment with a possible process for achieving this.

The first step in the process was for the choreographer to create movement material that could be captured. Experiments were set up to discover what would work best

¹³ Digital Theatre Experimentarium. <http://www.daimi.au.dk/~sdela/dte>

using the magnetic system and Maya. Based on what was discovered, several minutes of movement material was choreographed and motion captured. Because there were only seven sensors, all of the material was captured twice, once with the sensors placed on the upper torso (head, shoulders, elbows, wrists) and once again with the sensors placed on the lower part of the body (three moving down the spine, the knees and ankles). The two data sets were then assembled together, one on top of the other, using Maya's hierarchical skeletal system and inverse kinematics (both these software tools are 'knowledge based' and mentioned earlier).

(See **Illustration** in the published Italian version: Thesis Page 396 Figure No. 12: basic skeleton with 14 sensor points)

Once the motion capture data was assembled and cleaned up in Maya, the search for an appropriate form (sometimes referred to as skin or geometry) was begun. Experiments ranged from extremely abstract forms to more human-like. In the end, a form was chosen which gave the smallest indication of where the head, hands and feet were. It is worth noting here that much of this process was conducted via the internet. The animation artist would come up with suggestions and email them to the choreographer. There are several stages in the early animation process when the motion capture data combined with the hierarchical skeleton system is still relatively small and can quite easily be emailed back and forth.

(See **Illustration** in the published Italian version: Thesis Page 396 Figure No. 13: scenographic design of the space)

The scenographic design of the space was developed with the assistance of Italian projection artist Luca Ruzza. A design was conceived using both front and rear projections in order to give the animations a three dimensional quality. Using two 3.5 x 4 meter pieces of Altoglass in the back for rear projection and a large single piece

of Trevira, a transparent net material which catches the projection, for the front projections we were able to create a 3 meter corridor between the two projection areas where the dancers could work. The animation projections were synchronized so that action on one screen would have choreographed consequences on the others.

Many discoveries were made during this final part of the Digital Theatre Experimentarium - especially about the difference in time scale between animation and live performance production processes. This difference in scale resulted in a situation where the fully rendered animations were not available to be seen in the space until the final day - therefore making it practically impossible to integrate it with the live material. It would also have worked better to involve animators and choreographers together on site for much more of the time. Computer animation artists are quite used to working remotely on commercial animation projects, but in this case the abstract demands of the choreographer were impossible to convey via standard storyboarding or other means. In the end, only a couple of minutes of the original motion captured material were utilized, but it was used repeatedly from different perspectives - not only from sides, back and front, but also from the impossible perspectives from above and below (a benefit of 'choreographing' in digital space).

Artistic Projects

Workshops and laboratories are important contexts for discovery and learning, but they rarely result in compelling artistic work for two reasons. Firstly, they are usually not long enough and secondly, they often bring together collaborators (dance and digital artists) for the first time. The projects I am going to share with you now come under the category of "artistic projects", as they involve ongoing collaborations and longer working processes. Each has also achieved, in my opinion, an important 'artistic' as different from 'research', result. That said, I have chosen not to report in

very much depth on the aesthetic implications of each work, a fact that may disappoint any readers searching for this type of discourse. I have focused rather on some of the practical aspects of the work as well as relationships that interest me in my own research into the different systems of knowledge production.

Software kinesthetics: the convergence between choreography and robotics

Two of the most interesting recent works were created by Riverbed, the digital arts partnership of Paul Kaiser and Shelley Eshkar.¹⁴ Their project with Merce Cunningham, titled *Hand Drawn Spaces*, premiered as a 4 minute film installation at the international graphics trade show SIGGRAPH in July 1998. *Ghostcatching* with movement captured from Bill T. Jones, premiered as an 8.5 minute film installation at the Cooper Union in New York City in January 1999. Both of these works also helped to bring a new level of visibility to dance and technology projects generally.

(See **Illustration** in the published Italian version: Thesis Page 396 Figure No. 14: still image from *Hand Drawn Spaces* by Merce Cunningham and Riverbed)

For *Hand Drawn Spaces*, Cunningham choreographed and motion captured 71 short phrases. The animation mapped onto this data had a hand drawn appearance, hence the name. The selection and joining together of the sequence of the recorded phrases was done with the help of new animation software developed specifically for the project titled the 'motion flow editor'. For Riverbed's work with Bill T. Jones, the challenge was partly to 'test' the potential for the motion capture technology to record the personal movement subtleties of a particular and unique dancer.

As Paul Kaiser is also contributing to this book I am going to limit my report on both of these projects – in anticipation that he will cover this in more detail. If not, the

¹⁴ Riverbed Website. <http://www.riverbed.com>

Riverbed website is a rich source for information about their work (see Appendix).

Working with Riverbed in refining the animation software for their projects with Merce Cunningham and Bill T. Jones were computer animation innovators and artists Michael Girard and Susan Amkraut. In an interview with Paul Kaiser, they discussed the evolution of some of their groundbreaking animation work. In the 1980s, Girard was one of the first to introduce gravitational dynamics into the computer animation process. Prior to this, computer animators had focused on developing software solutions that would "imitate what traditional animators do - that is, to come up with a set of keyframes and then interpolate what comes in between."¹⁵ Girard was one of the first to realize that physically-based (or 'knowledge based') software solutions could better imitate what the human animator drawing in-between the keyframes had always known intuitively about human movement and physiology.

Girard and Amkraut became less concerned with how their animations looked and more concerned with how they actually functioned in movement terms. One of the fields they investigated to find the physically based algorithms that could be used in computer animation was robotics. Robotics engineers are more interested in the autonomous locomotion of their robots than in their appearance. "We were fortunate that Ohio State University had one of the premier programs on walking and running machines in the country. Marc Raibert's work on running machines was particularly amazing. Some of the same algorithms used for making robots walk and run could also be used in computer animation, especially the crucial notion of inverse kinematics."¹⁶

¹⁵ Michael Girard in an interview with Paul Kaiser, published online. <http://www.riverbed.com/> (look under 'Conversations' and 'Unreal Pictures')

¹⁶ Michael Girard in an interview with Paul Kaiser, published online. <http://www.riverbed.com/> (look under 'Conversations' and 'Unreal Pictures')

(See **Illustration** in the published Italian version: Thesis Page 397 Figure No. 15: image of 'spring turkey' robot from MIT LegLab under direction of Marc Raibert)

The refinements Michael Girard and Susan Amkraut brought to the Riverbed dance projects focused on the development of the Motion Flow Network. The Motion Flow Network was an innovation that allowed for one motion captured dance phrase to connect to another. The computer software used physically based gait shifting algorithms (derived from robotics) amongst others to make a smooth interpolation between the two phrases. Here again we see mathematical equations, some of which are the offspring of innovations and discoveries from the end of last century, being used to provide contemporary computer software solutions. In this case, it's a poetic convergence - knowledge of human movement derived from the investigations of a century ago, used in computer software designed to move 20th century robots, and eventually participating in the choreography of a digital dance project.

Shifts of Time: Dancing with your 'in between'

Susan Kozel and Kirk Woolford form the company MESH Performance Partnerships. Kozel, a dancer, choreographer and scholar, has been exploring dance and technology overlaps in her work for several years. Woolford is a visual artist and computer programmer who has collaborated before on dance and technology projects. Their recent work together, *Figments*, uses motion capture technologies and computer animation in a unique way. *Figments* involves the performance of a live dancer wearing several motion capture sensors (a combination of magnetic and ultrasonic systems). The position and orientation of these sensors is displayed in real-time on a screen animating a very simple stick figure. Also projected on the screen is a pre-recorded sequence using the same data points and simple stick figure. Between these two figures a third body/ figure is created by the computer software - referred to by Kozel as the 'virtual body' - which

is a modulation between the real-time movement and the pre-recorded sequence. Kozel, the dancer in the work, discovered that this 'virtual body' - computationally generated as something 'in between' herself in the past and herself in the present - at times took on the quality of another sentient being.¹⁷

(See **Illustration** in the published Italian version: Thesis Page 397 Figure No. 17: the performer Susan Kozel in *Figments*, MESH Performance Partnerships)

Data Driven: human movement in non-human forms

Yvonne Fontijn and Dutch choreographer Karin Post have been collaborating on motion capture and animation projects for a few years now. Fontijn works as an animation artist for Motek, an Amsterdam based commercial motion capture house (mentioned earlier). This affords her unique access to the technologies necessary for her projects and gives her the opportunity to experiment and explore over a longer period of time. She uses both optical as well as magnetic motion capture systems and the Softimage computer graphics program. Approximately two and a half years ago, they did a motion capture session in which the movement of the torso and arms was captured from one dancer (Karin Post) and the movement of the pelvis and legs from a tap dancer.

This data sat stored in the computer for several months before Fontijn decided to use it in creating an animation film installation entitled *Upper/ Lower for the Traces of Science in Art* exhibition at Het Trippenhuis in Amsterdam in late Spring 1998. In order to get as far away from the representation of a human figure as possible while still retaining the special movement quality of motion capture... she superimposed the upper torso from Post directly on top of the lower half from the tap dancer.

¹⁷ Susan Kozel and Kirk Woolford. 'Utterance 5: Mesh Performance Partnerships'. On Line: Performance Research. Vol. 4: No. 2, Summer 1999. p.61.

What you see in the mesmerizing animation is a series of abstract shapes, which are animated with human movement. Once you are informed that it has been motion captured, it is possible to identify in the shifting forms the occasional and recognizable rhythm of the tap dancer's feet. If uninformed, one sees the film as an animation with highly organic movement - the source of which would be difficult to determine.

Catching Time: from ephemerality to solid form

In Denmark, choreographer and performer Dorte Persson heard an interview on the radio with a new commercial motion capture facility in Copenhagen.¹⁸ She contacted them and offered an exchange – motion capture data (herself dancing) that they could use in animation work for assistance on an artistic project she had in mind. Using one of their magnetic motion capture systems with 14 sensors, Persson improvised and captured several sections of movement. Working ONLY with the movement trajectories of each sensor, she selected a 2.5 minute piece of movement from the sensor on her left foot and a 10 second piece from the sensor on her right hand.¹⁹ Still working only with the trajectories of the movement, she had a representation of the pathways the sensors had travelled in three dimensions created in the animation software (3-D Studio Max). The intention was to meld these trajectories into a three dimensional sculpture out of solid aluminium piping (1.2 cm in diameter).

(See **Illustration** in the published Italian version: Thesis Page 397 Figure No. 16: image of the sculpture from Dorte Persson)

Originally, it was hoped that a machine (such as those used for making furniture) linked to the computer could be used to meld the aluminium into the 3-D form

¹⁸ Mocap Copenhagen. <http://www.mocap.dk>

¹⁹ For a videoclip sample of the 10 second trajectory of the right hand see Dorte Persson's website at <http://www.koreograf.dk>

directly from the digital data. However, these machines were not flexible enough to conform to the complexity of Persson's captured movement pathways. Eventually, it was necessary to print out several viewpoints of the sculpture on blueprint forms and take them to a jewellery craftsman who had the proper tools and skills to create the sculpture by hand. The 2.5 minute movement section used up approximately 80 meters of the aluminium piping.

Persson's title for the work is *Moments of Invisibility* that appropriately captures the essence of the piece. It was exhibited at the Art Crash Festival in Aarhus, Denmark in May 1999 and since then at the Modern Art Museum in Brandts Klædefabrik, Denmark. A simple concept, it elegantly illustrates some of the potential of motion capture technologies for dance artists. By making solid both the ephemeral qualities of dance and digital imagery, *Moments of Invisibility* captures time and brings an articulate fourth dimension to the three dimensions of visual phenomenon. In so doing, this work resonates with the work of Etienne-Jules Marey who also spatialized time with his graphic instruments and cameras in his pursuit of the understanding of movement.

Future of Motion Capture

The workshops/ laboratories and artistic projects I have written about represent just the beginning. Organizations devoted to the documentation and preservation of dance (such as the National Initiative to Preserve American Dance) are considering the possibility of using motion capture. Links are being established between the choreography software tools such as Lifeforms and motion capture which will allow for greater manipulation and editing of motion capture data. Research projects into artificial creativity, such as *Coppelia* at Surrey University in the UK, are creating software that can generate dances from libraries of motion capture material.²⁰ With the ease of transportation via the internet, raw motion capture data can be easily

²⁰ Coppelia Website. <http://www.ee.surrey.ac.uk/EE/VSSP/groups/human/coppelia.html>

'emailed' anywhere in the world. This could be a boon for the dissemination and teaching of dance and choreography if the issues of intellectual copyright are solved.

In the future, as cheaper and simpler camera based systems for motion capture are developed and hardware and software prices drop, we will see dance artists using motion capture technologies to look at their dance material in three dimensions as part of their creative process in the studio. It is likely these systems will use some form of software engineering referred to as computer vision, sometimes called image understanding. As mentioned earlier, this is software that can simulate the way the human eye sees depth and movement. Like some aspects of movement modelling, it is also 'knowledge based' in that it incorporates an understanding of the physiology of perception into its algorithms.²¹ These systems will do away with the need for the encumbering wires of the magnetic and ultrasound systems and even the round reflective markers of the current optical systems. They will also make it possible for the capture of multiple persons in the space.

Still, these newer, cheaper forms of motion capture will not replace video, because the fidelity of the two dimensional video image will remain of a higher affordable quality for many years to come. Three dimensional motion capture systems that can track movement of fingers and facial expression are being developed, but these will remain out of reach for the average dance maker. What we will see in the studio is a combination of both sources of information used to review one's dance material from every possible viewpoint and to replicate and blend movement phrases together in software programs such as the Motion Flow Network mentioned earlier. These systems should be within the reach of most dance artists within 8 to 10 years. And, as with all new technological forms of image production, this new way of looking at

²¹ Descriptions of 'computer vision' can be found in the class information in various computing science departments at university sites, e.g. <http://www.cs.umass.edu/autogen/cmppscidescf99.html> and http://www.cc.gatech.edu/classes/cs7322_97_spring/info.html. A commercial site providing an interesting camera based system is SIMI/ Reality Motion Systems at <http://www.simi.com/en>.

movement material during the making process will influence the art of making dances.

Postscript

I am not the first to suggest that video and computers will someday be used together in the dance studio. Merce Cunningham, always far ahead of his time when it comes to exploring new technological possibilities in the dance making process, made the following speculation in the late 1960s.

"It seems clear that electronic technology has given us a new way to look. Dances can be made on computers, pictures can be punched out on them, why not a notation for dance that is immediately visual? There have been some slight experiments that I know of made in this direction, probably there are a good many more by now. A situation that strikes me as being immediately accessible to the dancer would be roughly like this: two screens, video or otherwise, synchronized as to time, and the same size. One would have the dance on it as performed by a soloist or group, that is, a performance complete with costumes, etc. if essential. Next to it, on the second screen, images in stick-figures that work in depth."²²

Scott deLahunta

2000 - 01

Appendix

Motion Capture Systems:

Ascension - <http://www.ascension-tech.com/>

Polhemus - <http://www.polhemus.com/home.htm>

Vicon - <http://www.vicon.com/>

Qualisys - <http://www.qualisys.com/>

Animation Software:

Maya - <http://www.aliaswavefront.com/pages/home/index.html>

Softimage - <http://www.softimage.com/>

3-D Studio Max - <http://www.softimage.com/>

Kayadera's FilmBox - <http://www.kaydara.com/>

²² Merce Cunningham. *Changes: Notes on Choreography*. Ed. Frances Starr. New York: Something Else Press, Inc., 1968 (no page number). Merce Cunningham's website is <http://www.merce.org>.

Commercial Motion Capture Houses:

Motek - <http://www.motek.org>

Mocap Copenhagen - <http://www.mocap.dk>

Artist's Websites:

Riverbed - <http://www.riverbed.com>

Dorte Persson - <http://www.koreograf.dk>

Mesh (Susan Kozel/ Kirk Woolford) - <http://www.mesh.org.uk/>

Miscellaneous Reference:

Motion Capture Research Website -

<http://www.visgraf.impa.br/Projects/mcapture/index.html>

'Hot Wired Live Art: observations, reflections and interviews'

in 3T: Norwegian Theatre Journal. Spring 2000, pp. 6-17.

In February 2000, I received an invitation from Marie Nerland, issue editor, to write something for an issue of 3t: Norwegian Theatre Journal based on the first 'Hot Wired Live Art' (HWLA) interdisciplinary research lab held in Bergen, NO in January 2000. I had been invited to participate in HWLA to document and facilitate dialogue. I recorded separate individual interviews with each artist-participant which remained on-line for a period.¹ Nerland suggested transcribing these video interviews which make up the majority of the article.

3t: Norwegian Theatre Journal was established in Bergen, Norway, in 1996 to create a forum for reflection on the performing arts by publishing interviews, performance texts, visual contributions and theoretical articles. Source: <http://www.trete.no/> (accessed 7 May 2010)

¹ Minimal documentation site: <http://www.ubermatic.org/hwla/> (accessed 7 may 2010)

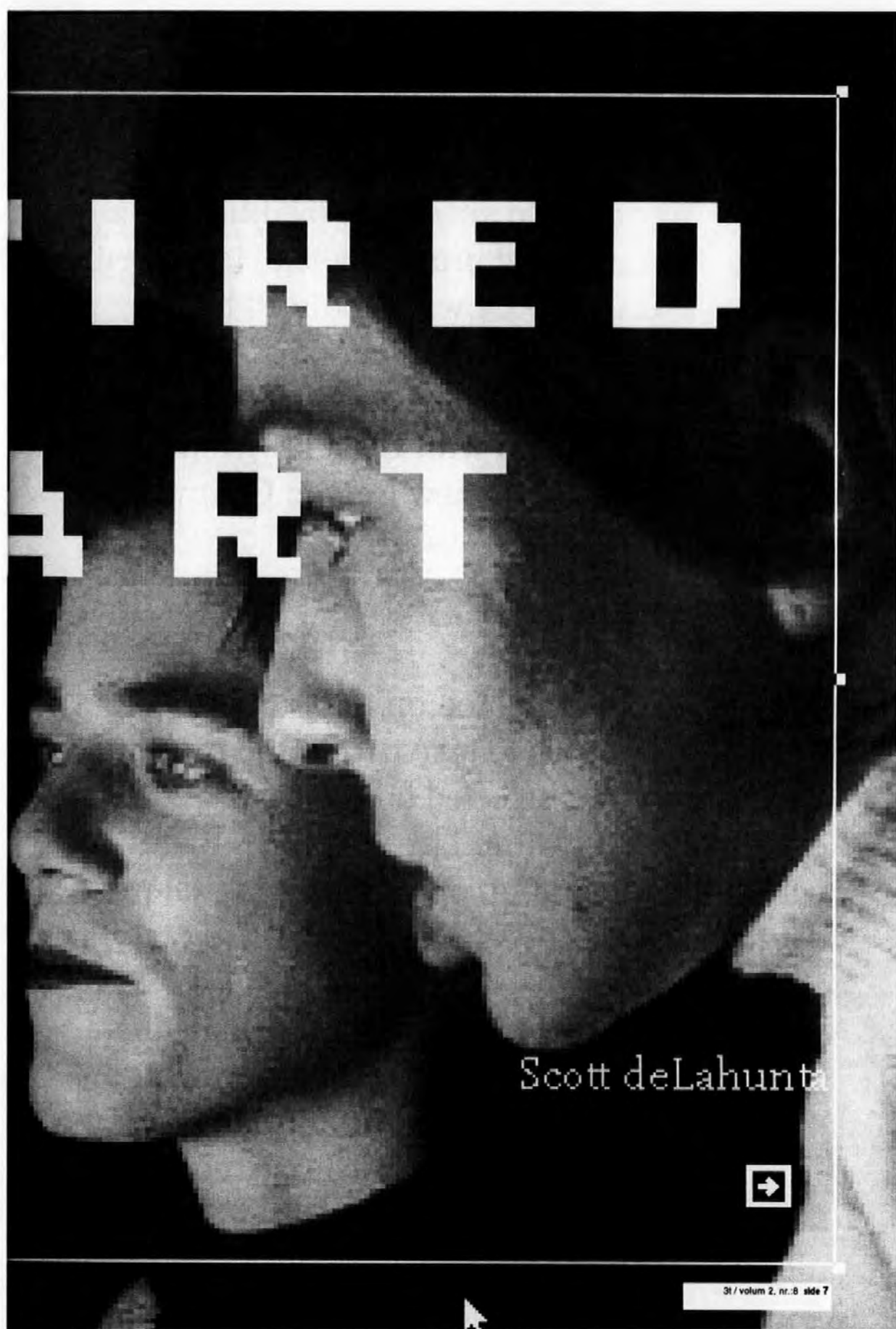


HOT W

LIVE

- OBSERVATIONS,
REFLECTIONS AND
INTERVIEWS

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FIRED ART

Scott deLahunta



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From 4-16 January 2000, the Bergen Academy of Fine Art provided space and facilities for a unique experimental project called Hot Wired Live Art (HWLA). HWLA was produced by Amanda Steggell and Per Platou of Motherboard (<http://www.notam.uio.no/motherboard/>) working in collaboration with Gisle Frøysland and Jørgen Larsson of the new Bergen Centre for Electronic Arts (<http://www.bek.no/>).

[See the website <http://www.bek.no/hotwired/info.html> for details about the setup of the project and links to relevant sites.]

Amanda and Per invited up to 16 artists from different countries to take part in the project. Each invitee was selected on the basis of their experience in creating Live Art works that involved the integration of emerging digital media technologies.



My role was to facilitate dialogue and discussion with the goal of contributing to the evolving discourse related to this area of work.

Evolving discourses

In a posting to the Nettime discussion list 25 October 1998, media theorist Lev Manovich writes that "new media requires a new critical language – to describe it, to analyze it, and to teach it". He goes on to say that "to articulate the critical language of new media we need to correlate older cultural/theoretical concepts and the concepts that describe the organization/operation of a digital computer. As an example of this approach, consider the following four categories: interface, database, navigation, and spatialization. Each of these categories provides a different lens through which to inquire about the emerging logic, grammar, and poetics of new media; each brings with it a set of different questions".

I agree with Manovich's concept for defining frameworks for interrogating new media, i.e. correlating selected cultural concepts with digital ones, and support his four categories in relationship to certain manifestations of new media such as netart, cdrom based work, interactive installation, etc. However, I found it more useful during HWLA to consider a different set of categories when looking at the employment of digital technologies in the context of live art that by definition necessitates the presence of the performer/maker in the work.

The following set of six categories was conceived in the first few days of HWLA: environments, materials, potentialities, convergence, fidelity and sensitivity. The intention is that these will serve to stimulate discussion/ debate and contribute to the evolving discourses in this area of work.

1) Environments

In the early days of HWLA, the space begins empty and we have to fill it. Positioning of tables and chairs and creation of open spaces overlap with placement of machines and electronic and data cabling (we are not yet in a wireless environment). As soon as hard drives are booted the electronic interfaces are set up to take advantage of the new network, and the virtual environment is soon being explored and debugged to enable networking both internally and externally. Input and output devices are installed and explored. The new environment introduces something unfamiliar for everyone, an environment which has to function so that the project can move to the next

step. To refer to Manovich, there may be "navigation" taking place here, but spatial metaphors are set aside for the more important systemic efficiency and reliability.

2) Materials

Artistic practice is built on the notion of material or materials which whether composed, bricollaged or choreographed supply the basis of an artistic form. Traditionally, in particular in the modernist conception, these underlying materials have their own underlying or 'essential' form. Digital technologies upset this relationship between materials and forms, presenting us with bits rather than atoms to play with. Bits are fundamentally changeable as a consequence of the operational range of various software codes. What is the nature of artistic practice on the level of codes? HWLA has only one experienced programmer who spends most of his time debugging and adding functionality/ features to Keystroke, a multi-user multimedia software being tried out during HWLA. Is debugging an artistic practice?

3) Potentialities

The code machines are able to do anything – in principle any digital material should be available for reconfiguration via every chip in the space. Working with binary data, 0s and 1s, no gates should be permanently closed to the persistent digital artist. Within these parameters, the relationship between machine and man/ woman becomes related to the intelligence and experience, the ability of the digital artisan – a condition of the ego. The ego is so far a very non-machine condition, although several of the artists seem happy to give their kit a passing mark for the Turing Test (see the interviews). However, HWLA is a 12 day project so pragmatics become a strategy for making decisions about what possibilities to pursue and what not to. It is only time, apparently, which limits the potential of the code machines.

4) Convergence

Networking is based on input and output and causes one thing to run into another. Transformation on the level of 'language' occurs at these moments. It is not a 'chemical' interaction, but a linguistic one. Successful convergence results in communication and not crashes. This requires an awareness on the part of both hu-

mans and machines of protocols, rules and syntax. One program needs to be able to speak to another, one piece of hardware must talk to another. Midi, Max and Keystroke... all these softwares are written with throughput and convergence intended – requiring the metaphorical handshake and 'hello, who are you? I know you, okay let's talk'.

5) Fidelity

Transformable code may be at the core of digital materials, but at the reception (or output) end, the audience, viewer and/ or reader in general needs to receive an effect of some kind. Computers generally manifest audio/ visual effects. Haptics (or touch) is also possible but in the case of HWLA these were reserved for the radio controlled balloon. Researchers are also working on digital smells and tastes, but these effects are some way off. The dictionary description of fidelity is "the degree to which an electronic device accurately reproduces its effect (as sound or picture)". Fidelity is related to articulation, clarity, focus, sharpness, precision, more or less ambiguity. As digitization still digs itself out from under the memory trials and processor limitations related to high resolution, fidelity can be seen as a limitation to be exploited or a goal to push the technology further.

6) Sensitivity

Matthew McCullough in his book *Abstracting Craft: the practiced digital hand* proposes that "our nascent digital practices seem more akin to traditional handicrafts, where a master continuously coaxes material". While many of the artists involved in HWLA may be opposed to the idea of being or becoming a "master" artisan, nevertheless some form of a feeling for the digital object is coming through the control of the mouse, the speed of fingers on keyboard, listening to an adjusting or 'fine tuning' aural and visual effects. Listening to each other in an online, interactive work... playing together in multi-user environments.





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☐ The following is a transcript from the video interviews done by Scott deLahunta. (ed. Red)

Daniel Aschwanden is the director of Bilderwerfer, a dance company based in Vienna consisting of a mix of performers with and without "disabilities".

Question #1:

Can you talk a little bit about your ideas for using Internet chat to stimulate or trigger action in the live performance space.

-Well, behind the concept of using an Internet chat to trigger a live performance, was the idea of the possibilities to use real people in a virtual space to interact in a live performance. And a chat is something that is always available, with enough people to speak to, and you can go for content, some time go for different content and you can find a feed for an improvisation structure in the live performance.

Question #2:

Will the people on the Internet know that you are using their chat for the performance triggers.

-I've not decided yet, but I think we could let the people know "hello we are doing a performance now, and can you give us any advice or can you join in, or rather give us some input? Or we could just use it. One idea was to during the performance pick up incoming text, read it or make as if a voice was left out of it, whereas others would have to act on it and answer it and we would have to write to this person. Or in the extended version, maybe use a voice-recognition system that would bring the text back to the chat, and in this way make it faster.

Question #3:

In your dance company you work with different bodies, some of them disabled, and you have suggested that new technologies might offer alternatives for "speed". Could you talk about this a bit.

-Bilderwehrr consist of performances with different bodies, some disabled and where speed sometimes is a topic. And as we have a spastic member or we have a woman who is paralyzed they can't move at the same speed, sometimes

they suffer. We call them walkers, or runners. The idea came up that through an interface they would be given possibilities of more movement or slow movements, to trigger very fast action, and maybe in exchange of normal speed. It would also transform it in a virtual space where also the identity of your body doesn't mean that much. But, even though we talk of fast machines and computers and stuff we learn that there is one thing that makes it slow, which is the time we use to handle it, to set it up and make it operate. With these factors, once solved, I think you can be very fast.

Amanda Steggell is one of the organizers of Hot Wired Live Art and is co-director of Motherboard, based in Oslo. Motherboard creates performances and installations which utilize and relate to digital pop culture and social interaction.

Question #1:

Can you describe some of the main characteristics of Keystroke? (A new software program designed and engineered for artists which is being alpha tested at the HWLA).

-Keystroke is being designed for people to interact over the Internet. Almost, or very much based on a game situation where you communicate with a remote key through anything you can get down

through the band width. And I think this is what the development team are focusing on, how much information can you actually get through the lines and what you can play with.

Question #2:

Both Keystroke and Image/ine are real-time media editing softwares that are able to synthesize one media using properties from another. What do these softwares make possible for the artist?

-Say you're taking in news. The news has inherently it's own properties. It has its commentator, there's a voice and they speak in a special way (gesturing). And then comes the report bit, from the war zone or from the football match, so the dynamics are shifting. If I can use that type of dynamic to control other features within the basic setup, I feel that they become connected in



the same kind of dynamic landscape. At the same time unpredictable things happen when you do it this way. So I like this possibility of being able to script, and the little environment within the machine. You put it on and it runs itself, but it feels alive to me.

Question #3:

Where do you find your material when you make art work that makes use of digital media and its possibilities?

-In this kind of workshop situation, which Per and I set up together, what's happening in the room is actually what we dictated. It's the physical fencing session where the material comes from, mainly. The other material is coming from when the group did physical actions. It is interesting, because you have to acknowledge that we are human. We are cyborgs as well, but we have to be out to interpret. And I really believe in this physical action affecting the choices that are made. The material that's being made. When you then put this into this digital setup, where we don't quite know what's going to happen, then it will really influence what is going to go on there.



Question #4:

You work a lot with the possibilities for communicating with other people via digital media. How do you respond if it is just a machine talking back to you... or a computer that seems to be making its own aesthetic choices?

-Anything that talks back to me, I talk to it. I love generators that can take my input and do something.

Q: So you don't have a problem with anything that takes on its own mind?

-No I love it, I don't have any problems with it at all.

Leon Cullinane is a member of C6.org, an arts organization using modern media techniques to communicate with a non-gallery going public in both real and virtual environments.

Question #1:

You use your body as your material in your endurance works. Would you ever consider using your

body as a site for inserting or implanting digital technologies - such as a subcutaneous computer chip?

-Well about the time of the box, Stelarc was in town, and he turned up in the gallery. I took some photographs of him in the box, some video stuff, cause everything was surveillanced up. And we did a net chat with him, online in the gallery, one terminal to one terminal, posting up at the same side. He is doing a lot of that type of work, putting little electronic sensors on to his face, I mean, he is out there, he is fucking out there. But no that doesn't really interest me. The only way my work would go like that... I've worked with Franko B. and his stuff really interests me. It is personal, the blood-laying, I love that opening up, that honesty. That's why I like my endurances, because I have no secrets. You can access me like a

web-page and I will tell you anything about myself... you know, perhaps I'm considering some type of mutilation now to my body.

(Stelarc and Franko B are both artists who use their body in what some consider extreme artistic actions, e.g. suspension from sharp hooks and cutting words into oneself.)

Question #2:

Orlan is a French artist who has cosmetic surgery performed on herself and uses the media to broadcast the operations to a viewing public in real-time. Would you ever consider doing self mutilation on the web in this way?

-If it meant cutting myself open, and exposing the inside of me to an audience, then I wouldn't do that. Not in an Orlan type of way, cause I find that too performance exploited, Franko's work is performance related, but it also has an honesty and a consequence for the artist that is very real. Orlan's work also has a consequence to it, but it has a very staged, explanatory nature. I like the consequence and the act, but the explanation and education is not something, I really like. You should watch what the artist is doing and then refer it to your own life and discover something about you. Art is communication not education.



- (laughs) **Loops**
and feedbacks
and feedbacks,
and feedbacks,
and loops and
feedbacks.

Question #3:

With your interest communicating with others it makes sense for you to move your work on to the web as you have been doing. Wouldn't it be something if you could actually perform bloodletting on the web.

(Laughs.)

Gisle Frøysland is a visual/electronic artist based in Bergen. A member of 220Hex and BEK. He has been creating interactive works for galleries and stages for several years.

Question #1:

You have been making interactive art work using electronic and digital technologies, but recently you said "interactivity" is losing its interest for you. Can you explain what you mean by this?

-Well, it's not that I'm not interested in interactive work, I have been working with it a lot and I will continue exploring the possibilities. It seems now though that it's not really getting anywhere. There has been a period where people working with media arts have had this idea about everything having to be interactive. Like if you're not working with interactive things it's not worth anything. But I've kind of got past that period and to me it is like if it is going to be interactive there has to be a real reason that it should be interactive. The interactive part has become just a new way of making instruments that you play with, useful for making sounds or abstract visuals. I'm bored with that too, it's just a kind of aesthetic wanking, it doesn't have that kind of content that I'm interested in.

Question #2:

You have worked with the theatre group Baktruppen creating interactive environments for the stage (involving triggers and sensors which are interacted with by the performers). How does

this compare with your installation work?

-I think that's even more difficult than installation environments, when you work with a performance material you have to make the interactivity transparent to the public in a totally different way. When it's an installation the public can experience it themselves, but in the theatrical thing, you're used to sound and light coming when the actors are doing something, so how can you then show that this is real...

Q: Triggered by activity?

- Yes. Of course you can do it when you use instruments, when your kind of improvising with a device that makes sound or visuals.. but to me that is not interesting.



Question #3:

You obviously use your knowledge of hardware and electronics in creating your art work. Do you think an artist who wants to work with digital technologies needs to have a deep understanding of mathematics and

electronics?

-Well, it is kind of difficult because you have so many layers of knowledge in this field but to begin with I don't think you really have to be an expert to make good art with something. But you kind of lose very much control of the material if you don't know what's underneath in the different layers down to the core of technology. Many who work in this field use technicians to do the various parts of things, and they are then actually doing very much aesthetic choices for you.

Question #4

What do you think about collaborations then between artists and technicians - wouldn't this be one way for artistic and technical knowledge and experience to come together?

-The problem with working with technicians, is

that they are often used to work the right way with tools and so it can be really hard for an artist to kind of break out of that and make the technicians and this collaboration work so that you get something that's different from everything else.

Niels Bogaards has a degree in electronic composition and music software. He is currently one of the key programmers and developers working on Keystroke.

Question #1

You are doing a lot of the programme for Keystroke (being developed as a multi-user art making environment) so you must be working with a lot of artists. How do you find these working relationships / collaborations?

-I was an artist before I became involved with software so I do have an understanding with aesthetics and such. Not a real artist in such a way that it's my life to do real works of art, but I do have a basic understanding of what artists would like, I think. And then with people here and other artists I put myself in the position that what the artists want is always right. Cause he/she bears a bit of the final responsibility on the value of the output. But I feel it is often difficult for the artist to see all the possibilities so I like to show what we thought of as tools for the artist.

Question #2

What do you learn from the artists who are testing and using the programme such as they are here at HWLA?

-It is often very simple basic things that the artists like and then they often want some extras that we didn't think about. Like now we can skill them and we can do all kinds of effects, but we cannot then mechanically load another movie to do the same because we never felt the need to when testing. We were mainly occupied with making the effects work.

Question #3

Do you think an artist who wants to work with digital technologies needs to have a deep understanding of mathematics and electronics?

-Sometimes I miss some background with the ar-

tists. Things that for me are very logical often seem or seemed to be difficult for artists, not mathematics but a basic understanding of how machines work, information works. That's something often a bit lacking and that means I would have to explain more than I would like.

Question #4

In some circles, technicians have a reputation of becoming frustrated when technology is used in the 'wrong' way. What do you think when an artist uses your software in a way you had not envisioned?

-Often the nicest works are those where software or any other machine is used in a different way than was intended. So what I like is to build a machine that is so open that you can modify it to your own needs. I don't have to do that myself.

Per Flatou is one of the organizers of HWLA and is called director of Motherboard based in Oslo.

Question #1

HWLA is a project set up to explore in one level the possibilities of working artistically with a networked environment where various nodes and people are connected via computer network within the space

with links to the larger Internet. Is this the first time you have set up a project like this?

-We been experimenting a bit, or I have at least on my own tried to set up these kind of networks. We had a thing called Terrial loop with real audio and real video transmission to another node on the Internet. Then maybe being processed or maybe not and being sent further. And coming back so that it would be a kind of loops of event starting perhaps by just a performer coming doing a tiny little action and then it would be distorted around, it's like a kids game when you whisper words and it gets distorted along the way. But this is the first time I think we have tried to do it in this kind of setting with professional artists. I think that would make this room more like part of the idea of the Internet, more like several nodes connected actually physically and technically connected which I hope also will make them connected on a more abstract level. But we'll see.



Question #2

It's interesting that you think this project and this space/room being set up at HWLA will be part of 'the idea of the Internet'. Can you elaborate on this a bit.

-I have always been stating that Internet even if it is a technical network, of course it is going through electric wires, but it is still humans on both sides of it. So that I think, makes it organic. This will help to show that it is organic or give it some pulse, some kind of organic pulse that along with the physiology of the machines will interact with the physiology of the body and I think it might grow into something beautiful. I'm a romantic basically.

Question #3

Your main collaborator in Motherboard, Amanda Steggel has said that if a machine talks to her, she talks back to it. Do you share her view on machine life or intelligence?

-Of course that is the Turing test. I think still it is a kind of valid question to put up and it is hard to tell something. It is interesting. I might talk to a machine if it is a total stranger, why not? All that ELIZA thing still work in a way

(ELIZA is an automated psychoanalysis program written by Joseph Weizenbaum at MIT in 1965 and is considered one of the oldest examples of Artificial Intelligence)

Question #4:

Can you talk a little bit about what Amanda and you has written in the project description of HWLA - that "live manipulation of recorded events takes precedence over closed product"?

-Yeah, that goes back to the improvisational part. But even in this workshop I see a lot of prepared material, which can be nice of course. It's a framework and I'm happy to work within that. But still in the real-time performance you're actually there, especially in a network you have to kind of feel the spirit. I know this sounds like New Age. When you then start manipulating you have to be very sensitive and if you have the material on beforehand, the performance is likely to be somewhat like the next one. While when we've been

doing some stuff totally improvised, the timeline and the framework will develop in a certain kind of way over a time period. And suddenly we will realize that we need this kind of sound, and I'll then immediately go and get it or make it, or I'll need an image, ok, I feel like stripping, striptease, I feel like swearing, dancing, I feel like turn on the lights, turn off the lights. All that is what I personally would like to develop more. So even if Keystroke seems like a perfect platform for this kind of thing, I feel like until they get mediafiles online on a server basis so you can upload immediately and start using new files, it will have somewhat limited kind of live feeling to it.

Question #5

The experimentation during HWLA have been very open, but one of the structures you have stressed is that each station and action, whether the conducted using technology or mainly as a physical event, should maintain a constant source for "input and output". It seems that this one of the key features of the network as an art making environment for you. Can you say something about this?

- I have been into that idea of networking for more than ten years and it is like what you put in is what you get out, so you can't just connect to a network and just sit there and get anything. You have to get in and get output at one time. At some point you will get feedback, I'm into loop things also I think I'm living in a constant world of loops and feedbacks, loops and feedbacks.

Q: Could you say that again? (laughs)

- (laughs) Loops and feedbacks and feedbacks, and feedbacks, and loops and feedbacks.



'Virtual Reality and Performance'

in Performing Arts Journal. 24:1. 2002, pp. 105-114.

In October 2000, I received an invitation from media and performance artist and scholar Johannes Birringer to write an essay for an issue of Performing Arts Journal for which he was responsible for the 'dance and technology' section in a special issue of the journal on new media and digital art. He asked for something on my current thinking on "digital dancing" or on one of the interdisciplinary research labs I had just worked on or the impact on dance education. He asked that the essay to be well written without "jargon or highwire theory" and more for an interested audience that cares for art and dance."¹ I took the opportunity to explore some of the limits and possibilities for performance in 3-D spaces.

Performing Arts Journal is published by MIT Press Journals. Admired internationally for its independent critical thought and cutting-edge explorations, PAJ charts new directions in performance, video, drama, dance, installations, media, film, and music, integrating theater and the visual arts. In 2010, the journal celebrates its 34th year of publishing. Source: <http://www.mitpressjournals.org/loi/pajj> (accessed 7 May 2010).

¹ Email to author, 19 Oct 2000.

VIRTUAL REALITY AND PERFORMANCE

Scott deLahunta

This article will set out three things: a description and contextualization of art work I will call virtual reality/performance; a presentation in some detail of a recent manifestation of a virtual reality/performance work; and a perspective on why choreographers and dancers remain largely absent from these developments.

VIRTUAL REALITY/PERFORMANCE WORK

Virtual reality/performance work tends to engage actively with open forms of audience participation and interaction; site-specific responses to space (whether virtual or actual) and the possibilities inherent in discontinuous, gaming, interactive and user/participant-led time frames. Historically, the concept of virtual reality/performance work draws on several genres of art work, i.e., Happenings, performance and live art, participatory art, interactive art, installation art, media and communication art, etc.

The "virtual reality/performance work" invites the audience/viewers/users to participate in or interact with an art work that involves being able to navigate freely "within" a three-dimensional environment created by computer software. This entails the use of sensors and devices to register input from the user/audience member to be integrated with the computer generated 3-D environment. An input device can range from something as simple as the familiar mouse or keyboard to more complex apparatuses that are able to register movement of other parts of the body in space and transmit this information (often position and orientation, but other possibilities are pressure, acceleration, and proximity) to the computer. Common to most virtual reality/performance work is the notion of building a customized input device that becomes a part of the work itself. The computer takes the input information and more or less immediately calculates a perspective within the 3-D environment and renders and displays this as "output" to the user/viewer/audience member via projection devices.

This combination of activities (input, calculation, output) working together may take different forms, and these essentially range from the popularized Head

Mounted Display (developed from ideas pioneered by Ivan Sutherland at the University of Utah in the late 1960s), which uses different left and right eye views to create the illusion of 3-D, to the CAVE. The CAVE (Cave Automatic Virtual Environment, developed in 1992 at the Electronic Visualization Laboratory, University of Illinois) is an immersive 3-D environment that dispenses with the bulky Head Mounted Display.¹ One walks standing up into a 10 by 10 foot room wearing a special pair of active stereo glasses and carrying a mouse "wand" that interacts with the space. There is an input device in the form of a "head tracker" that provides information about the user/audience member's position in the space. The software synchronizes all the devices and calculates the correct perspective for each wall from the point of view of the user. Four projectors send the computer-generated images onto three walls and the floor.

Everything about these technologies of virtual reality emphasize audience interaction, immersion, or participation over watching from a single vantage point. Thus, they align themselves with the formative cultural movements of the 1950s when interdisciplinary experimentation challenged the borders of conventional arts disciplines and their presentation and sought to break down barriers between performer and audience, maker and viewer. A historically recognized marker of this rupture was the event (untitled) organized by John Cage in the summer of 1952 at Black Mountain College and featuring a radical interdisciplinary juxtaposition of dance, visual art, music/sound, and poetry and text readings. Allan Kaprow's Happenings of the later 1950s and early 1960s extended this experiment to include "disparate and discontinuous events and spaces" and the notion of events "for performers only"—in other words, participatory performance work.² The anti-establishment ideologies of the period that may have motivated these early pioneers disappeared, but interdisciplinary practices remained. Interdisciplinary art makers and groups continued to work with a growing range of media and communication tools, challenged the traditional locations or sites for performance and further explored the relationship between maker/viewer, performer/audience, producer/user. This range of diverse arts practices not only frames the view of performance I am writing about in this article, but they also aided in the cultural production of precedents for the interactive/participatory and installation approaches that dominate the exploration of Virtual Reality technologies today.

From the early 1990s onward, interdisciplinary artists continued to exploit the growing plenitude of information and communication technologies and tools being created by scientists and engineers in academic and industry laboratories. This has led to more involvement of artists collaborating and working in the laboratories directly with the technologists. In a report to the Rockefeller Foundation published in July 1999, new media historian and consultant Michael Century has written an overview of the development of these sites for hybrid (art/science/technology) innovation.³ He refers to them as *studio-laboratories*, and all five art works I refer to later have been at least partially created in one or more of these sites. It is worth mentioning that the creation, distribution, and display of works created by

collaborations on this scale can often be an international affair, but one that reinforces the view that the cultural landscape of the United States tends to sustain technological advances more readily than the artistic experimentation and development that finds conditions of support more easily in Europe.

The following relatively short list of works falls within the definition of virtual reality/performance work. In chronological order they are Jeffrey Shaw's *The Legible City* (1988), Char Davies's *Osmose* (1994), and Michael Benayoun's *World Skin* (1998).

Jeffrey Shaw is an Australian artist now working in Europe who expanded his practice of creating participatory environments for the active viewer to the exploration of the possibilities of interactive computer technology in the early 1980s. *The Legible City* was an interactive installation that placed a bicycle in front of a computer screen or single screen projection. The bicycle functioned as the input device that allowed the participant/user to navigate through a 3-D city by pedaling. *The Legible City* was based on the actual physical space of a city (Amsterdam and Karlsruhe), but with the buildings replaced with 3-D letters where each "letter's proportions, color and location are derived from the building it replaces."⁴

At the time of making *Osmose*, Char Davies, an artist with a background in visual arts, was based in Montréal. Like *The Legible City*, *Osmose* similarly models the input device on a real-life activity, in this case on the experience of the scuba diver rising and falling underwater while breathing in and out. A vest customized with sensors to detect the movement of the chest enables the user/wearer to move up and down in the virtual world by breathing and right/left, forward/back by tilting. A Head Mounted Display is used to render the 3-D visual experience for the interactive user/participant/viewer (as mentioned in the first section). The sensation is described as one of floating through the twelve virtual worlds—worlds with titles like Forest, Clearing, Leaf, Stream, Pond, and Abyss, "intended as metaphors or sites for the contemplation of a renewed connection with nature."⁵ Another feature of *Osmose* was the attempt to accommodate two audiences, one was the single participant, the "immersant," who was strapped into the input devices, the other was an audience of viewers of the immersant's journey who were supplied with polarized glasses in order to watch a stereoscopic projection of the view of the immersant/participant/user.

World Skin, created in 1998 by Michael Benayoun, makes use of the advanced CAVE technologies described above. In *World Skin*, the viewer/audience/participant is referred to as the "tourist." Benayoun, who has a background in video, computer animation and graphic art, created a 3-D visual landscape "scarred by war-demolished buildings, armed men, tanks and artillery, piles of rubble, the wounded and the maimed."⁶ The CAVE is large enough to take a small group of "tourists" supplied with cameras. Each picture taken removes a portion of the visual scenario and replaces it with a black silhouette. The "picture" is then printed out. Each group of "tourists" is led by the "driver," the only one to have the interactive mouse wand.

A third group of audience/observers/viewers can be accommodated in non-interactive roles as watchers from the back of the CAVE structure, and they can also wear the shutter glasses that will generate a stereoscopic view of the work.

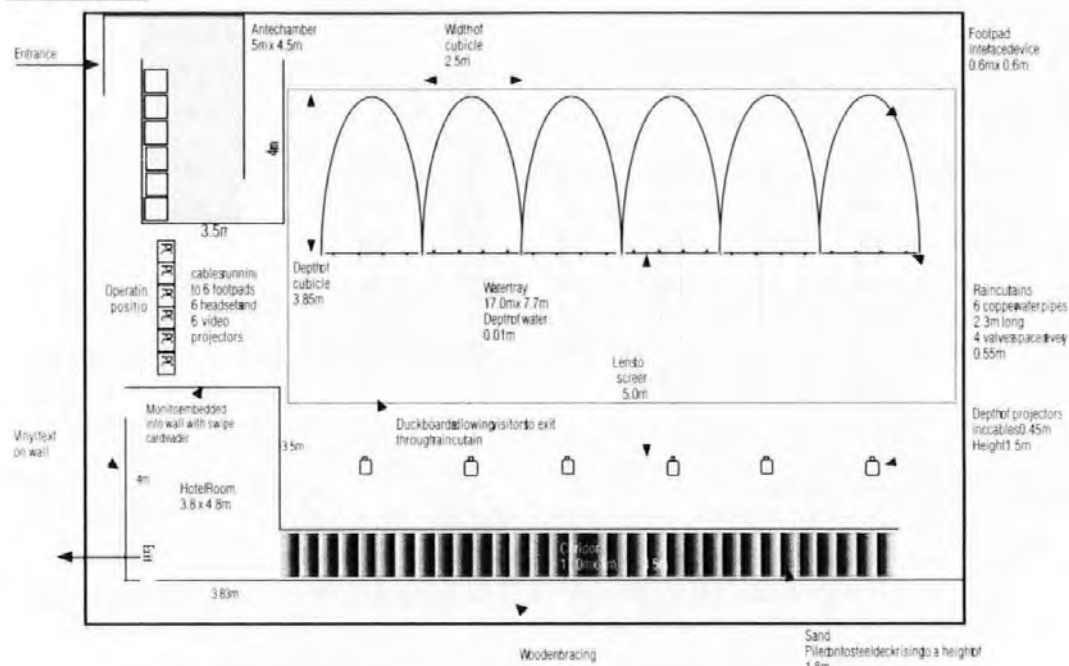
EXTENDING THE POSSIBILITIES—DESERT RAIN

The Mixed Reality Laboratory (MRL) is an interdisciplinary research initiative at the University of Nottingham (UK), bringing together “leading researchers from Computer Science, Engineering and Psychology to research mixed reality—new technologies that merge the physical and digital worlds.”⁷ Projects conducted in the lab combine newly developed or evolving technologies under such headings as “inhabited television,” “immersive user interfaces,” “collaborative virtual environments,” “robot social proxies,” and “traversable mixed reality boundaries.” Some of these projects involve collaboration with artists such as writers and actors giving input into the development process, both creative and experiential, as users. In 1997, the MRL began to collaborate with Blast Theory, a theatre group working in the tradition of “devised theatre” in the UK, on a performance project eventually to be titled *Desert Rain*.⁸ The collaboration also involved eRENA partners ZKM, Karlsruhe, and KTH/Royal Institute of Technology, Stockholm, with commissioning support from the NOW Festival, Nottingham, and the Arts Council of England.⁹ The project was based around the creative implementation of MASSIVE, a multi-user distributed virtual reality system developed at the Mixed Reality Lab in combination with the development of specially designed interface technologies at ZKM. The end result was a large-scale event described variously as a performance, computer game, and installation.

In the collaborators’ conception, *Desert Rain* is organized like a journey, sending six participants on a mission into a virtual world. Each player is zipped into a cubicle and stands on a moveable footpad that controls the journey through this world. Together, they explore motels, deserts, and underground bunkers, communicating with each other through a live audio link. The world itself is projected onto a screen of falling water, creating a “traversable interface” through which performers can visit the players at certain key moments. Players have thirty minutes to find the target, complete the mission, and get to the final room, where others may have a very different idea of what actually happened there.

While utilizing concepts, forms, and processes borrowed from computer games and installation art, *Desert Rain* sustains at its core a clear understanding and manifestation of the processes of performance-making derived from theatre. The roots of the aforementioned “devised theatre” can be traced to that same mixture of artistic avant-gardes of the 1950s and 60s, combined with the UK’s particular brand of alternative theatre that began with the People Show (1965) and continues today with groups such as Forced Entertainment, Reckless Sleepers, Gob Squad, Theatre PUR, Blast Theory, etc. The term “devised theatre” or sometimes the word

SAMPLE PLAN OF SPACE



Plan for Mixed Reality Laboratory and Blast Theory's *Desert Rain*, 1997.
Photo: Courtesy MRL.

Jeffrey Shaw's *The Legible City*, 1988. Photo: Courtesy of the artist.



"devising" alone makes reference to a process of making performance through original rehearsal processes that are usually collaborative and inevitably experimental. Some generalizations that may be said of "devised theatre" are that it may avoid the pre-written script as a starting point and might use a multiplicity of materials in a non-hierarchical relationship, i.e., movement, text, objects, electronic media. It adjusts easily to alternative performance sites, and it favors fragmented or non-linear narratives structures. In describing themselves, "devising" groups often find ways to avoid being seen only as theatre makers so as to keep their practice fluid and responsive to different contexts—as Blast Theory does by referring to themselves as "four artists who make live events for theatres, clubs, galleries, and the street"—but nevertheless the conventions of theatre tend to be well understood if only that they may then be subverted.

I attended *Desert Rain* in Bristol, UK, by entering a large warehouse beside the water and waiting in a receiving area where we were given our first set of basic instructions. *Desert Rain* unfolds in six distinct "pedagogical phases," each carefully scripted in order to give us just enough of these instructions each time to enable us to get through. One set of instructions lies at the core of the experience—that is, how to move in the virtual world. How to move forward and back and, crucially, how to turn. Technically (in the sense of Marcel Mauss' *Techniques of the Body*), this is accomplished by the same set of skills one might develop to use a skateboard, to surf or ski, by shifting the centre of gravity forward, back, to the right and to the left.¹⁰ Other instructions give information as to the significance of various objects, virtual as well as actual. Others come later from the performers who, for the most part, remain unseen only to be heard giving me personalized instructions over my headset. Instructions are also coming to me from the other participant/audience/team members. Further and final instruction comes in the shape of a performer who materializes through the water screen and ushers me into the final chamber.

"You have 20 minutes"—the game in *Desert Rain* has given me an overall goal, to find my way out of this virtual world within which I am currently "trapped." This condition of entrapment has already begun forming in my mind as a result of the information received so far, the instructions on the way into these individual cubicles. The imaginary condition is further heightened by the reality of the hooded coat I have been given to wear, the dark, murky, and pixilated quality of the VR imagery being generated by MASSIVE-2, the water on the floor surrounding the navigation footpad I am standing on, and the atmospheric ambient music coming over my headset. A further layering of experience occurs in the purposive construction of a social dynamic between myself and the other five audience members, one that makes it clear it is my choice to either find the exit on my own or with the help of and/or by helping the others in the audience/team. In the end, I play the helpful one and go back to rescue those as the time counts down. I do not escape—I assume I have perished. In the final room, I meet the other members of my team, one or two I have saved, but the hero sensation is fast fading.

If we take a moment to compare the participant/audience/user/viewer strategies of the four works mentioned so far, *Desert Rain* is distinctly different in two ways: 1) six people are immersed *equally* in the experience without assigning one of them the primary role of "driver" or "immersant," and they can speak directly to each other when close enough in the networked virtual world; and 2) the piece involves the *integration of real-time performers*, not always visible, but who are instrumental in contriving the experience of the participant. Levels of interactivity therefore vary within the work from audience member to audience member, audience member to virtual symbolic entity, and audience member to an "off screen" performer who materializes through the rain curtain when one has completed the journey through the virtual world.

The lead artists in the three projects mentioned earlier, while surely considering themselves to be interdisciplinary artists, nevertheless had backgrounds in creating participatory performance art (Shaw) and in the visual and video arts (Davies and Benayoun). It is useful to consider the different sorts of performance-making practices that Blast Theory, as "devised theatre" practitioners, brought effectively to the collaboration with the Mixed Reality Lab on *Desert Rain*.

ABSENCE OF CHOREOGRAPHERS IN VIRTUAL REALITY

Virtual reality/performance works tend to engage actively with open forms of audience participation and interaction, site-specific responses to space (whether virtual or actual), and the possibilities inherent in discontinuous, gaming, interactive, and user/participant time frames. In conclusion, I want to address the relationship of dance to virtual reality and ask why choreographers, so often on the forefront of experimentations with interactive technologies, seem at present much less involved in making a response to these environments.¹¹

It is rare these days to discover that a choreographer has made an installation or engaged in site-specific work, exploring the "disparate and discontinuous events and spaces" initiated and validated as art-making strategies by the avant garde of the 50s and 60s.¹² In fact, dance was a strong ingredient in the admixture of these experimental movements, but from some point in the mid 1970s, choreographers began to express a clear preference for the coherence of conventional stage space/time. Since the mid to late 80s (with precedents established earlier), some dancers and choreographers have been exploring various interactive computer systems, but their works tend to integrate these systems into presentations in essentially proscenium-like settings and not engage in open and participatory models allowing the audience/user/viewer to cross the border between performance space and spectating space. It is interesting to note that dance seems to have migrated quite comfortably to the space of the screen as demonstrated by the strength and scope of activities producing "dance for the camera" works for film and television that have evolved in the last decade. However, one could also see this as a move towards the

further fixity of space and time offered by the linear film/video medium that is not even open to the energetic fluxuations of live performance no matter how set the choreography.

If these speculations are accurate, creating the best conditions for choreographic responses to virtual reality will require a greater commitment on the part of choreographers as well as the creative technologists to successfully and effectively incorporate dance into these environments. From the technology side, developments in more sophisticated input devices and mixed reality environments should be integrated in an experimental laboratory context with a more sophisticated understanding of what comprises dance and dance-making practices. The difficulties encountered when trying to migrate these practices from the stability of the studio/stage and screen to more open circumstances, can be partly accounted for by considering the ontological difficulty of defining what dance IS as it persistently resists the stabilizing and reifying forces of language. In her introduction to *Choreographing History*, Susan Leigh Foster writes about the "conversation" a trained dancer is able to sustain in rehearsal and performance "that imaginatively invents and then lucidly enunciates their specific corporeal identities."¹³ This fluency, however, is not one of spoken or written language, but of some other ability to be eloquent and articulate that lies under the surface of the skin in a mesh of neurons, muscles, organs, and bones. Kinesiologist Hubert Godard, who has done extensive work on embodiment, perception, and gesture, suggests that in order to better understand dance we need to bear in mind the "labor of dance," i.e., the long periods of work in the studio whereby the dance passes into the "deep strata of the non-verbal."¹⁴

It is this separation from language that makes dance prone as no other art form to losing its contact with the viewer, to stop making sense, and to generate perplexity on the deepest level. These are also possibly some of the reasons why the fixedness of the space/time of the stage and screen continues to attract (and entrap) even the most radical contemporary choreographers. This requirement for what is unchanging, whatever its various reasons for existing, contributes to the lack of choreographic responses to virtual reality. However, given enough support to explore and experiment, there is nothing that should prevent choreographers from breaking free of these contexts (again) and indeed there are signs that these things may be beginning to shift. For choreographers to respond effectively to the possibilities of virtual reality/performance environments, they will need to explore them fully *together with those who are creating the technologies*. This will require more attention to the mechanisms for fostering, funding and facilitation of collaborations that will enable this.

Acknowledgements: With thanks to Matt Adams/Blast Theory and Susan Rethorst for contributions to the writing of this article.

NOTES

1. For more information on the CAVE visit the website of the Electronic Visualization Laboratory, University of Illinois. <http://www.evl.uic.edu/EVL/VR/systems.shtml>.

2. Kaye, Nick. *site-specific art: performance, place and documentation*. London/New York: Routledge, 2000, 107.

3. Century, Michael. *Pathways to Innovation in Digital Culture*. Centre for Research on Canadian Cultural Industries and Institutions, Next Century Consultants, McGill University. Report supported by the Rockefeller Foundation, July 7, 1999. <http://www.music.mcgill.ca/~mcentury/PI/Pimain.html>.

4. Manovich, Lev. *Navigable Spaces*, 1998. [http://www.manovich.net/under "articles."](http://www.manovich.net/under%20articles)

5. McRobert, Laurie. "Immersive Art and the Essence of Technology." *Explorations: Journal for Adventurous Thought*, Vol. 15, No. 1 (Fall 1996).

6. Quote from Michael Benayoun's website: <http://www.benayoun.com/worldskin.html>.

7. Reynard, Gail, ed. *Mixed Reality Laboratory*. The University of Nottingham, 2000, 3.

8. Blast Theory members are Matt Adams, Ju Row Farr, Nic Tandavanitj, Jamie Iddon. For more information on the company visit the website: <http://www.blasttheory.co.uk/>.

9. For a highly detailed account of the *Desert Rain* project including evaluation of the work by social scientists, download the eRENA report from: <http://www.nada.kth.se/erena/doc/aD7b3.html>.

10. Mauss, Marcel, "Techniques of the Body" (1934) in *Incorporations*, eds. J. Crary and S. Kwinter. New York: Zone Books, 1994, 455-77.

11. In 1994, the Banff Centre for the Arts in Canada organized several projects to explore the emerging possibilities at that time for art in virtual environments. One of these projects, *Dancing with the Virtual Dervish*, involved the contributions of choreographer and dancer Yacov Sharir, who is based at the University of Texas, Austin. Wearing a Head Mounted Display, Sharir interacted with a 3-D computer generated environment created by Marcos Novak. An audience could view Sharir on the stage, and they could watch projected on the screen behind him the environment he was navigating through . . . as he was seeing it. This is similar to the opportunities created in *Osmose* and *World Skin* for a viewing public to watch as someone else navigates through the 3-D space. To read more about the work, see *Immersed in Technology: Art and Virtual Environments*, ed. Mary Anne Moser with Douglas Macleod. London/Cambridge, MA: MIT Press, 1996.

12. Perhaps dance installations are rare, but examples exist. One of these is *Trajets*, co-produced and created by Susan Kozel and Gretchen Schiller with support from the Banff Centre for the Arts. *Trajets* is an installation environment with ten suspended and motorized projection screens that move in response to the visitors' pathways. Images projected onto the screens are of moving bodies. At the time of this writing, this installation has just received support from the Arts Council of England to begin a tour in the United Kingdom. <http://ccii.banff.org/trajets/>.

13. Foster, Susan Leigh, ed. *Choreographing History* (introduction). Indianapolis/Bloomington: University of Indiana Press, 1995, p. 15.

14. Godard, Hubert (interviewed by Laurence Louppe). *Singular, Moving Geographies*. Writings on Dance/ French Issue No. 15, 1996. pp. 12-21.

'Ballet Moves from Dance Bar to the Smart Dance Studio'

in *METATAG*, ed. L. Haskel, Amsterdam: BIS. June 2001, pp. 79-81.

In January 2001, I received an invitation from Marleen Stikker, director of De Waag (Society for Old and New Media, Amsterdam) to write for their new annual print publication *Metatag*. This new journal was intended to "show the landscape in which the Waag can be located. It wants to voice the cultural, intellectual and political passions filtered into new technology projects of the people to which it feels related." They commissioned me to write an article as "an expert on performance technologies, the body and collaborative environments".¹

¹ Email to the author, 30 Jan 2001.

METATAG

Performance

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<META NAME = "Keywords"
CONTENT = "Human Computer Interaction,
No Manifesto,
choreography,
emergent technologies,
embedded body,
Ballet Frankfurt">
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In an 1999 interview with Paul Kaiser:
Paul Kaiser.
'Dance Geometry: William Forsythe in dialogue with Paul Kaiser'.
ON LINE, PERFORMANCE RESEARCH.
Vol 4: No. 2, Summer 1999.
pp- 66-69.

Following William Forsythe's example, the creativity of choreographers is increasingly informed by digital computation. But perhaps dance also has something to offer to increasingly ubiquitous and non-screen based computing which looks to the whole body and its range of movements for its interface. By Scott deLahunta, who'll return to teaching theory and composition at the School for New Dance Development Amsterdam this autumn. Currently he is Research Fellow at Dartington College of Arts, UK.

In the last few years, new media and emerging technologies seem to be returning in orientation to the body by concepts of pervasive, embedded, ubiquitous and mobile technologies. Perceptions of technology fostered by dehumanising terms like 'meatspace' or 'wetware' are being replaced by a view in which the body is seen as an essential part of the expressive self. 'Human centred computing' is promoting a shift in research fields such as HCI (Human Computer Interaction) away from a focus on the screen towards this essential body along with its role as part of a living network.

Technology research focuses increasingly on the arts as a source of inspiration. In developing human centred computing, dance, which takes the body in motion to be its primary medium of expression seems well positioned to play a robust role in today's explorations of emerging technologies. The difficulty with this is that dance practice cultivates unique bodies suited especially to performing on the public stage. These bodies, shaped with the art of dance in mind, are quite different from the 'average' ones that figure in most HCI problem-solving research.

French kinesiologist Hubert Godard refers to the dancer as a 'geographer, accumulating maps, intra-corporeal dispositions' out of which a

BALLET MOVES FROM DANCE BAR TO THE SMART DANCE STUDIO

SCOTT DELAHUNTA

history may be produced. For Godard, the dancer is not simply a 'body' but an 'accumulation of corporeities' which encompass centuries of evolving forms of dance and dance instruction. However, no century quite matches the last: individual artistic innovation, increased physiological and scientific understandings and a greater cross-cultural transfer of corporeal knowledge has produced an enormous diversity and range of dance techniques – each giving rise to its own form of virtuosity.

The bare essentials

Over the last 400 years ballet has emerged as the traditional form of dance technique in the West. It has the strictest requirements for an ideal body: thin, long limbs capable of displaying the formal geometric features of the tradition. Following a variety of anti-traditionalist and emancipatory cultural movements, in the first half of the 20th century several alternative dance techniques evolved out of the work of individual artists in the US. Despite their revolutionary beginnings, training techniques like those of Martha Graham and Merce Cunningham, developed to assist in the training of bodies capable of expressing their choreographic visions, eventually became more or less institutionalised. In the 1960s and 1970s, dance training and technique was eschewed for yet another alternative concept of dancing that took at its heart the 'No Manifesto' of Yvonne Rainer written in 1965. It celebrated the performing of non-virtuosi movement and activity on stage. This stripping of the dance to its essential elements during the experiments in the 60s and 70s proved a temporary revolution. In the 1980s, new virtuosity appeared on the stage that profited from the better understandings of the workings of the body that arose from this fierce re-evaluation of the two preceding decades, combined with traditional forms of dance training.

While Europe also had its own early 20th century innovators developing alternative concepts of dance training and technique, in particular Mary Wigman and Rudolf Laban, World War II interrupted and relocated nearly all of those involved in such research. Laban for example, left Germany for the UK where he continued to develop his influential movement theories. Following the war and well into the

1970s, dance training in Europe was inspired by the new ideas and practices coming out of America. Europeans, however, never gave up their love of the virtuosities of classical ballet, and it is from within that tradition of the 'ideal' that the latest unique bodies have emerged.

Picture points precisely

William Forsythe has been the choreographer and director of the Ballet Frankfurt since 1984. Trained in ballet, Forsythe has embraced the concept of the 'digital' by developing new techniques for his dancers derived from an analysis of the essential forms in traditional ballet. Forsythe refers to his series of discrete operations as 'improvisation technologies'. Through these he's able to apply 'computation' processes to create emergent forms of choreography in ballet. They are very basic ideas about matching lines and forms in space, but when combined in a series of algorithmic processes the result is extremely complex and requires rigorous practice to achieve.'

Barriedale Operahouse (<http://www.barriedale-operahouse.com>), a group of artists based in Europe/ UK comprising programmers, composer, choreographers and graphic artists, is creating a piece of software called ChoreoGraph that uses computation to generate instructions for dancers to receive on the stage via a cuing system. Currently, they are building this software to be used in a piece of choreography with a pair of Ballet Frankfurt dancers to be premiered in December 2001.

1. Forsythe told him he uses dancers trained in ballet technique because they have 'all the reflexes of the traditional ballet dancer', the ability 'to picture points in space very precisely' and the 'visceral thinking that is acquired over a long period of time'. This training conditions them to perform the complex movements of the 'improvisation technologies' instinctively or intuitively; they will not have to 'think' before moving but are able to rely on an intelligence that resides in the muscles, ligaments, nervous and fluid systems in the body. The dancers in Ballet Frankfurt each inhabit a unique body, each a repository for a complex set of skills, knowledge and experience derived over many years of training over which the 'improvisation technologies' can be layered.

Forsythe's choreographies are thus informed by an understanding and metaphorical application of the processes and structures inherent in digital technologies. His dancers are chosen on the basis of their ability to perform the choreographies that are based on these structures. Forsythe's choreographies rely on their ability to perform a vast repertoire of movement 'operations' that can be applied in any order, any arrangement, scaling, direction backwards or forwards. Just as not everyone can perform at a high athletic standard, it is only possible

for a relatively small number of individuals to essentially compute the movement algorithms and perform Forsythe's choreographies successfully. As more choreographers assimilate the influences of digital computation into the understandings and manifestations of their creative processes – what might be the implications for the future training of the dancer?

Smart studio

Choreographic inspiration may now be derived from increased assimilation of the structures and processes of computation, which leads to speculations about its influence on the training of the dancer. What if the unique body of the dancer were placed at the very centre of HCI research with the aim to enhance the dance studio?

Whenever training in techniques of the body is undertaken, whether in dance, sports, or therapeutic contexts, it takes place in an environment within which there is feedback. For the dancer, this may depend on the touch or voice of the teacher and the space itself. The floor, dance bar and mirrors create a feedback environment and observation and self-analysis is possible using video recording and playback. So why not construct a dance training environment where the feedback is enhanced through the development of specialised embedded and wearable computing technologies?

Imagine being in a dance technique class in 2020. The floor has pressure sensors that track your ability to change the orientation of your body centre (and relative weight); posture accelerometers sewn into areas of your clothing (so small you won't feel them) utilise aural or light contact feedback to let you know that you are losing energy in the turn because there is the wrong alignment between knee and hip. Running along the centre of the mirror will be a small graphic display letting you know if your breath and heart rate are remaining in sync. A video system is analysing your shapes in an adagio and is able to inform you that these conform to your internal sense of them or not. 3-D motion capture will be running alongside 2-D video recording and playback showing your movements from every dimension. Rather than waiting to watch this material after the exercise, they may be played simultaneously or within seconds on a large LCD screens in the walls.

A collaboration between the fields of human centred computing and dance would serve to overcome the difficulties that currently persist. For dance, becoming an embedded body will entail more than simply telling someone what is required, as happens today when building the traditional dance studio. Becoming an embedded body will encourage dance to analyse its accumulated practices of instruction and creation in even greater detail and be prepared to enter into a new relationship with corporeality – one that is pending at present but for which we have no clear view yet.

'Armando Menicacci and Emanuele Quinz: interview with Scott deLahunta'

in *Anomalie digital_arts #2: Digital Performance*. ed. E. Quinz. Paris: Anomalie. January 2002, pp. 83-84 (a selection of two pages only).

In July 2001, I again received an invitation from Armando Menicacci and Emanuele Quinz, this time to write something for their second issue of *Anomalie* focused on digital arts. I was the chair of their 'New Interfaces for Dance' session organised for the ISEA Paris Conference in December 2000 with presentations from Stelarc, Flavia Sparacino, Joe Paradiso and Palindrome (Robert Wechsler and Frieder Weiss). They proposed to do this as an email dialogue and posed a number of topics to me such as: 1) New trends in body/machine interface; 2) Mapping versus Triggering?; 3) How do you feel dance world is receiving, waiting for, fearing these interfaces?; 4) You are now concentrating on a programmers think tank: why passing from motion capture research to software development? What is the meaning of this change of perspective in your research?¹ The selected pages that follow address these last two questions.

Anomalie digital-arts is a collectively produced bilingual English/ French annual publication. Each issue explores a different theme in the arena of the arts and the digital technologies, illustrating historical, technical and aesthetic developments..

Source: <http://www.editions-hyx.com/> (accessed 7 May 2010).

¹ Email to the author, 28 Jul 2001.

ARMANDO MENICACCI / EMANUELE QUINZ

Interview with Scott Delahunta



A.M. / E.Q. : You are now concentrating on a programmers think tank : why passing from motion capture research to software development ? What is the meaning of this change of perspective in your research ?

S.D. : Well, that project called Software for Dancers finished on 6 October 2001 and was fascinating. Rather than describe the project in much detail it's probably most useful to point your readers to <http://huizen.dds.nl/~sdela/sfd>. In response to your question about the apparent shift in my research, in fact, my interest in programming originates in two places, firstly when I began to research the work of choreographers such as Trisha Brown and William Forsythe, both of whom have used some form of rule based structures in their dance making at some time, Trisha Brown in the 1970s with her « dance making machines » such as Locus and Accumulation and Forsythe in a period in the 90s during which he also produced the material for the « Improvisation Technologies » CD-ROM which focuses on ways of thinking about dance material using various operations. What is important is that one is able to point to this work as « computation » without a computer - and this illustrates very well the concept that the computer is only brought to life, so to speak, by the software which runs through its system and software is the output of the human imagination and writing software can be considered as a creative act. In the last few years, we have also seen the notion of « software art » really rise to the surface (although it was also happening in the 1960s already), and one of the digital artists working with us on the project in London was Adrian Ward whose work Auto-Illustrator had just won the Transmediale Software Art prize in Berlin. The other point of initiation for my interest was an interview by Paul Kaiser with Michael Girard and Susan Amkraut - for your readers Paul Kaiser's company Riverbed (<http://www.riverbed.com>) has done some exemplary motion capture work with choreographers Merce Cunningham and Bill T. Jones. Anyway, Michael and Susan are programmers working on developing high end 3D animation tools used by Riverbed on those projects, and in the interview (on the Riverbed site by the way), Michael comments on how it is that they found some solutions to some of their software animation problems in the field of robotics - this was in the 1980s. So, I just became fascinated with trying to understand where human motion and movement is somehow embedded in different fields of software development and that these fields can share knowledge.

So, in fact I haven't necessarily moved from an interest in motion capture research to software development, it's all part of the same area of research - today if you are looking to understand emerging technologies in any context I feel it is ESSENTIAL that you have some grasp of what comprises software. It should not remain a mystery to you. I am not so familiar with his work, but I have always grabbed onto the observation attributed to media theorist Friedrich Kittler's that understanding today's culture requires a knowledge of a natural language and an artificial language. I think that's exactly right.

A.M./E.Q.: What are your projects now?

S.D.: Well, I'm going to give a short answer to this question - essentially from this moment at the start of November 2001, I have the opportunity to step back to reassess and to refocus what it is that I should be doing. This is such a huge area to look at. However, I have the feeling that what concerns me now is actually something to do with the future of publishing. The projects I have been associated with have been incredibly interdisciplinary involving always artists from different disciplines, but in the last year I have had the opportunity to spend time looking at how to support collaborations between performing artists and computer scientists and engineers (this was supported by the Collaborative Arts Unit, Arts Council of England and my report is on line here: <http://www.dartington.ac.uk/~s.delahunta/ace/gwl/>). Part of setting up the best conditions for such collaborations means being very articulate about process. This can be accomplished very effectively in face to face communication, but outside of this is the need to further document and disseminate the results of the research in such a way that overall understanding and utility of ideas can be increased. So, I am thinking about performance research, documentation and dissemination platforms - and one could place this under the heading of publishing. Something you guys are also doing very well.

'Software for Dancers: Coding Forms'

in On Translations: Performance Research, 7:2 2002, pp. 96-102.

In August 2001, I sent in a proposal for this article to Performance Research for their themed issue 'On Translations' which called for material which would "consider the changing nature of performance texts and relations between writing, textuality and performance". The timing was good for me to use this as an assignment to write about ideas coming out of the 'Software for Dancers' research project underway at that time. In October the proposal was accepted.¹

Performance Research is a specialist journal published by Routledge that promotes a dynamic interchange between scholarship and practice in an expanding field of performance. Interdisciplinary in vision and international in scope, its emphasis is on research in contemporary performance arts within changing cultures. Source: <http://www.tandf.co.uk/journals/titles/13528165.asp> (accessed 7 May 2010).

¹ Email to the author, 16 Oct 2001.

software for dancers: coding forms

Scott deLahunta

AN INTRODUCTION

In January 1967, A. Michael Noll, one of the first computer scientist/ artists to explore and espouse the convergence between computers and art, wrote an article in *Dance Magazine* entitled 'Choreography and Computers', in which he described a software program he was creating that would indicate stage positions of stick figures and be of potential use to choreographers. In the same issue, Ann Hutchinson-Guest (an authority on dance notation) argued that whilst the computer would 'never replace' the facility a choreographer has for composing movement with the dancer, it might assist in the overall outlining and editing of a score for a dance (Noll and Hutchinson 1967).

While the debate started by A. Michael Noll and Ann Hutchinson is arguably still relevant today, after three decades our perceptions of both computers and dancing have changed considerably and generally not along the same trajectories. The cultural environments that have incubated contemporary dance since the 1960s, largely the United States and Western Europe, have also been the factories for the production of cultural facts and myths related to emerging technologies. Obviously, the computer has not replaced the choreographer, nor did it ever really threaten to do so. The ways in which it has evolved to influence how we think, communicate and interact suggest that this might be a fruitful time to revisit the question of how a software program might be of use to a choreographer.

The *Software for Dancers* research project that took place in the autumn of 2001 in London was conceived as an opportunity to update the 1967 debate.¹ The main research team comprised four established contemporary choreographers and four digital artists, three of whom had experience with dance. The digital artists came with a high level of skill with sound and image editing software tools, as well as a range of experience with programming and scripting, thus aligning themselves with the notion of 'coding' as creative practice. The shared central task of the group would be to develop concepts for software rehearsal tools for choreographers. This provided the stimulus to explore shared and divergent approaches amongst the participants across a range of ideas related to the recognition and transformation of structures and materials in the process of art making, whether computational or choreographic. Some of these explorations were made more explicit through dialogue, while some evolved as tacit frameworks within which other discussions took place. The question 'what is software?', while never overtly exposed, repeatedly nudged itself close to the centre of the discussion, and it is to this that I devote the remainder of the essay.

The study of the impact of software as a cultural force still resides primarily in the fields of computer science, engineering and mathematics, with a rapidly increasing dissemination throughout the biological sciences – a field that computation is poised to revolutionize. The question 'what is

software?' will initiate a very different response when asked within these fields than in an arts and humanities context, where it is essential that frameworks for exploring software and its implications are further developed. *Software for Dancers* provided a modest but significant context for contributing to this discourse by investigating what software is under the following headings: as a language; as a tool; as a material.

AS A LANGUAGE

Computer programming relies on the use of artificial languages, e.g. C, Fortran, Pascal, C++, Java, etc. These languages follow a strict formal schema; they have a precise syntax and vocabulary that leave little room for the forms of semantic and interpretive slippage we are accustomed to with natural languages such as English or Spanish.² The computer will always interpret an instruction (or algorithm) written in a computer programming language in exactly the same way every time. These instructions often come in blocks of code created by someone else and are then assembled, more a building structure than something written.³ If we accept that any symbolic system of expression, such as a natural language, shapes a way of thinking, then learning and using a computer language could have the same effect. Computer languages have evolved through several generations, from raw 'machine code' that spoke directly to the computer's microprocessor using strings of zeros and ones; to second and third generation computer languages each making the task of coding easier to learn and perform. Third generation languages are significant for having developed a set of standards that enabled programs to run on a greater variety of computers because the syntax of the language is 'in principle independent from the computer they run on' (*Economist* 2001). Beyond a certain point any discussion of computer languages in generational terms is misleading because it implies a steady development from one generation to the next, which is not the case (see Miller 2000). Although the trend has been towards creating programming languages that are easier to learn and use, there is

more to consider than simple skills acquisition. A coder chooses a language both for what it can do (some languages are designed to perform certain functions better than others), as well as how it allows one to think through the coding process (Sol 2001).

Certain developments in programming languages are influenced by cultural shifts in our understandings and uses of computation: for example, 'object oriented' programming (OOP) which began to evolve in the late 1980s. OOP favours the modelling of real-world entities in computer code and is designed to simplify and streamline programming. Previously, computing languages kept functions (code) and structures (data) formally disconnected. In OOP, software objects operate as scaled combinations of data and code, and the sending and receiving of 'messages' conducts communication between them (Montlick 2001). This represents a fundamental change in the field of computer science. In his essay, *Society of the Instance*, Shapiro writes that 'beyond a certain (imprecise) point in time, without realizing it, object-orientation definitively transgressed the limits of the discrete, binary, nominalist, symbolic logic which was the "original" foundation of computing' (Shapiro 2001). Others have made similar observations. Philosopher Brian Rotman, in an essay on the relationship between serialism and parallelism, also positions OOP as one of the signs of the shift to a post-von Neumann conception of the computer. He posits that the rise of object-oriented programming counterposes 'the linear flow of procedural programming languages by foregrounding the manipulation of . . . available objects' (Rotman 2000).

Shapiro's essay is a critique of OOP on the grounds that it is another symptom of the increasing tendency to provide 'substitutes for human experience', while Rotman induces from several developments a cultural trend towards a 'collectivized, distributed, pluralized' intelligence, of which OOP is one example. Both positions contribute to a growing area of critical discourse as regards the evolution of software as a condition and

shaper of culture. Others go further: media theorist Friedrich Kittler proposes that the acquisition of an artificial language should be as important as learning a natural language:

I can't imagine that students today would learn only to read and write using the twenty-six letters of the alphabet. They should at least know some arithmetic, the integral function, the sine function – everything about signs and functions. . . . Then they'll be able to say something about what 'culture' is at the moment.
(Griffin and Herrmann 1996: 740)

Kittler's emphasis on the sort of schooling required to understand software may be debatable, but not the importance of implanting in more students/people a broader appreciation of what software is and its implications for culture. It is necessary to find ways to shift this study from its current science, engineering and biology base towards the arts and humanities. A. Michael Noll's 1967 computer symbolized an entirely different entity than the computer in 2000 – and the evolution of computer languages is one of the reasons why.

AS A TOOL

In terms of current cultural perception, software is probably more commonly conceived of as a tool, or part of a tool set that includes the computer, than as a language. In this discourse, the utility of a piece of software is embedded in the assumption that (like hardware) it has a purpose: a hammer drives a nail (amongst other things); a calculator performs calculations; iMovie (a software program that now comes bundled with every Apple computer) edits digital video.

In the industry, the top-down process of 'software development', begins after the 'purpose' of the software, what the client or customer wants it to do, is thoroughly understood and articulated. In this process the purpose tends to be defined by the recognition and specification of the overall 'problem'. This problem then goes through a process of further analysis to break it down into smaller pieces. Once this is accomplished, the next

step in the procedure is to devise the solutions for the problem(s) in the form of algorithms or instructions to the computer. Once the algorithms are defined, then they are implemented in some form of software language. There are other systems or software environments that encourage a more 'bottom-up' approach to programming. One of these would be Max, a high-level graphic programming language geared specifically to real-time computer music applications, where it's possible that the individual coder may employ a much more experimental approach in which 'immediacy, serendipity and play' are explored, coding in such a way that one choice leads to another with unexpected results (Winkler 1999: 73).

The *Software for Dancers* discussions didn't consistently employ either a top-down or bottom-up process, but borrowed from each. Because we had agreed to develop concepts for a screen-based software rehearsal tool using a range of different approaches, the discussions were initially dominated by top-down procedures that generated questions around the utility and purpose of the software. Alongside this, we worked through a process of selection and elimination of various possibilities. We established some additional parameters at the outset, such as that the software should run on a standard (off the shelf) portable computer with only mouse, keyboard and audio video input. The consensus was that we were investigating the possibilities for some sort of digital 'choreography sketchbook' and that we would rigorously explore what could be done with two-dimensional representations. This eliminated the creation of software that would model the real world (objects, space and human figures) in three dimensions.⁴

Paradoxically, during the *Software for Dancers* discussions, as soon as someone identified a potential use for a certain software application in the dance studio, it would be negated by arguments both pragmatic (e.g. the problem was solvable in a more efficient way) and artistic (e.g. fundamental formal contradictions could be named). Software as a tool for the making of dances also became the

object around which a balance between the technophobe and the technophile in each of us was maintained. In another contradictory setting, both the choreographers and the coders agreed that they would like to 'abuse the software' and get 'beyond the tool', while at the same time it was apparent that no software was going to be coded until there was some consensus on the function it would serve.

Transcending and abusing the software as tool returns us to the consideration of software as a language – for to enact either requires access to and knowledge of the code – and to the cultural meanings of software. I have already pointed out that software as a language differs from natural languages due to its strict formalisms and precise syntax. Software as a tool, developed for a particular purpose, further expands this separation between artificial and natural languages. For example, two different programs may be coded to serve the same purpose. So, syntactically they will differ, but semantically they might be considered to be the same, a separability that does not occur in natural languages. Philosopher Peter Suber in his article *What is Software?* asserts that the intended use of software tends to shift its meaning entirely from the

uninterrupted arrays of bits to the function computed or the output and operation as interpreted by human beings. We look to the uses of the program to the programmer or user, not to the structure that permits it to serve those uses.

(Suber 1988)

Seen from this perspective, the labour of the software programmer is rendered invisible; with the code unseen the software becomes a tool, an implementation device for the end user alone, which is perhaps not the most compelling argument to support Kittler's view that everyone should learn an artificial language – if through its use the writer never actually speaks directly to the reader. However, it is one of the most compelling arguments for some form of software literacy that neither provides reward for the individual coder in the shape of a 'reader', nor requires everyone to

learn to program a calculator in Visual Basic. This other form of software literacy might emphasize access to a discourse that contextualizes these products and processes of culture in such a way that we better understand our complicated relationship with computers.

AS A MATERIAL

The use of computers in art can be traced to computer graphics experiments in the 1950s. In the 1960s and 1970s, before the arrival of the personal computer, the conception of the computer as a creative instrument or tool promoted the view that artists should be working together with scientists and engineers from within whose domain 'art-useful' computing discoveries were being made. During this period, two early computer researchers, A. Michael Noll and John Lansdown, both showed a particular commitment to the integration of choreography and computers. As already mentioned, Noll was working on a computer program that would provide a graphical notation aid to the choreographer, and Lansdown, an architect by training, was especially interested in the use of the computer to provide creative input through the algorithmic generation of choreographic scores (Lansdown 1978).

The creative use of the computer underwent radical transformation in the 1980s and 1990s, following major developments in technology partially marked by such headings as the emergence of the personal computer and graphical user interface, the internet and world wide web, etc. During this time, art making involving digital technologies gave rise to different branches of computer art: digital art, interactive media art, telematic and net art, etc. The particular conditions that supported the collaborative interests of artists and computer scientists in the 1960s changed through easier access to hardware and software. During the 1980s and 1990s, artists were developing the ability to customize or create their own software. Programming languages became easier to learn and use and image, video and sound manipulation software tools became widespread. However, despite artists

gaining more control over the software code, the perception of software in the context of art making still remained largely a function of its purpose.

Recently a discussion of an 'art of which the material is software' has begun to take shape, marked by the newly established Software Art award category at the *transmediale.01* art festival in Berlin, Germany. The naming of 'categories' for emergent arts practice is always contentious, but whether this concept of software as a material is new is not the discussion I am interested in opening up here. The point is that since the 1960s, our perception of software, its surfaces and interiors, is reflected back to us from many sources, especially our screens, and the Software Art prize has taken note of this. To quote Florian Kramer and Ulrike Gabriel reporting on the Software Art award: 'Thirty years later, after personal computing became ubiquitous, cultural stereotypes of what software is have solidified' (Kramer and Gabriel 2001). Both of the awardees for the *transmediale.01* Software Art prize had created software that played with the conventionality of certain user interfaces through parody and disruption. This approach isn't new, and their software pieces sit alongside a history of artworks aiming at and subverting social stereotypes using various media materials, e.g. video, radio, etc. But the award does seem to mark the first recognition of software specifically as a material in this context.

Perhaps to consider software as a material reflects less on categories of practice than on the pressing need to recast software in ways that are 'at least relevant to our individual styles of thought'. These are the words of John Maeda, computer programmer and graphic artist whose recently published book on digital design, *Maeda @ Media*, demonstrates the creative and intellectual latitude that comes into play when software is treated as material. Maeda is the director of the Aesthetics and Computation Group at MIT's Media Lab and a leader in the field of integrating computation and visual design and in developing software as an art medium.⁵ Maeda is committed to liberating the computer as a 'truly plastic medium' to counter the

current tendency to produce 'two distinct types of thinkers: one who is technically adept and humanistically inept, the other who is humanistically adept and technically inept' (Maeda 2000: 439). For Maeda, for whom visual design is paramount, the fact that the underlying code is rendered invisible is offset by his belief that creating in code (as opposed to conventional design instruments) contributes to a fundamental reshaping of cognition. Perhaps the materiality software has to offer, then, is not in the classic sense of a material seeking to have form imposed upon it or in works seeking to expose software stereotypes, but the manner in which it forces the creative thinking process into an double externalization of itself: firstly the code, and secondly its execution.

A BRIEF SUMMARY

It would seem that the exponential advances in digital technology would have rendered possible some of the aims of those early explorations into the use of computers in dance. Thirty-plus years of cultural assimilation has also created a willingness on the part of the dance field to consider the input of computers anew. In fact, a handful of software concepts did emerge from the *Software for Dancers* project, and these are being proposed for further development.⁶ However, equally interesting was that a certain line of questioning could transform the computer from a sleek object of desire into a manifestation of creative ideas, a process of invention open to critical consideration and insight that could reflect upon both computation and choreography.

Software provided one of the ways into the discussion, but my examination here of the question 'what is software?' reveals an inquiry in need of more exposition. Maeda's revival of the individual creative artist working with software is worth comparing to Brian Rotman's reading of the evolution of technology that emphasizes the emergence of cognitive and collective interconnect- edness. Still, there emerged some general points worth reiterating: that the study within the arts and humanities of software as a condition and shaper of

culture is already taking shape as can be seen in the various critical discourses emerging from the fields of philosophy, sociology and media theory, relating to computer languages and software; that software seems poised to resist being considered predominantly as a tool, and move towards some more dynamic balance between utility, programmability and linguistics.

In this regard, the materiality of software is a compelling concept worthy of further development as it can place an emphasis on giving ideas shape through code, on the process where thinking, coding and form intertwine.

NOTES

1 *Software for Dancers* was a London-based research project taking place from 24 September to 6 October 2001 which aimed to develop concepts for a software rehearsal tool(s) for dance makers and to use this opportunity to open up discussion about collaborative practices involving live performance and digital technologies. The project was organized by Writing Research Associates in collaboration with the Arts Council of England, Sadler's Wells Theatre and Random Dance Company with primary funding from the Dance Department, Arts Council of England. The primary research team comprised London-based choreographers (Siohban Davies, Shobana Jeyasingh, Wayne McGregor and Ashley Page) working in collaboration with digital artists/ coders from the UK and Germany (Guy Hilton, Jo Hyde, Bruno Martelli, Adrian Ward and Christian Ziegler) and two researchers/writers (Sanjoy Roy and Saul Albert). The project was facilitated by Scott de laHunta. A website with information about the project is at <http://huizen.dds.nl/~sdela/sfd> [accessed 20 December 2001].

2 This reference to 'natural' languages should not be confused with Natural Language Processing (NLP) which is the work being done in the field of computing science and engineering to 'design and build a computer system that will analyze, understand and generate languages that humans use naturally, so that eventually you can address your computer as though you were addressing another person'. This quote is from the NLP section of the Microsoft Research pages <http://research.microsoft.com/nlp/> [accessed 20 December 2001].

3 Although here I am steering away from using writing to describe programming, I would like to suggest that those interested look at the work of writer and translator John Cayley who has covered extensively the relationship between writing and programming in his own research and practice. Several essays on this topic are on his website at <http://www.shadoof.net/> [accessed 20

December 2001].

4 This was partly due to the complexities of coding such programs and partly to the fact that they already exist, e.g. Life Forms, a 3-D character animation software developed with significant input from choreographer Merce Cunningham.

5 For more information visit the Aesthetics and Computation Group website at <http://acg.media.mit.edu/> [accessed 20 December 2001].

6 There is currently some information on these proposals/ prototypes on the project website at <http://huizen.dds.nl/~sdela/sfd> [accessed 20 December 2001].

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A classical ballet move coded in Apple Script by Adrian Ward and Ashley Page.

— performs a classical ballet move (v1.0-beta)

— known issues: no hand/arm support (will be fixed in v2.0)

on dance

do glissade

— do assemblé — not yet coded

end dance

on glissade

do fifthposition

do plié (demi)

do degagé (my left leg)

put the weight of my body **from** my right leg **onto** my left leg

do degagé (my right leg)

return the foot of my right leg **infront of** the foot of my left leg

do plié (demi)

end glissade

— definition of fifth position

on fifthposition

put my left leg **behind** my right leg **with** distance **set to** 0

put the foot of my left leg **facing** left

put the foot of my right leg **facing** right — *ouch!*

end fifthposition

— a deep plié continues until both heels are off the ground

on plié { depth }

if depth is demi **then**

while the heels of the feet of my legs are slightly off the ground

bend the knee of my left leg

bend the knee of my right leg

end while

else if depth is deep **then**

while the heels of the feet of my legs are very off the ground

bend the knee of my left leg

bend the knee of my right leg

end while

end if

end plié

— (the foot should be extending straight out from the leg

on degagé { whichleg }

keep the knee of the leg which is **not** whichleg bent

lift whichleg with the foot of whichleg **not on** the ground

point the toes of the foot of whichleg **towards** the ground away from my body

end degagé

'Periodic Convergences: Dance and Computers'

in *Tanz und Neue Medien: Dance and New Media*. eds. Dr. S. Dinkla & Dr. M. Leeker. Berlin: Alexander Verlag. 2002, pp. 66-84. (The page numbers located at the top of the following facsimile are even, because the German version was printed on the opposite odd numbered pages.)

In October 2001, I received an invitation from Söke Dinkla and Martina Leeker to submit a chapter for a book on dance and new media they were planning as a way of publishing documentation from the CROSS FAIR dance and new media workshops they had organised in 1999 and 2000 at the Choreographic Center NRW in Essen. They invited me to submit something that would "put the experiences of the workshops in a broader cultural historic context and should present the contemporary practise. We would be happy if you could give an overview over the contemporary work in the field of dance and new media with a special focus on internet performances/net dance."¹ I used this opportunity in part to touch on a couple of developments from the 1960s not normally mentioned that connected with my research interest in dance composition and computation [see Critical Appraisal footnote 14]. Other authors in the book include: Gretchen Schiller, Paul Sermon, Nik Haffner, Hans-Christian von Hermann, Wayne McGregor and Wolfgang Hagen.

¹ Email to the author, 25 Oct 2001.

Periodic Convergences: Dance and Computers

Scott deLahunta

Since the 1960s, the arts have been increasingly impacted by developments in computer related technologies. Some, such as video, film, graphics, photographic and sound art, have largely gone the way of the digital, embracing the 0s and 1s comprising the underlying encoding of forms as a newly creative means of recording, composing, storing, transforming and transmitting materials. Historically, these art forms have integrated new technical developments as they have occurred along a path marked by increasing computer processing speeds and storage capacities, the evolution of software programming languages and greater access to knowledge and facilities within dominant media producing cultures.

Dance and computers also have a history of convergence traceable to the early 1960s, but computer related technologies have not attained the level of integration within the field of dance as with the other art forms for the obvious reason that as a material the body in motion does not lend itself to digitisation. Historically, this convergence between dance and computers is perhaps best characterised as *periodic* or *episodic*, involving particular artists at particular times. This essay locates and describes a selection of these episodes in detail combined with some critical reflection on the historical contingencies from which they emerged.

The 1960s: Cybernetics, Computation and Choreography

In America in the early 1960s, seminal developments in both computation and choreography took place. Computation was recognising the need to develop its own field of theory, and in 1962 the first Department of Computer Sciences in the United States was established at Purdue University. In the field of choreography, at the encouragement of John Cage, Robert Dunn began a series of highly influential choreography workshops in New York City, in the fall of 1960, which culminated in the first *Judson Church* performances in 1962. While these events probably occurred isolated culturally one from the other, it is possible to speculate on some conditions of contingency and possible influence of computational ideas on choreography at that time. It is fair to speculate that the focus in Robert Dunn's choreography workshops on the use of chance, indeterminacy, rules and constraints in generating choreographic structures might have been influenced by an awareness of developments in computation, but as far as I am aware there was no explicit connection. John Cage, a major influence on Dunn, did not begin to explore composition possibilities with the computer until the 1980s. A more indirect influence on the experimentation encouraged by Dunn in his workshops, attended by future luminaries of post

modern dance such as Steve Paxton, Yvonne Rainer, Simone Forti and Trisha Brown, might have come from the significant scientific discourses of the time such as *cybernetics* as written about by Norbert Weiner in 1948, the same year information theorist Claude Shannon published his thesis laying out a new paradigm for communication. These theories emphasised process, systems and interactivity and the quantitative dimension of information. *Cybernetics* in particular was to be a powerful influence on artists; providing the intellectual underpinning for the emphasis on process in art works and the developments of *participatory art* in the 1950s and 1960s such as the happenings – which John Cage is often cited to be the first to have staged at Black Mountain College in 1952.¹

While Robert Dunn's workshops established the conditions out of which emerged several seminal pieces of experimental choreography, the practice of *computer art* was beginning to take shape. Early computer artists, often mathematicians and computer scientists by training, were experimenting with algorithmically generated graphic images and patterns and writing programs that explored forms of computer intelligence and creativity. In 1961, A. Michael Noll began work as a researcher with Bell Labs in Murray Hill, New Jersey. While working with the Labs, Noll began to explore the possibility of using digital computers in the visual arts by studying three-dimensional computer graphics and computational aesthetics. In a crude approximation of the *Turing Test* in which human and machine intelligence are compared, Noll invented the algorithms that would instruct a computer to generate an image that would mimic in its patterns and structure Piet Mondrian's *Composition with Lines* (1917).²

In 1965, Noll created a work of computer animation he titled *Computer-Generated Ballet*, reported to be the »first such use of a digital computer to create an animation of stick figures on a stage«.³ But perhaps his most significant contribution to the convergence of computers and dance was in January 1967 when he published an article in *Dance Magazine* entitled *Choreography and Computers*, in which he described a software program he was creating that would indicate stage positions of stick figures and could potentially be of use to choreographers. In the same issue, Ann Hutchinson-Guest – an authority on dance notation – penned *A Reply* to Noll's speculations, in which she writes that the computer will never replace the facility a choreographer has for composing movement with the dancer. However, she does concede that the computer might assist in the overall outlining and editing of a score for a dance.⁴

Another 1960s pioneer of the convergence between computers and choreography, who pursued a different vision of the computer and dance to A. Michael Noll, was John Lansdown, an architect by training. Based in London, Lansdown was particularly interested in the possibilities for *artificial*

creativity, in other words to use the computer to contribute to a creative process as an autonomous composer, rather than to support or augment an existing one. In his introduction to *Artificial Creativity*, a paper given at the *Digital Creativity Conference* in Brighton in 1995, Lansdown describes the computer's ability to make decisions according to rules and traces the history of the use of related *regulatory* systems in music composition, architecture and painting and distinguishes between two types: those that are *randomised* and those that are *rule-based*.⁵ Contemporary choreographers have used similar systems. Merce Cunningham's and John Cage's experiments with aleatoric methods were explored further in Robert Dunn's choreography classes already mentioned, and in the 1970s Trisha Brown devised *dance making machines* – rule-based systems that generated particular performances such as *Accumulation* and *Locus*.⁶ William Forsythe's use of algorithmic structures in the 1990s is well documented.⁷

In 1968, Lansdown began to experiment for the first time with *computer-generated* dances. He first attempted to use the computer to generate all the instructions a dancer would require emulating to some degree the information carrying capacity of a notation system such as *Benesh-* or *Labanotation*.⁸ Soon, however, he determined that a more satisfactory method was to provide a looser framework within which there was some room for interpretation by the dancers.⁹ Over time, Lansdown developed the concept of generating *peaks* of movements rather than the movements themselves and allowed the dancers to fill in the material between the *peaks*. This way the dancers functioned as *in betweeners*, to borrow a term from the practice of *key frame animation* where the major dramatic moments are sketched first and the in-between Frames filled in later.¹⁰ These projects did not just remain on the conceptual drawing board. Lansdown's work resulted in many performances between 1968 and 1993 with various dance companies including London-based *Another Dance Group*, the *Royal Ballet School* and *The One Extra Company* of Sydney.

It is important to recall that in the 1960s and 1970s access to computers was extremely limited and programming a slow tedious process. A. Michael Noll states optimistically in his 1967 *Dance Magazine* article that »The computer and graphic output equipment might be centrally located and time-shared with many users. Anyone could apply this technology to produce this form of dance notation typewriter«. ¹¹ Perhaps Noll thought the conditions he describes would generate more convergence between computer and dance. It did, but not surprisingly it was choreographers working in academic institutions with access to the new computing science departments who were best able to explore the possibilities, and the mainstream of contemporary dance practice tended to be unaware of, or disinterested in, the outcomes of this work. In the 1970s, software to support dance notation systems like *Benesh-* and *Labanotation* began to be develo-

ped, and the early 1980s saw the emergence of interactive performance systems. However, it was in the 1960s that Noll and Lansdown laid out the basic concepts of where computation and the practice of choreography could overlap.

One invention that has received little mention in accounts of the early history of convergence between dance and computers, partly because it had little to do with dance directly, is Lee Harrison III's ANIMAC (hybrid graphic animation computer) developed in the early 1960s. Appearing in the Ars Electronica-show *Pioneers of Electronic Art* curated by Steina and Woody Vasulka in 1992, the ANIMAC was designed to be able to generate an animated stick figure in real-time on a CRT (cathode ray tube) screen. From Woody Vasulka's account of his research for the show, the ANIMAC was a unique technical concept and aesthetic project that was never fully realised.¹² According to David Sturman's retrospective on the history

of computer animation published for SIGGRAPH¹³ in 1998, the ANIMAC was replaced by a more commercially successful product Harrison invented called SCANIMATE. Harrison's systems, largely analogue, were eventually outmoded in the 1980s when digital computer graphics *keyframe animation* was developed, e.g. *LifeForms*.¹⁴



Abb. 1: Ein Werbebild mit einem Tänzer, der über am Körper befestigte Sensoren die Echtzeitanimation am ANIMAC kontrolliert. Denver, 1962.

Fig. 1: A publicity image featuring a dancer with body mounted sensors controlling real time animation on the ANIMAC. Denver, 1962.

A. Michael Noll, John Lansdown and Lee Harrison to varying degrees each played a role in the weave of theory and practice out of which current relationships between computation and choreography can be traced. Some elements of these early convergences have receded, such as the discourse of cybernetics, and others have been transformed. The ANIMAC may have been superseded, but the technologies commonly referred to as *motion capture* or *performance capture* that record human movement in three-dimensions for use in computer graphics animation have managed a measure of integration into the field of dance practice through the work of a number of artists.¹⁵ Computing aids – either generative or supporting – for choreographic compositions have not proliferated to a large degree as perhaps Noll and Lansdown were inclined to foresee. The piece of technical equipment that became ubiquitous in the rehearsal studio is clearly the

video camera and television monitor, but there has been little incorporation of digital technologies, software or hardware, into this set-up. Some of the reasons for this are pragmatic having to do with costs and access. Other reasons are more fundamental, where formal disjunctions exist between properties of the *digital* and the essential components of dance practice involving human motion, corporeality and physical presence. A useful comparison is the music field where the formalisms and initial constraints

underlying musical notation, composition and execution and the physical (analysable) properties of sound are inherently conducive to generative investigations and artistic integration with digital technologies. These formalisms and particular physical properties are either absent to a large degree or are of a qualifiedly different nature in dance.

The 1980s: Seeing Spaces and Bodies as Interface

An American artist and computer scientist, Myron Krueger, is credited with being the first to use the video camera as a computer interface in an artistic context in the 1970s. However, in the early 1980s Canadian artist David Rokeby began to develop the *Very Nervous System* (VNS) which he would not only use in the creation of his own work, but would also eventually make available to others to use. It is this that distinguishes the VNS as significant amongst other similar developments up to that time. The VNS uses a video camera as an eye, the cable to the computer as an *optic nerve* and the computer as the *brain* to create an interactive *seeing space* in which the movements of one's body triggers sound and/or music.¹⁶ While there are several other similar systems available today including the *Big-Eye* software at the *Studio for Electro-Instrumental Music* (STEIM) in Amsterdam and *EyeCôn* by the *Palindrome Inter-Media Performance Group* based in Nürnberg, VNS has become one of the softwares of choice for live performance artists wishing to explore interactive systems.¹⁷

Rokeby's own work, shown in exhibitions and art shows throughout Europe and North America, is installation based and favours the experience of the person who steps into the range of the video camera and uses their whole body as the *active element of the interface*. This space is intended to be experienced on an intuitive level, according to Rokeby, simulating the raw sensory perception of the body in a state of *pre-consciousness*. Through changing associations in familiar patterns of perception, awareness outside the system may seem heightened or altered. Rokeby describes his own experience:

»An hour of the continuous, direct feedback in this system strongly reinforces a sense of connection with the surrounding environment. Walking down the street afterwards, I feel connected to all things. The sound of a passing car splashing through a puddle seems to be directly related to my movements. I feel implicated in every action around me. On the other hand, if I put on a CD, I quickly feel cheated that the music does not change with my actions.«¹⁸

Rokeby sees himself as an interactive artist, who creates experiences, but what is crucial to the aesthetic and social construction of the work is that

the audience is fully participant in it – they become the performers. Within the terms of contemporary art production, this means the system works best in the context of an installation or a situation in which the audience is free to come and go at any time. Confusing the boundaries between audience, participant and performer was a feature of the avant-garde art movements of the 1950s and 1960s, but now this could be further blurred with the notion of the *user* or *player* drawn from the rhetorics of human computer interface research.

The classes of input devices for interactive systems can be extended beyond video based systems to include haptic (touch) e.g. pressure and flex sensors, and non-haptic (distance), e.g. ultrasound, etc. But a *seeing space*, i.e. video based technology like VNS, requiring only a camera and software and relatively easy to set up, is an attractive option for choreographers and dancers who wish to experiment with an interactive system in performance.¹⁹ However, here is where the discourse of experience employed by Rokeby and others working with interactive systems, becomes increasingly problematic. Experience in the context of live dance performance on a stage is complicated by the conditions of performer presence and its reception by the audience who in this situation are definitively non-participants. Positioned as spectators, their sense of the performance may emerge from a weave of subjective representations, semantic associations, memory, pattern recognition, etc. How close or how far the audience's experience is from the dancers' is difficult to determine, but besides the possibility that there exists in the viewer of dance a sympathetic kinaesthetic response, it is entirely reasonable to say that the viewer's experience is not the same as the dancer's. Therefore, if indeed the primary efficacy of these *seeing spaces* is in invoking a sensory experience, then to understand its implications for dance performances for the stage we should consider the question of training for performance.

Training in dance is accomplished through repeated exposure to a set of conditions with the aim of embodying the forms these conditions are intended to give rise to. Sensory experience is something that is harnessed towards this aim. The dancer or performer is able to achieve and maintain a state of heightened awareness that is normally reserved for specific spaces, the rehearsal studio and the stage. Each has feedback conventions embedded in them as cultures of performance practice. So what might emerge from dance-training conducted in an interactive space designed specifically for this practice? There has been some experimentation with repeated exposure to systems like the VNS in the therapeutic field, but despite well over a decade of access to interactive spaces, little sustained research in the possibilities for dance training has taken place. While believing such research in this area would benefit both dance and computer related fields such as *Human Computer Interface design* and *physical compu-*

ting, I also share this perspective on the VNS and related systems as a critical reflection on a tendency to simplify the complex relationships between experience, perception, presence and culture of the participant/performer in the interactive system, the *body at the interface*.

The 1990s Convergences noted: Telematics and Motion Capture

This essay proposes that the historical trajectories of dance and computers converge periodically, intersecting at various points in time around the work of particular artists. Sometimes this convergence is around the object of choreographic practice, exploring computation in the context of making dances. At other times, it is to explore the body as an interface, stimulating reflection on the relationship between the social and everyday body and the trained and specialised. New options, new periodic conver-

gences arose in the 1990s. Two events that will be recalled in terms of dance are the arrival of the Internet and, post-ANIMAC, digital *motion capture*-technologies. While experiments in telecommunication and dance dates back at least to the telematic work of Kit Galloway and Sherrie Rabinowitz in the 1970s,²⁰ increasing access to the Internet and the web made it easier for dance artists to explore remote communication as type of performance space. *Motion capture*-technologies benefited directly from the entertainment industry's interest combined with increases in computing power, speed and ability to store and access greater amounts of memory. While *motion capture*-technologies and expertise are still relatively difficult to gain access to, some determined dance and computer artists have succeeded in setting up the necessary collaborations to explore the possibilities.²¹



Abb. 2: In der Performance *CO3* der australischen *Company in Space* aus dem Jahre 2001 sind Motion Capture und Internet kombiniert. Tänzerin: Hellen Sky; Foto: Jeff Busby.

Fig. 2: In this performance in 2001 of *CO3* by Australian based *Company in Space* motion capture and Internet are combined. Dancer: Hellen Sky; Photo: Jeff Busby.

At the same time, work and research into the possibilities for dance composition software and interactive systems are still very much ongoing. Some artists and groups are developing consistently along a specific trajectory of experimentation, some consolidating and assimilating new technology options as they become available. There have also been a number of workshops, conferences and symposia beginning in the early 1990s involving computer scientists, digital and dance artists, each event or project making contributions to developing shared practice and discourse.²² This constellation of activity cannot help but sustain certain historical lines along which dance and computers have already overlapped. However, convergence in

the future may reflect less the episodic character of the last forty years and much more the negotiation of the integration of the computer and computation into all forms of cultural transaction. On the other hand, the *body in motion* has not become any less resistant to digitisation, and shifting conceptions of the arts as a research practice combined with the evolution of wearable and wireless computing could also suggest that the impact of dance on computers may be just at the start of more periodic convergences.

All URLs listed accessed June 4, 2002

Notes

- 1 One accessible and fairly comprehensive reference to the developments in computation related concepts is Howard Rheingold's *Tools for Thought* available at URL: <http://www.rheingold.com/>. See also Dinkla, Söke: *Pioniere Interaktiver Kunst von 1970 bis heute*, Ostfildern 1997, S. 25–42.
- 2 Noll, A. Michael: Human and Machine – A Subjective Comparison of Piet Mondrian's *Composition with Lines* 1917, and a Computer-Generated Image. In: *The Psychological Record*. Vol. 16, January 1966, pp. 1–10.
- 3 This quote of A. Michael Noll's is available at the URL under the heading *computer art*: <http://www.citi.columbia.edu/amnoll/>.
- 4 Noll, A. Michael: *Choreography and Computers*. In: *Dance Magazine*. January 1967, pp. 43–46 and Hutchinson, Ann: *A Reply*. In: *Dance Magazine*. January 1967, pp. 81–82.
- 5 Lansdown, John: *Artificial Creativity*. A version of this paper was given at the Digital Creativity Conference, Brighton, April 1995. Available at URL: <http://www.cea.mdx.ac.uk/CEA/External/Staff96/John/artCreat.html>.
- 6 Trisha Brown's dance making instructions can be found published in different locations, e.g. *Locus* in: *Contemporary Dance: An Anthology*, ed. by Anne Livet. New York 1978, p. 54–55, and *Accumulation* in: *The Postmodern Dance Issue: The Drama Review*. Vol. 19: No. 1, March 1975, p. 29.
- 7 For example in William Forsythe interviewed by Paul Kaiser: *Dance Geometry*. William Forsythe in dialogue with Paul Kaiser. In: *On Line. Performance Research*. Vol. 4: No. 2, Summer 1999, pp. 66–69, and in Dana Caspersen interviewed by Senta Driver: *It Starts from Any Point: Bill and the Frankfurt Ballet*. In: *Choreography and Dance*. Vol. 5: Part 3, 2000, pp. 24–39.
- 8 Editors' Note: *Benesh- and Labanotation* are two notation systems, one developed by Rudolf Benesh and his wife Joan in 1955, the other invented by Rudolf von Laban in 1928. In contrast to the *Benesh Notation*, which uses classical dance as a basis, the *Labanotation* is a system to analyse and record every human movement, that means also the movement, which is not connected to dance-ideology. For further information see <http://www.rz.uni-frankfurt.de/~greisbec/LABANE.html> or <http://www.ickl.org> or rather <http://www.benesh.org>.
- 9 Lansdown, John: *Computer-Generated Choreography Revisited*. In: *Proceedings of 4D Dynamics Conference*, ed. by A. Robertson. Leicester 1995, pp. 89–99. Available at URL: <http://www.dmu.ac.uk/ln/4dd/guest-jl.html>.
- 10 Lansdown, John: *The Computer in Choreography*. In: *Computer: IEEE Computer Society Journal* 11:8, August 1978, 19–30.
- 11 Noll, A. Michael: *Choreography and Computers*. In: *Dance Magazine*. January 1967, p. 44.
- 12 The sources for this information can be found in the Vasulkas' on line archive. Available at URL: <http://artscilab.org/eigenwelt/pdf/092-095.pdf>. An off line version can be found in Schier, Jeff: *Early Scan Processors – ANIMAC/SCANIMATE*. In: *Exhibition catalogue Pioneers of Electronic Art – Ars Electronica* 1992, ed. by David Dunn. Linz 1992, pp. 94–95.
- 13 Editors' Note: For SIGGRAPH see also the glossary.
- 14 Sturman, David: *The State of Computer Animation*. In: *RETROSPECTIVE*, Vol. 32, No. 1, February 1998 ACM SIGGRAPH. Available at URL: <http://www.siggraph.org/publications/newsletter/v32n1/contributions/sturman.html>.

15 For a description of *motion capture*-technologies and some work involving dance artists, please see deLahunta, Scott: *Coreografie in bit e byte: motion capture, animazione e software per la danza*. In: *La Scena Digitale: Nuovi media per la danza*, ed. by Armando Menicacci and Emanuele Quinz. Venezia 2001, pp. 83–100. A version in English is available at URL: <http://www.daimi.au.dk/~sdela/bolzano/>.

16 David Rokeby interviewed by Douglas Cooper: *Very Nervous System*. In: *Wired* 3.03, March 1995. Available at URL:

<http://www.wired.com/wired/archive/3.03/rokeby.html>. See also Dinkla, Soke: *Pioniere Interaktiver Kunst von 1970 bis heute*. Ostfildern 1997, p. 147–166. Further information on Myron Krueger cf. ibid, pp. 63–96.

17 More information available from the following URLs: Palindrome Inter-media performance group available from URL: <http://www.palindrome.de/>; STEIM available from URL: <http://www.steim.nl/>.

18 Rokeby, David: *The Construction of Experience*. Interface as Content. In: Dodsworth, Clark (Ed.): *Digital Illusion: Entertaining the Future with High Technology*. Jr. Addison-Wesley Publishing Company 1998. Available at URL: <http://www.interlog.com/~drokeby/experience.html>.

19 Two examples of dance and electronic composers/digital artists developing wearable sensor systems for use in interactive spaces are Troika Ranch based in New York City and DIEM based in Aarhus, Denmark. More information is available at these URLs: <http://www.troikaranch.org> and <http://www.daimi.aau.dk/~diem/wayne.html>.

20 Editors' Note: For further information on the beginning of telematic art cf. the interview with Paul Sermon in Chapter 2 of this publication. For further information on Kit Galloway's and Sherrie Rabinowitz' remarkable work cf. ibid, especially reference 3.

21 See reference 15.

22 This list represents several key projects and events, but is by no means comprehensive. For example: the *Shadow Project* in Jackson Hole, Wyoming organised by Thecla Schiporst and John Crawford in 1991 was followed by similar workshops at San Francisco University in 1992 and 1993, 1994 and 1995. A series of *Dance and Technology Conferences* were hosted by the University of Wisconsin (Madison, 1992), Simon Fraser University (British Columbia 1993), York University (Toronto, Ontario 1995), followed by a 4th *International Dance and Technology Conference* hosted by Arizona State University (Tempe, 1999). In Europe, Terry Braun and *Illuminations Interactive* produced the *Digital Dancing Workshops* in London annually from 1994 through 1998 followed in 1999 by the *Shifts* symposium organised by *Barriedale Operahouse*. Two workshop/symposia events, *Connecting Bodies* at the School for New Dance Development in Amsterdam and *Future Moves* at Theatre Lantaren-Venster in Rotterdam were organised in 1996. *Future Moves* subsequently has taken place in collaboration with V2 Media Lab during the last two DEAF – *Digital Electronic Arts Festival* events in 1998 and 2000. In Germany, the *Cross Fair 1999* and *Cross Fair 2000 – The intelligent Stage* symposia initiatives took place at the Choreographisches Zentrum NRW, Essen. See *Tanzdrama*, No. 51, Issue 2/2000 and No. 57, Issue 2/2001.

'Open Source Choreography?'

in *Code: The Language of Our Time*. Katalog zur Ars Electronica 2003.

Ostfildern-Ruit: Hatje Cantz. 2003, pp. 304-310.

In August 2001, I received an invitation from composer and digital media consultant Michael Century to contribute to a volume he was editing for MIT press as a follow up to the April 2001 CODE (Collaborative Ownership in the Digital Economy) conference which we both attended.¹ He was planning to including "a number of new pieces, mainly from artists but not solely, to widen the artistic terrain and make the whole thing more vivid. It occurs to me that your thinking on notation, performance arts, and open source really would/could suit this context well."²

In December 2001, I sent him the article, but for some reason he did not continue as editor and the book was eventually published without my contribution. In May 2003, after I had been invited to give a presentation at the Ars Electronica Festival that year, I suggested to editor Ingrid Fischer-Schreiber that the article would fit the festival theme which was CODE and she accepted it for their annual catalogue.

¹ Documentation site: <http://www.cl.cam.ac.uk/CODE/> (accessed 7 May 2010).

² Email to the author, 1 Aug 2001.

Open Source Choreography?

Scott deLahunta

This essay is an exercise in applying concepts derived from the Open Source software movement to the creative processes and products of contemporary choreography.¹ Across its three sections, comparison and contrast is used to open up and explore some questions related to issues of authorship and originality, whether or not choreographic methods are decoded through forms of discourse, and if the sharing of these methods could constitute a form of Open Source.

The Art of Making Dance

The history of contemporary, modern or "post modern" dance is usually written as a 20th century affair that originates in America and Western Europe and has a canonical sequence beginning at the turn of the century with Isadora Duncan. There is a tendency to organise this canon in two parts, early modern dance and post modern dance, along the lines of the general shift from modernism to postmodernism in the arts and architecture and on either side of a particularly iconoclastic rupture in the early 1960s known as the Judson Church movement that broadened tremendously the scope for choreographic methods.² Prior to the 1960s, documentation of specific choreographic methods for contemporary dance is minimal. Just before her death in 1958, a member of the early canon of modern dance, choreographer and teacher Doris Humphrey, completed a small book entitled *The Art of Making Dances*. This book, published in 1959 and again in 1987, is widely perceived to be the "first" book to comprehensively present the art of choreography in a "how to manual" for dance making.³ As such it is likely to be found in the bibliography of most dance composition courses in higher education in the United States, the United Kingdom and some dance programs in continental Europe.

In her introduction to the book, Humphrey contends that there were no theories of craftsmanship or form for dance making before the 1930s. Missing, she writes, was something equivalent to what music had "with its counterpoint and harmony, or painting with its laws of perspective and proportion". In *The Art of Making Dances*, Humphrey produces her theory on the "craft" of choreography organised around the concepts of ingredients and tools, design and dynamics, rhythm, motivation and gesture, words, music, sets and props and form.

As it is one of the original reference points for the discourse on how to make dances, the book marks the beginning of a period when the compositional techniques, strategies and methods of dance making begin to gather momentum. Interestingly, new books written by subsequent generations of choreographers do not follow. What does is that the discourse begins to evolve through the multiple accumulating acts of writing and publishing of a growing number of dance writers, critics and increasingly scholars. Sometimes the writings are explicitly "about" choreographic methods, such as Sally Banes on the "Choreographic Methods of the Judson Dance Theatre".⁴ Insight into how a particular choreographer makes dances occasionally comes through in an interview with a writer; at other times a close description of the work carries methodological information.⁵ It is



Photographer: Lois Greenfield

important to note that plenty of choreographers were also involved in documenting their making processes, and some were producing sizeable publications either solely or in edited collections filled with scores, sketches, notes, etc. However, the point I wish to make is that this figure of the writer / interviewer, someone standing alongside and observing the actual practice, becomes instrumental in exposing and disseminating the methods of choreography without them our collective understanding of how to make dances would be significantly diminished.

To summarize briefly up to this point: Prior to the 1960s, lacking a discourse, information about how to make dances would have come from watching dances or taking workshops with the artist. Subsequent to the publication of *The Art of Making Dances* there begins a collective process of knowledge building about choreographic process through the growth of a variety of forms of discourse in the field of dance (in parallel with a growth in the practice of making dances and public interest in the art form). Some choreographers contribute documentation, notes and some larger works to this discourse, but much of its production enters the domain of the writer / interviewer.

Open Source Software is software that is freely available not only as its executable binary code, but also as its source code. This way the software can be modified and used for other programs by anyone. Within the concept of Open Source resides the notion that some form of collective creativity produces and maintains the software product. This product is owned by everyone and no one—as intellectual property this software can be protected by various licensing agreements that preserve this freedom of ownership and the rights of the user to adapt the software to his or her needs. It would be difficult to apply this concept of collective creativity as it might relate to choreography. I have suggested that choreographers and writers / interviewers work together collectively to provide open access through discourse to explanations and explications of choreographic method (a type of intellectual property), but I would not refer to this as a form of collective creativity as the dances that are made are almost always reconfigured as objects of individual choreographic authorship. As such, in fact, copyright law in many countries protects these dances, a topic I will address below.

Neither could one say that "open access" to discourses about dance making is anything like open access to software code despite some correspondence between choreographic methods and code that can be teased out by looking at the work of choreographers who have at some point in their career made dances based almost entirely on a set of rules or instructions or an "algorithm" and as such their "source code" is freely available. In the 1970s, New York choreographer Trisha Brown and member of the Judson Church group did two performances in particular which were based on instructions. These were *Accumulation* and *Locus* (and their various manifestations). The instructions for these dances are published in several books, and nothing prevents me from placing the algorithm for *Accumulation* here in this text with the appropriate citation:

The accumulation is an additive procedure where movement 1 is presented; start over. Movement 1; 2 is added and start over. 1, 2; 3 is added and start over, etc., until the dance ends. Primary Accumulation accumulates thirty movements in eighteen minutes. The 29th and 30th movements each cause the figure to revolve 45 degrees, making a 90-degree turn with each completion of the sequence. Therefore, a 360-degree revolution occurs in the last two minutes of the dance, giving the audience three alternate views of the dance before finally stopping.*

Despite the fact that with this algorithm, the "source code" so to speak, one could recreate a dance that was performed in 1975, only Trisha Brown is entitled to compile and perform it as *Accumulation*, due to the extending of American copyright law to protect abstract choreography in 1976. Prior to 1976, copyright protection could be extended to dance works if they could be classified as "dramatic or dramatico-musical compositions".² However, the copyright in either case has only applied to the finished work, not to its underlying rules.³ This further interrupts any direct correspondence between software source code that can be protected by law and choreographic methods that would not be considered intellectual property at the point prior to the finished performance. On the other hand, the "algorithm" for *Accumulation* can be pulled from the field of discourse around making dances (just as I have done here in this essay) and used to generate movement material that is going to be transformed in subsequent stages of the making process into something unique to another choreographer. Seen in this light, it is possible to suggest that there is some aspect of Open Source software in operation

in the practice of sharing choreographic methods. I will return to this notion at the end of the essay.

In order to identify a dance so as to defend a copyright, there must be some objective method of fixing the choreography in a stable form as evidence. The Copyright Office in Washington D.C. distributes the following guidelines: "for choreography, the work may be embodied in a film or video recording or be precisely described on any phonorecord or in written text or any dance notation system such as Labanotation, Sutton Movement Shorthand or Benesh Notation." The notation systems listed here come closest to the concept of software in terms of intellectual property. Unlike the audio video recording devices, dance notation systems are made up of a flexible classification of discrete symbols that can be recombined to form increasingly larger units of information relating to particular movements over time. The simplest unit of information in Labanotation for example is referred to as the "staff" (as in music) and within this staff one can combine the symbols necessary to indicate the direction, part of body, level and length of time. Out of the syntactical combinatorial strength of this fairly simple symbol language, complex information about movement can be represented.

This description of how dance notation works bears similarities to how software code functions. However, what distinguishes the dance notation system from software code is that in the practice of making dances, dance notation is not used as a generative device while software code is by its nature inherently generative; it produces the effect. Notation systems were created with the intention of preserving and restaging choreographies, not generating them. Choreographers would not devise a dance by writing it out in dance notation symbols first. However, in intellectual property terms notation functions as part of the system of owning choreographies; and this is similar to software code.

To review briefly from the last summary: The way that information about making dances is collectively aggregated from a variety of individual sources is not the same as the collective creativity practiced in the creation of Open Source software. Dances ultimately tend to resolve into objects of individual authorship and can be protected as such by recent copyright adaptations. While some choreographers may work with rule based systems for making dances, these algorithms themselves are not likely to be considered as intellectual property. In order for the copyright act to be used to protect a finished dance, the choreography of that dance must be fixed in the form of an audio and / or video recording or some form of written dance notation. Dance notation systems by their nature perhaps bear a closer resemblance to software than other features of dance—but they are used primarily to record choreographies, not to generate them.

Choreography and Open Source

Just as particular choreographers have worked with rule based systems in their dance making, something approximating a "copy" of a dance may be used by some choreographers to explore the philosophical implications of intellectual property laws applied to dance. Well known now in Europe for creating provocative conceptual dance works, French choreographer Jérôme Bel intended his 1998 piece *The Last Performance* to be made up of short sections or "quotes" from dances by other choreographers that have influenced him in some way.⁸ He obtained permission to use some of this material, but also some rejection letters citing copyright laws. These were read aloud at the first performances of *The Last Performance*.

One of the choreographers who provided permission for Bel to use her material was German choreographer Susanne Linke, and one of the dancers in *The Last Performance* wears a white dress and states, "I am Susanne Linke." In this context, the significance

of the "copy" is the set of references it holds for the viewers at the moment of its representation in the performance. No longer bound by the logical structures of language or the code of software or law, this "copy" begins to play on the blurry edge of mimesis—to claim to be the original performer is to perhaps step into the role as an actor or as an imitator. Dancing bodies are extremely complex in informational terms and will resist reified readings. *The Last Performance* illustrates the point at which the relationship between contemporary choreography and Open Source diverges and a comparison becomes too inconsistent to be worthwhile. To bring this essay to a close, just as the example of *The Last Performance* can be used to illustrate a situation in which comparisons between choreography and Open Source can unravel, another choreographer can provide a clear case for carrying through with the exercise. I wish to return to the suggestion that some aspect of Open Source software is in operation in the practice of sharing choreographic ideas of which the following is an example.

William Forsythe, the artistic director and primary choreographer of the Frankfurt Ballet since 1984, has made elements of his choreographic process available through the distribution of an interactive multimedia CD-ROM entitled *Improvisation Technologies: A Tool for the Analytical Dance Eye*.¹⁰ His motivation for starting the CD-ROM project was to provide new dancers to the company with a way of studying the basics of his innovative improvisation techniques. Unlike Doris Humphrey's *The Art of Making Dances*, Forsythe had no intention of producing a publication that would address all aspects of dance making, but to provide information about what he refers to as "building blocks" for developing a way of analysing motion while moving improvisationally. In Forsythe's view, these building blocks represent concepts or ideas more than techniques or strategies. From this perspective, choreographic methods resolve into choreographic thinking.

The CD-ROM presents four categories of information: lines, additions, reorganising and writing. Within each category there are up to five subcategories (e.g. point point line, rotating inscription, isometries, etc.) and within these several more. This hierarchical organisation of the information allows the reader / user to proceed easily along a learning trajectory that goes from simple to more complex principles. The reader / user also has the option of entering the information through watching these building blocks or ideas danced by members of the company. There are a total of sixty-three separate building blocks represented on the CD-ROM and many of these contain other building blocks within them. They represent a small but important portion of William Forsythe's choreographic thinking. Because they are disseminated and made accessible through this electronic document, they are in the public domain as a form of Open Source code not only providing insight for those who wish to understand more about the process of making dances in general, but making the building blocks themselves available for anyone else to use. When asked if he felt he is giving something away by publishing this information in the form of the CD-ROM, Forsythe has responded:

Well, the CD-ROM doesn't tell you how I choreograph, it doesn't teach you anything other than how to observe motion. (...) It shows just some of the ways of thinking about analyzing motion. I think there is a whole new attitude towards work. Put it this way: work is not some sort of secret. It's rather superstitious to think one has to keep one's method secret. (...) At the end of the 20th century, work doesn't need to be kept secret. It won't disappear just because we communicate. We might be apprehended, so to speak, and that could force us to abandon our own methods, which is not such a bad thing either. (...) I would hope that the users would actually discover their own dancing en route to understanding ours."



Photographer Lois Greenfield

Dance critic Jennifer Dunning describing a choreography by Susan Rethorst in the *New York Times*, 21 September 1995: "The dance is packed with exquisite movement phrases and striking small gestures, fleeting though they may be."

To review briefly from the last summary: when finally produced as a performance, a dance can be registered for copyright, and it is possible for the choreographer to refuse to allow other choreographers to reproduce any section of that dance as happened with *The Last Performance* by Jérôme Bel. However, when on stage the dancing body does not easily conform to the neat fixed entity that the institution of copyright might prefer. The dancing body on stage also resists being compared to the dynamics of Open Source. Connections between choreography and Open Source as a particular set of concepts and practices are more likely to be found in the conditions of openness as manifest in the *Improvisation Technologies* CD-ROM of William Forsythe.

Conclusion

The creative processes and products of contemporary choreography practice can only be inconsistently aligned with those of the Open Source software movement. Forsythe suggests that the days of keeping one's methods secret are disappearing, but I am not sure to what degree this is contingent upon or simply coincident with the Open Source movement (both are in the same historical time frame). Different types of questions emerge: do the software licenses that preserve free access to source code suggest any adaptations to the choreography copyright law? In seeking to answer this question, we would find our comparison rapidly breaking down as it has occasionally in this essay. Another type of question: wouldn't one need to know how to choreograph or be a choreographer to make use of the source code of a particular dance? This asks us to consider the possibilities of knowledge as something other than property. Perhaps understanding how a dance is made, having access to its "source code", could help us deepen our grasp of creative processes in general. A dance performance then might begin to be widely perceived as inseparable from the process—an executable of choreographic thinking. Perhaps if choreographic processes are better understood, they could be used to produce things other than performances. If comparing the world of choreography to the world of Open Source software inspires this shift, then it's an exercise well worth doing.

- 1 This essay was originally written for an MIT Press book (as yet unpublished) inspired by the CODE conference organised in April 2001 (<http://www.cl.cam.ac.uk/CODE/>). I have chosen Open Source rather than Free Software as my term of reference for the concept of software that is freely available not only as its executable binary code, but also as its source code. However, it's important to note that while both may fit this same technical description, Open Source and Free Software have divergent histories and in some contexts are ideologically opposed. Both have their own websites, and for additional clarifying reading I suggest some of Florian Cramer's essays: *Free Software* (<http://www.fsf.org/>); *Open Source* (<http://www.opensource.org/>); Florian Cramer (<http://userpage.fu-berlin.de/~cantsin/>).
- 2 The Judson Church movement refers to a series of dance composition classes and performances in New York City that took place in the 1960s. At the start of the decade at the suggestion of John Cage, the composer Robert Dunn conducted a small number of influential composition classes in New York City out of which some of the best-known and most innovative contemporary choreographers of the second half of the 20th century emerged. The classes created the conditions for moving away from the choreographic formulas that had been developed by early 20th century theorists like Doris Humphrey. Names of dance artists who participated in the classes include Trisha Brown, Lucinda Childs, David Gordon, Douglas Dunn, Kenneth King, Yvonne Rainer, Steve Paxton, Simone Forti and Deborah Hay. A selection of this group gave their first in a famous series of performances that would last four years on 6 July 1962 at the Judson Memorial Church in Lower Manhattan, thus earning them the title of the Judson Dance Theater group.
- 3 Doris Humphrey. *The Art of Making Dances*. Edited by Barbara Pollack. Princeton Book Company, Hightstown, NJ, 1959 / 1987.
- 4 Sally Banes. "Choreographic Methods of the Judson Dance Theater". In *Writing Dancing in the Age of Postmodernism*. pp. 211-226. Wesleyan University Press, February 1994.
- 5 For example see: 1) this edited book of interviews with choreographers: Jo Butterworth and Gill Clarke, eds. *Dance Makers Portfolio: conversations with choreographers*, Bretton Hall, Wakefield, UK: Centre for Dance and Theatre Studies, 1998; and 2) any issue of a dance journal that often includes feature articles on particular choreographers such as *Ballet International / Tanz Aktuell* (<http://www.ballet-tanz.de/>) or *Dance Theatre Journal* (http://www.laban.org/dance_theatre_journal.html).
- 6 One source for this dance "algorithm" can be found in an interview with Trisha Brown in *The Drama Review, Post-modern Dance Issue*. T-65, March 1975.
- 7 Julie Van Camp. "Copyright of Choreographic Works." 1994 - 95 *Entertainment, Publishing and the Arts Handbook*. edited by Stephen F. Breimer, Robert Thorne, and John David Viera. pp. 59 - 92. Clark, Boardman and Callaghan, New York, 1994. This article can be found on line at <http://www.csulb.edu/~jvancamp/copyright.html>.
- 8 Actual litigation involving dance and copyright law has only occurred occasionally. One example is a written court case over the use of the name of iconic modern dance figure Martha Graham. David Finkle. "The Future of Dance's Past: Graham Center Wins a Round in Court and Wakes Up Choreographers". *The Village Voice*. Week of August 15-21, 2001. This can be found on line by searching on David Finkle at <http://www.villagevoice.com/>.
- 9 Gerald Siegmund. "The Endgame of Dance: 'The Last Performance' by Jérôme Bel in Nuremberg." *Ballett International Tanz Aktuell*. January 1999.
- 10 William Forsythe. *Improvisation Technologies: A Tool for the Analytical Dance Eye* (CD-ROM). Hatje Cantz Verlag (ISBN: 3775708502), Ostfildern, June 2000.
- 11 These quotations are extracted from an interview with William Forsythe conducted by Nik Haffner on 22 April 1999 that is published in the booklet that accompanies the *Improvisation Technologies* CD-ROM. Nik Haffner, Volker Kuchelmeier and Christian Ziegler made major contributions to the conceptual and technical aspects of the CD-ROM.

**'The Finished Middle: a Hot Wired Live Art conversation about
collaboration, prototypes, tools as art and rules of engagement'**

in *A Guide to Good Practice in Collaborative Working Methods and New Media
Tools Creation*. eds. L. Goodman & K. Milton. London: Office for Humanities
Communication Publication 18. October 2005, pp. 105-113.

In January 2002, I responded to a call for proposals from Elizabeth Goodman for their book and online publication for an Oxford series that "focuses on performing and visual arts and digital interfaces, so we must emphasise those types of projects in this book, though of course other kinds of work can be highlighted on the website or in other publications".¹ I proposed to edit the interviews I had done with the artist-participants of 'Hot Wired Live Art 2', August 2001 in Banff, Canada into a single conversation covering the following themes: Keystroke, Collaboration, Terminology, Debates, Tools, Wireless/ Wearables, Social Space, Games, Prototypes.² Eventually the book was published by the Office for Humanities Communication and is also available on line: <http://ahds.ac.uk/creating/guides/new-media-tools/> (accessed 7 May 2010).

¹ Email to the author, 16 Jan 2002.

² Documentation website: <http://www.ubermatic.org/hwla/airwaves.html> (accessed 7 May 2010).

The finished middle

A Hot Wired Live Art conversation about collaboration, prototypes, tools as art, and rules for engagement

Scott deLahunta, with Niels Bogaards, Sher Doruff, Gisle Frøysland, Hans Christian Gilje, Jeff Mann, Per Platou, Amanda Ramos, Ellen Röed, Amanda Steggell, and Michelle Teran

Hot Wired Live Art (HWLA) is a laboratory model for artistic research into a playful, inventive, collaborative, and critical engagement with electronically networked environments. In peer-to-peer intensive working sessions, HWLA brings together an interdisciplinary group of practitioners with a combined range of creative skills and expertise in electronics, streaming media, programming, sensors, wireless and communications technology, live video and audio processing, architecture, film, dance, theatre, and music.

The first HWLA – title, concept, and event – was the creation of Amanda Steggell and Per Platou of Motherboard, an interdisciplinary performance company based in Oslo, Norway, whose work engages with digital pop culture and social interaction. Organized over a two-week period in January 2000 in collaboration with the Bergen Centre for Electronic Art, Norway, HWLA-1 involved sixteen artists from Norway, The Netherlands, Canada, Germany, Austria, and the United Kingdom.

The second HWLA was initiated by Michelle Teran, a Toronto-based artist whose performance and installation work seeks to integrate the digital and the organic in networked environments. HWLA-2, subtitled 'Airwaves', took place from 18 August to 2 September 2001 as a co-production with the New Media Institute, Banff Centre for the Arts and involved eleven artists, nine of whom took part in HWLA-1. Their biographies can be found at the end of the following conversation, which is edited together from three separate conversations broadcast during HWLA-2 over Radio 90, a pioneering Internet radio/pirate FM station based at the Banff Centre.

Talking about collaboration, prototypes, tools as art, and rules for engagement

The conversants are Niels Bogaards, Scott deLahunta, Sher Doruff, Gisle Frøysland, Hans Christian Gilje, Jeff Mann, Per Platou, Amanda Ramos, Ellen Røed, Amanda Steggell, and Michelle Teran.

SdL: The KeyStroke software has been central to both HWLA sessions; Sher is the project director, Niels has co-developed the user interface and Michelle wrote the user manual for it. While I know we don't want to focus solely on KeyStroke in this conversation, perhaps one of you could describe what it is? Sher?

SD: I am always describing KeyStroke, could someone else say what he or she thinks it is?

MT: I think of it as a real-time, multi-user, multimedia, cross-media synthesis tool that enables collaboration over a local area network or over the Internet.

ER: I can see why they had you write the manual.

SdL: Ellen, Michelle and you started to work with KS on your own after the HWLA-1 session. Can you say a few words about how you have been working?

ER: Sure, we have been calling it 'Girls Meet in Different Ways Now'. And it's not a public performance using KS. It is mostly an online visual jam session between the two of us as a way of generating and working together on material. We use webcams to give us live input and from this use the software to mix different kinds of visual expressions. We've scrambled these into a very loosely organized website that people have been able to see, and we've also exhibited the images as photography in a gallery.

SdL: So the software is a process rather than a performance tool for you? Using KS for the online collaborative construction of visual images that can be then redisplayed in different contexts. Can you say a few words about the collaborative aspect?

MT: Yes. We are making the visual image together, because we literally meet in the middle at the interface of KS. This is what makes the software unique. I'm sitting in Toronto and she's in Trondheim, but what she's seeing is what I'm seeing in real-time, so she's responding to what I'm sending and I'm in turn responding to what she sends back. So it's not like we have our own interpretation, we are both seeing and responding to the same thing. The resultant image is that finished middle that is a combination of our two inputs.

SD: I am curious about something. There is a lot of effort going into trying to define what goes on in these 'online virtual collaborative environments',

and what seems to always come up is the need to know things beforehand, to set up certain parameters within which one can establish trust, etc. What sort of parameters do you start out with? Do you begin with a shared intention around what it is you wish to make together?

MT: I don't know. I think each experience is different but we have found that if we start with an intention or with the aim to create a particular meaning, then it just screws it all up. As far as parameters, we both work with the live camera, and we both work with an environment we feel we can immerse ourselves in. But these are completely different. Ellen is very interested in using the projection of the KS output as part of the environment and then layering it. Her environment is a dark room totally isolated from any type of light. I have a studio that has south and west windows so there is no way that I can avoid light, partly because of the time difference of six hours. So my second monitor is a television monitor, and if I'm sending feedback I am capturing the monitor. There's no way in my studio to match the environment that Ellen has created.

ER: Which brings us back to the whole collaborative aspect. It's not about getting rid of intention; it's about keeping hold of your original starting point. I think that we've been seeing it a little bit in this lab as well. Whenever we are doing something it is the person or the people who are genuinely interested who are contributing. And I think that this is the essence to the whole Hot Wired Live Art collaboration. We get to keep our starting point within the group.

AR: I can say something based on the experiences I've had working within collaborations. Firstly, I could probably say that I only work in collaboration. It can happen on different levels; you might set up a productive collaboration where you work with others to make something, and this might be more or less interdisciplinary, or you might set up a situation that is collaborative in the sense that the audience gets involved. But what has surfaced during this workshop is a form of collaboration that combines these in a way I've never really experienced before. I think that one of the things that I'm really intrigued by and enjoyed being a part of is this idea of having a space that fosters these different kinds of collaborations. We've set up this laboratory so that there are times when we can work in collaboration, or times when the space becomes collaborative or we are just helping each other out. It's sometimes almost a casual opportunity to collaborate, but very generative.

JM: Well, I almost never work in collaboration. So this is a different situation for me. I've done things that were more like a group show where there is this kind of group environment, but still people working generally on their own projects. Hot Wired Live Art has been a little like that. There

have been a number of individual projects that have been going on, but it's all kind of happening together and there is a lot of back and forth about things, ideas bouncing off of each other. I find that there is a lot more energy than there is if there is just one person. I guess the question is how to focus that energy, all those different ways of working.

AS: Speaking for myself and how our group Motherboard works, we base our collaborations on social aspects. We like to work with people that we gel with socially, because getting to know each other includes gaining respect for each other's skills and ways of working as well as their approaches to life. From this we find there is a greater chance of a collective consensus emerging without needing some sort of planned or overly analysed approach to the collaboration.

SdL: Yes, I have been in collaborations where there is a tendency to try to deconstruct the collaborative process as it is happening, whereas I prefer to think of collaboration happening as a consequence of a situation or a set of conditions. This reminds me of Sher's question about establishing parameters, which can also be about conditions. In our case I think one of the conditions we agreed to was this concept of the prototype, which emerged from the notion of making things quickly, several things every day. When Michelle mailed me that she was thinking of using the 'prototype' as a way of working I was excited. It suggests to me a sort of recipe, a quick sketch of the ingredients and description of the meal that should come from them. As a recipe it becomes something somebody else can take and use. Because it doesn't quite exist yet, it is sort of more transferable.

AS: Well, I like cooking but I never follow the recipe. I have recipe books, but I kind of scan over them and get a general feeling for them. I'd rather go out and eat in the restaurants and ask them what kind of ingredients that they are using, and then go home and play around with the knowledge that I had before. But for getting a number of people to work together over a short intensive period of time, this idea of the prototype has been excellent for sharing ideas, gathering information from different people with different skills. Maybe in a way we are making recipes, putting these things together quickly. Sometimes hacking in to connect things that weren't compatible before.

JM: I think that the focus of Hot Wired Live Art is the 'live art' so it's really about being live and being improvisational. Not coming with prepared ideas, not coming with prepared media. We have just brought in mostly raw materials and some tools and things. I think the prototype idea was used to support spontaneity and a situation where we are trying a lot of things out. Of course we're going to learn things, how we can do this and why we can't do that and here's a new idea, etc. If we document that and keep a record then

it's useful, but I don't think it was the intention of this project to come up with a lot of recipes that are going to be used by other people. It may be a result of what we have been doing, but it wasn't the starting point.

SdL: You mention the concept of 'tools', Jeff. The 'Human Generosity' conference here at Banff had as one of its themes the concept of software tools that enable collaboration and creativity. We presented the work of the laboratory there in the form of about a dozen prototypes we have come up with so far in the first week, and there was a lot of interest in KS as one of these tools. There was also a discussion of this shift towards the programming of tools as an arts practice, so that the making of KS is the making of an artwork as much as the making of a tool, and a part of this phenomenon includes its rapid dissemination via the Internet. Does anyone wish to comment on this?

GF: There are some interesting software tools that I think are more like an artwork, but only when it is part of an overall concept like with nato.0+55 (*a cross-media synthesis program somewhat like KS except for the multi-user functionality*) in which the software is one small part of a larger picture, which includes an evolving community of users, etc. If you are a nato.0+55 user then you tend to get involved in this community. Of course, the software in itself can be used in many different ways, but as a member of the community one is constantly being drawn to the Netochka Nezvanova ~ kind of aesthetics through the mailing list and the website and these Quicktime movies that he or she puts out all the time. It kind of imposes that this is the way to use nato.0+55 and very many do.

NB: I agree, I think the fact that the work of many nato.0+55 artists looks the same is because there are not so many of them anyway and they all came out of the same mailing list, the same environment. But they don't have to look the same. I think anyone could pick up nato.0+55, or KS for that matter, and make work that is very different and original. Sometimes we hear people say that the software itself sort of makes you go into certain directions, artistically, such as Flash or Photoshop, but this is often due to the reliance on the use of defaults that are set up to make certain things easier or more obvious. Hence you get these apparent styles that some people never break out of. But I'm not sure if you should blame the tool for that, as long as it's open enough to experiment with for someone who wants to take the time to learn how to work with it.

GF: I think the only solution is for every artist to make his or her own software tool. Then you know every aspect of what that program really does, because with commercial software, you can't really do that.

SdL: That might be good, but it seems it may not be realistic. So, I'm still thinking we are in a situation where more artists are making tools out of software

- and there will be other artists who will be using these tools. To some extent then, those who made the tools set up some limitations on the processes and products of the users. I'm just trying to think if this is unique due to the existence of software as a sort of medium or material for toolmaking?
- PP: I think you could say that this started to happen in the 60s or in the 70s, in particular when the means for making and distributing media became more accessible and available. For example, take what happened in the early 70s when the Portapak came out, putting the means for making and distributing media in the hands of artists and no longer solely with the big TV studios.
- SdL: Well, I suppose if you got a hold of a Portapak, you might possibly hack into it and work with its raw electronic materials to manipulate and distort the video signal, for example, but I don't know to what extent you might say, 'Look, now I've taken this apart and I've reconfigured it into a new tool that I now want to give to other artists to use.' That's what I mean.
- PP: Look at Woody and Steina Vasulka and how they pioneered the work with electronic media tools, setting up collaborations and establishing The Kitchen in New York in those days. I wasn't there but I think this is exactly the same as what you are talking about: giving access to a certain set of ideas, ways of working, tools if you will, creating possibilities. I would say even in setting up the Hot Wired Live Art sessions, this is kind of the same thing. So I would think that just because there is software does not mean that this toolmaking and distribution by artists is radically different now.
- MT: I agree with Per, there seems to me to be a relatively long tradition of providing access to and exchanging methodologies and ways of working that has not only begun with the take-up of software. For example, take our ability to go deeper into someone's process – so when you meet someone for the first time you might start with certain assumptions, like, 'Well, this person is an architect, they design buildings and know all about building materials and spaces, etc.' But then you have to go through a process of getting to know them, through discussion or listening to them talk about their work, before you understand what that person's practice actually is. Is her or his way of making things all ordered and nice? What is beneath the materials themselves, what is their creative approach? So this means that an artist's input is not just limited to perhaps the hardware or software tools and related skills that they brought. That is why we organize presentations to each other as part of the HWLA laboratory.
- SdL: I think you are absolutely right Michelle, and it's an interesting point you both make. But just to take the toolmaking thing a bit further, I wonder what the connection is between artists making tools in the twentieth century with the nineteenth-century surge of instrument-making for scientific purposes, tools for measuring things.

- NB: Well, I think that artistic and scientific toolmaking was actually very much linked back then; look at the way optical instruments of the nineteenth century so quickly became small platforms for creative activity. But for me, if we are looking for what is new, the big difference nowadays is the Internet in the way it provides a measure of independent and cheap production never before available.
- PP: But I have the impression that kids today think the Internet is for the 35-year-olds. Because it is a static thing that is now associated with sitting in front of the fucking computer in a boring office with a mouse and a keyboard. That is one reason it's been exciting to concentrate on wireless networking during this HWLA laboratory, because, at least in Europe and in Asia, the Internet is going to become much more a site for mobile and wireless communication.
- JM: Speaking of kids today, I also think it's worth taking a hard look at gaming culture. I think gaming is informing a lot of art and performance making. It's a lot less about work as work and more about work as play. When we talk about KS, we talk about the 'multi-user environment', but this is really a gaming environment. I think that what else is happening is we are moving away from an industrial and manufacturing based economy to one that is knowledge or information and service based and that perhaps in this context, artworks are going to be less about physical manifestations and more about thinking about the language and rules involved in social interactions. All of these kinds of things are a lot more evolved already with games. I think we could think about this whole HWLA laboratory as a game. We're trying to figure out what the rules are and make them up at the same time.
- AS: That is interesting to think about, because if I go to make an artistic intervention in a social space, whether it's online or offline, for me it's important to try not to construct something that could happen in that place, a performance or something, but to become involved in the environment that is there and work from that. Recognizing the protocol, the rules governing the social interaction of a particular place, is the way to go about this, I think.
- AR: This is partly what enticed me to go from being a practising architect to someone making installation artworks. I found that creating installations allowed for a combination of experiences and small elements at a certain scale that could start to prototype new ways of living or new ways of being in a space with a lot of people.
- JM: The thing with the game, though, that seems to be unlike a prototype is that if you make up a game it's simply there for everyone to play. It isn't about following a recipe to produce or reproduce something. It is somehow more process-oriented than that.

ER: And I think we have to go back to that communication tool thing, because 'live art' implies some kind of performance, but it's so often not about making or being in a performance for us. It is definitely not about being on a stage. I'm not saying that in the work Michelle and I have been doing we would never do that, but then it would be something completely different. It would be the result of wanting to do something particular, create a common space in a performance setting, but that is not what we have been working on.

SdL: I sense we are about to open up another area of discussion here, but it's probably getting close to time to wrap this conversation up. Michelle, as the initiator of this second HwLA session, do you have anything to conclude with?

MT: Well, I'm sure Amanda and Per can attest to the difficulty of persuading supporters to recognize the value of these types of open-ended working laboratories. However, I think we are developing useful frameworks for the forms of collective creativity that are emerging in the context of networked environments. We each carry these outcomes with us when we return home where they can be tested and adapted further in preparation for the next HwLA session.

For a list of the materials and several of the prototypes that were developed during HwLA-2 'Airwaves', please visit <<http://beagle.WAAG.org/~hwla2>> (accessed, May 2005).

Artists participating in HwLA-2 'Airwaves'

Niels Bogaards (The Netherlands) is a musical composer and computer programmer interested in both artistic expression and technology. He is currently the developer of the user interface for the KeyStroke project at the WAAG Society for Old and New Media. <<http://www.keyworx.org>>, <<http://www.WAAG.org>>. Accessed, April 2005.

Scott deLahunta (The Netherlands) does research, writing, speaking, and consultation work related to the impact of new media and information technologies on live performance arts practice with a particular focus on dance. <<http://huizen.dds.nl/~sdela/>>. Accessed, April 2005.

Sher Doruff (The Netherlands) is a media artist working with real-time interactive performance technologies for hybrid physical and virtual spaces. She is currently project director of KeyStroke/Keyworx and co-artistic director of the Sensing Presence department of the WAAG Society for Old and New Media in Amsterdam. <<http://www.keyworx.org>>, <<http://www.WAAG.org>>. Accessed, April 2005.

Gisle Frøysland (Norway) is co-founder of the Bergen Centre for Electronic Art (BEK) and develops interactive systems for the web. <<http://www.bek.no>>. Accessed, April 2005.

Hans Christian Gilje (Norway) is a media artist currently based in Berlin working with mostly video in different contexts: live jamming, interactive installations, scenography, and time-based works. Most works currently infected with nato.0+55. <<http://www.nervousvision.com>>. Accessed, April 2005.

Jeff Mann (Canada) has been working with telecommunications art since 1985. He is the founder of the Art & Robotics Group at InterAccess, and is currently creating electronic systems for electrophysical installation and performance. <<http://www.interaccess.org/arg>>. Accessed, April 2005.

Per Platou (Norway) is co-director of Motherboard. In 1995 he started NOOD, a project dedicated to sound exchange on the Internet. He is also a freelance journalist writing on digital art and hacktivism. <<http://www.liveart.org>>. Accessed, April 2005.

Amanda Ramos (Canada/USA) is an architect who focuses on creating environments that integrate architecture and media. She provides skills in developing public opportunities to explore the connections between physical and virtual spaces.

Ellen Røed (The Netherlands) is a digital media artist whose offline and online performance and installation works involve various hybrids of KeyStroke, Nato 0+55 and Max. <<http://www2.khib.no/~ink/>>. Accessed, April 2005.

Amanda Steggell (Norway) is a choreographer and co-director of Motherboard, an interdisciplinary performance company whose work engages with digital pop culture and social interaction. Motherboard unscrupulously uses a combination of ancient technical gadgetry and modern hard- and software to create dynamic environments for performers and audiences, and seek to make visible the seamless connection between on- and offline existences. <<http://www.liveart.org>>. Accessed, April 2005.

Michelle Teran (Canada) is an artist interested in networking the digital and the organic, social spaces and mixed reality. Her online and offline performances and installations are fuelled in part by KeyStroke, live video streaming, video teleconferencing, and the basic webcam. <<http://www.ubermatic.org/misha>>. Accessed, April 2005.

'Permuting Connections: Software for Dancers'

in *Sound Unbound - an anthology on Sound Art, Digital Media and new*

Compositional Strategy. ed. P. D. Miller. Cambridge: MIT Press. 2008, pp. 265-272.

In March 2002, I was invited by Paul D. Miller (aka Dj Spooky) to write a chapter for his planned anthology on 'Sound Art, Digital Media and new Compositional Strategy'. He had seen a presentation I gave that involved some of the human figure animation work of Michael Girard's [see Critical Appraisal footnote 12] and was interested to see me include some of the "movement and flocking" material I showed in my lecture with a "little historical overview".¹ To construct the historical background I thought best for Girard's work, I reused some of the material from the 'Periodic Convergences: Dance and Computers' [No. 8] at the start.

The book was initially being published by Routledge, but something disrupted that plan and it took six years before eventually being published by MIT with the support of Doug Sery, well-known acquisitions editor for new media related topics at MIT Press. The list of other authors in the publication include: Manuel DeLanda, Cory Doctorow, Frances Dyson, Brian Eno, Moby, Hans Ulrich Obrist, Pauline Oliveros and Bruce Sterling.

¹ Email to the author, 18 Mar 2002.

Scott deLahunta

One can trace connections between computers and dance back to the 1960s when early computer artists, often mathematicians and computer scientists by training, were experimenting with algorithmically generated graphic images and patterns and forms of computer creativity. Working with Bell Labs in Murray Hill, New Jersey, A. Michael Noll began to explore the possibility of combining digital computers and the visual arts by studying three-dimensional computer graphics and computational aesthetics. In a crude approximation of the Turing test in which human and machine intelligence are compared, Noll invented the algorithms that would instruct a computer to generate an image that would mimic in its patterns and structure Piet Mondrian's *Composition with Lines* (1917).¹

In 1965, Noll created a work of computer animation he titled *Computer-Generated Ballet*, reported to be the first such use of a "digital computer to create an animation of stick figures on a stage."² But perhaps his most significant contribution to the convergence of computers and dance was in January 1967 when he published an article in *Dance Magazine* entitled "Choreography and Computers," in which he described a software program he was creating that would indicate stage positions of stick figures and could potentially be of use to choreographers. In the same issue, Ann Hutchinson-Guest (an authority on dance notation) penned "A Reply" to Noll's speculations, in which she writes that the computer will "never replace" the facility a choreographer has for composing movement with the dancer. However, she does concede that

the computer might assist in the overall outlining and editing of a score for a dance.³

Around the same period, John Lansdown, an architect by training, was pursuing a different vision of integrating dance and the computer. Based in London, Lansdown was particularly interested in the possibilities for "artificial creativity," to use the computer to contribute to a creative process as an autonomous composer, rather than to support or augment an existing one. In his introduction to "Artificial Creativity," a paper given in 1995, Lansdown describes the computer's ability to make "decisions according to rules." He traces the history of the use of related "regulatory" systems in music composition, architecture, and painting and distinguishes between two types: those that are randomized and those that are rule-based. Contemporary choreographers have used similar systems.⁴ Merce Cunningham's and John Cage's well-known experiments with random methods were explored further by experimental choreographers in the early 1960s. In the 1970s Trisha Brown devised "dance making machines"—rule-based systems that generated particular performances such as *Accumulation* and *Locus*.⁵ William Forsythe's use of algorithmic structures in the 1990s with the Ballet Frankfurt is well documented.⁶

Back in 1968, Lansdown had begun to experiment for the first time with "computer-generated" dances. He first attempted to use the computer to create all the instructions a dancer would require, but soon determined that "a more satisfactory method" was to provide a looser framework within which there was some room for interpretation by the dancers.⁷ He developed the concept of generating "peaks" of movements rather than the movements themselves and allowed the dancers to fill in the material between. Using these methods, Lansdown contributed to many performances between 1968 and 1993 with various dance companies, including London-based Another Dance Group, the Royal Ballet School, and The One Extra Company of Sydney, Australia.

In the 1960s and 1970s access to computers was extremely limited and programming a slow tedious process. A. Michael Noll states optimistically in his 1967 *Dance Magazine* article: "The computer and graphic output equipment might be centrally located and time-shared with many users. Anyone could apply this technology to produce this form of 'dance notation typewriter.'¹³⁸ Perhaps Noll thought the conditions he describes would generate more convergence between computers and dance. It did, but not surprisingly it was

choreographers working at academic institutions with access to computer science departments who were best able to explore the possibilities, and the mainstream of contemporary dance practice tended to be unaware of, or uninterested in, the outcomes of this work. Computing aids (either generative or supporting) for choreographic compositions have not proliferated to a large degree as perhaps Noll and Lansdown would have predicted. The piece of technical equipment that has become ubiquitous in the rehearsal studio is clearly the video camera and television monitor, but there has been little incorporation of computer technologies into this setup.⁹

In the 1980s, we saw the emergence of "interactive performance systems" such as Canadian artist David Rokeby's *Very Nervous System* (VNS).¹⁰ The VNS uses a video camera as an "eye," the cable to the computer as an "optic nerve," and the computer as the "brain" to create an interactive "seeing" space in which the movements of one's body triggers sound and/or music.¹¹ There are several other similar systems available today for performance artists wishing to explore interactive systems, including the BigEye software at the Studio for Electro-Instrumental Music (STEIM) in Amsterdam and EyeCon by the Palindrome Inter-media Performance Group based in Nürnberg.¹²

The classes of input devices for interactive systems can be extended beyond those that are video based to include haptic (touch), for example, pressure and flex sensors, and nonhaptic (distance), for example, ultrasound. However, a "seeing" space—video-based technology like VNS—requiring only a camera and software and being relatively easy to set up, is an attractive option for choreographers and dancers who wish to experiment with an interactive system in performance.¹³ In all these systems, performer movement or action triggers some sort of event (sonic, visual, robotic, and the like) in the space around or in some proximity to the performer. The connection between the "input," the performer action that oscillates the data stream, and the output event is determined by "mapping" the input to the output in the computer software.¹⁴

The concept of mapping is a topic of creative interest and a focus of artistic practice in the field of electronic music in particular. In a paper entitled "Towards a Model for Interactive Mapping in Expert Musical Interaction," Marcelo Wanderley and Ross Kirk review the ways "performer instrumental action can be linked to sound synthesis parameters."¹⁵ They describe two main "mapping" directions: (a) the use of generative mechanisms (e.g., neural networks) to perform mapping, and (b) the use of explicit mapping strategies.

Once completed, however, the instructions that make up the mapping itself are relegated to the invisibility of computation. It is the manifestation of mapping, the performer-triggered event, which enters the field of perception of the viewer-listener, not the mapping itself. This poses a challenge to those artists integrating "interactive performance systems" on the stage (in the conventional sense of a space for performance separated from an audience). Some "hide" the interactive systems, placing the emphasis on what is visible; others prefer to expose their workings.

Many accounts of interactive systems shift the focus of discussion to those occasions in which the viewer becomes a player or participant, rather than questioning circumstances and issues surrounding the more traditional performer-audience separation. An alternative to this could be to reorient a set of questions toward the notion of the performer again, but in the condition of training, practice, or rehearsal rather than in performance.

In the interactive computer music improvisation duo *Interface*, Dan Trueman and Curtis Bahn, build their own technologically augmented stringed instruments that are "extended, surrounded, and obscured ... with a variety of technologies."¹⁶ These "composed instruments," combine idiosyncratic sensor designs with equally idiosyncratic speaker configurations that encourage the development of new playing techniques. Finding a way to practice these techniques outside of the live performance context has produced some innovative strategies. Trueman has developed a method for fine-tuning his playing through the recording of a reduced amount of gesture-derived data that can be played back as a trace of the live performance. He analyzes this "recorded sketch" for the types of adjustments that might be made to the interactive system. In his own words:

So, what I do is take these "recordings" of me playing the instrument and spend hours developing and refining mappings of the sensor data to audio (and video, to a lesser extent) signal processing and synthesis algorithms. This technique could be used in exactly the same manner with dancers, and could offer a better way for dancers/choreographers and composers/electronic musicians to collaborate, compose, and choreograph "offline." It can be so tedious to "mode switch" all the time between playing a mapping and actually composing the mapping. This way, you can sit down, look at the recording of the "performing body," and develop the instrument, away from the instrument.¹⁷

A similar fascination with the recording or tracking of movement can be traced to the "precursor to film" technologies of the late nineteenth century,

for example in the work of French physiologist and instrument inventor Étienne Jules-Marey. But the computer-based technology we commonly refer to today as motion capture has a briefer historical trajectory that is closely associated with the development of advanced computer graphics. In the early 1980s, the MIT Architecture Machine Group and the New York Institute of Technology Computer Graphics Lab experimented with an optical tracking system for human body.¹⁸ Toward the end of that decade, motion capture had evolved into a robust means for recording human (or animal) motion in a simulation of three-dimensional space and using this motion either for analysis (sports science/ergonomics) or to animate a variety of forms (film entertainment industry). With an obvious attraction to those working with movement as their material, several dance artists became involved in using these systems during the 1990s.¹⁹

Motion capture is a form of sampling, but computer animation is equally concerned with the synthesis of motion using a variety of computational approaches. For example, it has become increasingly possible to instruct animations to perform tasks, to develop behaviors, and to maneuver autonomously in differentiated environments. Computer scientists have developed a variety of classification systems for these approaches. Nadia and Daniel Thalmann (directors of MIRALab in Geneva) have developed a classification in three parts: (1) *locally controlled* motions driven by data via either motion capture or key frame animation; (2) *dynamic simulation* where motions are controlled using equations relating to forces, torques, and constraints; and (3) *behavioral animation* in which motions emerge within an environment in which all objects act in relation to other objects.²⁰ As these tools increasingly rely on dynamic and behavioral computation to generate motion, the role of the animator shifts toward defining the conditions within which these motions or gestures take place, the environments and the tasks involved.

Susan Amkraut and Michael Girard are software developers and multimedia artists who have had a significant impact on these developments in the field of computer animation through their exploration of human and animal figure animation when they were working with Ohio State University's Computer Graphics Research Group in the 1980s. They contributed to the development of the spline and inverse kinematics approaches and provided key input toward the development of dynamic simulation and behavioral animation. They are now developing software tools for commercial animators, most recently producing a software extension called Crowd, which integrates local

control (motion capture data) with dynamic simulation and behavioral animation.²¹ Crowd supports the organization of the behavior of large numbers of animated figures by drawing on some of the principles of bird flocking systems. Amkraut is credited with some of the early work in the mid- to late 1980s on flocking systems. Flocking systems use three simple rules: (1) separation: steer to avoid crowding local flockmates; (2) alignment: steer toward the average heading of local flockmates; and (3) cohesion: steer to move toward the average position of local flockmates.²²

Imagine you have motion captured someone jogging. Make twenty-five copies of this figure. Place these twenty-five figures in the space and give them the following instructions: keep running toward the center of the space and avoid collisions by turning right or left. From just these two simple rules complicated patterns of self-organizing movement emerge on the screen. With Crowd you can also define the terrain or the environment the figures are moving in. Although the rules are entirely deterministic, the emergent behavior appears to be undetermined, something one could not have predicted beforehand. In addition, this would be nearly an impossible task if we had to animate each of these figures individually.

Currently, the amount of time and effort it takes to learn to work with the software and render these complex animations effectively distances this as a creative activity from the choreographer who works with dancers in physical space. However, with eventual advances in computer hardware and software, nearly instantaneous processing should be possible as the gap between adjusting the parameters and rules and seeing the result becomes negligible. Combine this with software interfaces that are easier to use, and we may see the reconvergence of computers and dance in the practice of choreography echoing the creative possibilities A. Michael Noll and John Lansdown set out to explore in the 1960s.

Acknowledgments

Thank you to Susan Rethorst for editing assistance and to Dr. Söke Dinkla and Dr. Martina Leeker for permission to use an extract from the following essay:

S. deLahunta, "Periodic Convergences: Dance and Computers," in *Tanz und Neue Medien* (book and CD-ROM/DVD), ed. Dr. Söke Dinkla and Dr. Martina Leeker, pp. 66–84. Berlin: Alexander Verlag, 2002.

Notes

1. A. Michael Noll, "Human and Machine—A Subjective Comparison of Piet Mondrian's *Composition with Lines* 1917, and a Computer-generated Image," *Psychological Record* 16 (January 1966), 1–10.
2. This quote of A. Michael Noll's is available under the "computer art" heading at <http://www.citi.columbia.edu/amnoll/> (accessed April 5, 2002).
3. A. Michael Noll and Ann Hutchinson, "Choreography and Computers" and "A Reply," *Dance Magazine* (January 1967), 43–46, 81–82.
4. John Lansdown, "Artificial Creativity." A version of this paper was given at the Digital Creativity Conference, Brighton, April 1995; <http://www.cca.mdx.ac.uk/CEA/External/Staff96/John/artCreat.html> (accessed April 5, 2002).
5. Trisha Brown's dance making instructions can be found published in different locations, e.g.: *Locus* in *Contemporary Dance: An Anthology*, ed. Anne Livet (Abbeville Press, 1978), 54–55, and *Accumulation* in *The Drama Review: The Postmodern Dance Issue* 19, no. 1, (March 1975), 29.
6. E.g., in the interview of William Forsythe by Paul Kaiser in "Dance Geometry: William Forsythe in Dialogue with Paul Kaiser," *On Line: Performance Research* 4, no. 2 (summer 1999), 66–69, and in the interview of Dana Caspersen by Senta Driver in "It Starts from Any Point: Bill and the Frankfurt Ballet," *Choreography and Dance* 5, part 3 (2000), 24–39.
7. John Lansdown, "Computer-Generated Choreography Revisited," in *Proceedings of 4D Dynamics Conference*, ed. A. Robertson (De Montfort University, Leicester, 1995), 89–99. See <http://www.dmu.ac.uk/ln/4dd/guest-jl.html> (accessed April 5, 2002).
8. Noll, "Choreography and Computers," 44.
9. This issue was recently addressed at the *Software for Dancers* London-based research project taking place from September 24 to October 6, 2001, aimed to develop concepts for software rehearsal tools for dance makers. See <http://huizen.dds.nl/~sdela/sfd> (accessed April 5, 2002).
10. For an online historical account of the development of the "interactive performance system" see Söke Dinkla's seminal paper, "The History of the Interface in Interactive Art," presented at ISEA 1994, available at <http://www.isea.qc.ca/symposium/archives/isea94/pr208.html> (accessed April 5, 2002).
11. Interview of David Rokeby by Douglas Cooper, "Very Nervous System," *Wired* 3.03 (March 1995); <http://www.wired.com/wired/archive/3.03/rokeby.html> (accessed April 5, 2002).

12. More information is available from the following sites: Palindrome Inter-media performance group, <http://www.palindrome.de/>; STEIM: <http://www.steim.nl/> (accessed April 5, 2002).
13. Two examples of dance and electronic composers/digital artists developing wearable sensor systems for use in interactive spaces are Troika Ranch based in New York City and DIEM based in Aarhus, Denmark: <http://www.troikaranch.org> and <http://www.daimi.au.dk/~diem/digitaldance.html> (accessed April 5, 2002).
14. There are several options for software for mapping input to output, but Mark Coniglio's Isadora offers one of the best for the nonprogrammer to experiment with: <http://www.troikaranch.org/troikatronix/isadora.html> (accessed April 5, 2002).
15. The Wanderley/Ross PDF is available at http://www.ircam.fr/equipes/analyse-synthese/wanderle/Gestes/Externe/Hunt_Towards.pdf (accessed April 5, 2002).
16. More information about Interface can be found at <http://www.arts.rpi.edu/crb/interface/interface.htm> (accessed April 5, 2002).
17. From email correspondence between the author and Dan Trueman on March 10, 2002.
18. David J. Sturman, "A Brief History of Motion Capture for Computer Character Animation," SIGGRAPH 94: http://www.css.tayloru.edu/instrmat/graphics/hypgraph/animation/motion_capture/history1.htm (accessed April 5, 2002).
19. For a description of motion capture technologies and some work involving dance artists, see Scott deLahunta, "Coreografie in bit e byte: motion capture, animazione e software per la danza," in *La Scena Digitale: Nuovi media per la danza*, ed. Armando Menicacci and Emanuele Quinz (Venice: Marsilio Editori s.p.a., 2001), 83–100. An English version is available at <http://www.daimi.au.dk/~sdela/bolzano/> (accessed April 5, 2002).
20. N. Magnenat Thalmann and D. Thalmann, "Computer Animation," in *Handbook of Computer Science* (CRC Press, 1996), 1300–1318.
21. The *Crowd* extension comes with Character Studio, one of the 3D Studio Max animation software applications that is specifically designed to work with motion capture data.
22. Simple rules leading to complex results—emergent and unpredictable—is a conception underlying the computer-aided study of chaos and other complex systems. "Artificial Life" refers to the field of modeling and study of such systems using the computer.

'Isadora: an interview with artist/ programmer Mark Coniglio'

in *International Journal of Performance and Digital Media*. 1:1. 2005, pp. 31-46.

In July 2002, I initiated an email dialogue with close colleague and interactive media and performance artist Mark Coniglio about the unique software tool he had created. I had proposed this as an article for a book Johannes Birringer was planning to edit on interactivity to be published in Germany that September. That plan did not materialise, and I distributed the finished dialogue on-line in November 2002 to the Dance-Tech discussion list.¹

In early 2003, I was invited to join the Editorial Board of the *International Journal of Performance and Digital Media* and proposed this dialogue for the first issue. After peer review and final editing was complete it was published in the first issue of the journal.

The International Journal of Performance Arts and Digital Media is a forum to energise, innovative and inspire creative thinking and practice surrounding the combination of digital technologies with the performance arts (theatre, dance, music, live art).

Disciplines may be domain-specific or in convergence. Source:

<http://www.intellectbooks.co.uk/journals/> (accessed 7 May 2010).

¹ See: <http://www.scottsutherland.com/dancetechnology/archive/2002/0368.html> (accessed 7 May 2010). Also available in this pre-published version on the 'Software for Dancers' documentation site: <http://huizen.dds.nl/~sdela/sfd/isadora.html>. (accessed 7 May 2010).

Isadora 'almost out of beta': tracing the development of a new software tool for performing artists

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Abstract

Mark Coniglio is an artist who has recently programmed Isadora, a real-time software tool to support the creation of interactive live performance work for installation or stage. Programmed primarily to manipulate digital video, the Isadora software interface is designed to be easier to use than other similar real-time software tools. In dialogue with Scott deLahunta, Coniglio discusses his motivation and intention in developing Isadora, explores connections between his artistic and programming practice, talks about the use of the software in his own work with the performance company Troika Ranch and speculates on his role as author of the software in relation to those who use it to create their own work. This is followed by comments from some artists who have been using the Isadora software. The main aim of this dialogue is to provide an insight into the creation of software tools for artists to those who may be relatively new to this practice.

Keywords

dance
interactivity
real-time software
artist-programmer

Introduction

Real-time computer software tools designed to support the creation of interactive live performance work (either for installation or stage) and be useable by non-computer scientists have a history of being written by artists who were also programmers or were writing programmes in the context of arts organizations such as IRCAM (Institut de Recherche et Coordination Acoustique/Musique in Paris or STEIM (Studio for Electro-Instrumental Music) in Amsterdam. A few of these artist-programmers include David Rokeby who began to design his interactive Very Nervous System in the early 1980s, Miller Puckette who programmed Max in the late 1980s, Tom Demeyer who during his period at STEIM in the 1990s wrote the BigEye and lmag/ine software programmes, and the enigmatic Netochka Nezvanova who is credited with having created NATO.0+55 (2000).¹ The emergence of the Internet in the form of the World Wide Web in the early 1990s increased the dissemination of these software tools and now artists are customizing them to some degree, creating tools within tools, and sharing these developments with others. This short history, and in particular the list of artist-programmers, is by no means comprehensive, but is intended as a partial frame for the following dialogue with Mark Coniglio, an artist-programmer

1. Brief descriptions of some of the software referred to in the Introduction:

The Very Nervous System by David Rokeby is an interactive sound environment for which he has written the software SoftVNS which is a real-time video-processing and tracking software for use in the Max software environment.

Max is a screen-based patching language that could imitate the modalities of a patchable analogue synthesizer. Much of the early development of Max was aimed at

supporting music performance, but now is used in the support of real-time video manipulation.

BigEye is a computer program designed to take real-time video information and convert it into MIDI messages. *Imag/ine* is a program that allows a user to manipulate visual source material in a live performance environment in real time.

NATO.0+55 was built around comprised a set of QuickTime externals for the Max environment that could manipulate with any sort of QuickTime media (films, images, sound, QuickTime VR, QuickDraw 3D, Flash movies, etc.)

who has recently created the real-time software tool, *Isadora*. Some of above-mentioned software is referred to in the exchange below as *Isadora* has evolved from or alongside their development. The following exchange with Mark, conducted via e-mail in September 2002, is intended to provide an insight into the creation of real-time software tools to those who may be relatively new to this practice.

Biography/Background

Mark Coniglio is an artist who crosses the disciplines of music, dance, theatre and interactive media. Dubbed an 'interactive performance pioneer' by the *New York Times*, his work has been performed nationally and internationally primarily with Troika Ranch, a New York City-based performance company committed to creating multidisciplinary works of which he is co-director with choreographer Dawn Stoppiello. A native of Nebraska, Mark studied at the California Institute of the Arts (CalArts) with electronic music pioneer Morton Subotnick and received his degree in music composition in 1989. He was on the staff of the Center for Experiments in Art, Information and Technology at CalArts teaching courses in interactive music from 1990 to 1994. Troika Ranch was launched in 1993, while Stoppiello was still performing with Bella Lewitzky, and in 1994 they moved with the company to New York City. Besides the rehearsals, performances, symposia appearances and residencies that make up the bulk of their creative contribution to the field, Troika Ranch regularly conducts their popular Live Interactive (Live-I) workshops primarily in New York City. These give participants the opportunity to explore the use of interactive computer technology in the creation of live performance artworks. Participants also have a chance to learn to use the custom hardware and software Mark has created.

While the building of new interactive instruments or systems has a robust tradition within the electronic music field dating to the early twentieth century (e.g. the Theremin invented circa 1919), Mark is one of a handful of artists who have specialized in creating new interactive instruments or systems to monitor the movements of dancers and use this information to control other media events in real time. The *MidiDancer*, a wearable device Mark first built in 1989, measures the angular change at several joints on the dancer's body. This information is sent over a wireless link to a computer where the data (input) is used to control a variety of media events (output), e.g. sonic, video, lighting and/or robotic. Mark has written two software programs to map this data flow: *Interactor* and *Isadora*. *Interactor* was made available for others to use, however it required time to learn and learning was made easier with some knowledge of software like Max, a graphical programming environment for music and multimedia. Named after the renowned early twentieth-century modern-dance pioneer Isadora Duncan, *Isadora* was designed for use by a non-specialist after only the briefest of introductions, placing the control of the creative software tools in the hands of the dancers themselves. Another key development is that while *Interactor* was focused on handling MIDI (Musical Instrument Digital Interface) data - a communications protocol

established in 1983 that allows electronic musical instruments to interact with each other - Isadora, while it can also work with MIDI, is designed primarily for the manipulation of video.

(Following the dialogue with Mark is a selection of comments from some of the artists who have been working with Isadora and are familiar with the history and evolution of such software tools. This situates Mark's work in direct connection to a community of users of the software he has created. However, the reader will also find that they open up a range of topics and issues that will not be elaborated on here.)

Part 1: In dialogue with Mark Coniglio

Scott deLahunta:

You have been programming actually longer than you have been composing. So do you consider your programming a part of your artistic practice?

Mark Coniglio:

I definitely do, but it does feel a bit secondary to my composition and/or media art-making in that I see it as more of a 'support' activity. The software I program allows the creation of the artwork, whether sonic and/or visual in some combination with live performance, that I envision. I always seem to resort to musical metaphors for things like this. The artwork is like a musical composition; the software tools are like the instruments in the orchestra. If you can develop a more advanced instrument, you can create more advanced music. The French horn is a good example: early versions required removing a piece of tubing from the instrument and replacing it with another piece of a different length to change key. About 1815 the modern version of the instrument with valves was invented. This technological innovation meant that you could now include the horn in passages where there were rapid changes of key. This was immediately taken advantage of by composers, notably by Beethoven in his symphonies. The difference between Beethoven and me is that he was not driving the innovation directly. I am both artist and instrument inventor. My artistic ideas drive the development of software and hardware I need to realize them; while simultaneously the programming I do expands my world of expressive possibilities.

Scott deLahunta:

I understand the analogy with the French horn, but software 'instruments' are comprised of another type of material altogether. Instead of metals being forged into shapes; one could speak of algorithms, formal abstractions and language. As another way to relate programming and art-making, I am curious about the creative process of writing code compared to working with other materials. It seems that most programming is driven by the assumption that the software will have a purpose (more like the notion of the instrument). Once that purpose is understood and defined so there is a goal, only then does the programmer get down to the work of coding. If this is true then programming is a very different creative process than, say, how the choreographer might work with movement material.

Mark Coniglio:

When writing software it is useful to have a clear goal in mind, and this may not be true with other types of art-making, as you suggest. Having a goal

that is too specific can be detrimental to the process of making a dance, for instance, or composing music. I don't think I understood that early on, but over the last three or four years I found myself exploring much more organic, open-ended approaches to art-making. Being involved in dance in particular, which relies on improvisation as a primary source of generating material, has profoundly influenced my way of working. Now, my approach is a much more, 'try everything and follow your nose'. By this I mean, try not to preconceive as much, make lots of stuff and follow through with the material that seems interesting and let the material begin to tell you what it is about. Now, it's pretty difficult to program that way, a kind of 'goalless' coding. The architecture of the microprocessor, from which all programming languages derive, is actually antithetical to such behaviour. However, this 'follow your nose' approach has definitely influenced the way I program. I still have a goal, but I don't often plan out the algorithms. I simply write towards my goal, improvising my approach to solving the problem.

Scott deLahunta:

There is quite a big discussion about 'software as art' these days in Europe and I'm sure it's going on in North America as well. Besides its utility, its usefulness in helping to support your artworks, do you consider Isadora a work of art by itself?

Mark Coniglio:

In a word, I don't - not in and of itself anyway. It's bit like asking if the telephone system is a work of art. Does the creation of the technology to support that system display an incredibly high level of inventive thought and uber-craftsmanship? Definitely! I have the utmost respect for the creative people that designed and implemented such a robust, complicated, and reliable system. But that particular technology is dormant until you pick up the receiver, ring your lover, tell her that you no longer desire to see her, and a heated conversation ensues.

Scott deLahunta:

It seems to me that the telephone system is the collective result, over time, of a multiplicity of individuals and institutions labouring together, and it's difficult to locate individual contributions in that, or at least I don't use the telephone system and sense that I am in contact with one of its creators. But when someone opens up Isadora and begins to build a patch that will map an arm motion to the speed of a video clip, do they not encounter your presence directly, as the primary creator, in the look and feel of the interface?

Mark Coniglio:

Well, I guess the only way that I would consider Isadora to be an artwork is the personal stamp that I have on its design and functionality. To take that a bit further, in a broad sense I could say that I collaborate with each Isadora user as they use the program. Because I can't totally erase myself from the software I create, they have to embrace some of my predilections to make use of the program; which is what happens whenever you choose to collaborate with another artist. It's just a question of how apparent the influence of the software's creator is. That's where software designers and artists who make software may differ, I think. A typical software designer does everything he or she can to filter out their personality and create something that is useful in a general way.

Scott deLahunta:

Maybe we could say that the extent software like Isadora is an artwork is dependent on the degree to which the maker tries to remove him or herself from it? I suppose Isadora then is more of an artwork than say, Photoshop, but is maybe less of an artwork than something like Auto-Illustrator by Adrian Ward (which won the Software Art prize at the Berlin 2001 Transmediale Festival). Auto-Illustrator looks like a vector graphics program, but it doesn't act like one. It misbehaves frequently because it has seemingly autonomous behaviours built into it that take over for you. Adrian creates these behaviours using certain algorithms when he does the coding, so as such his authorship is revealed every time the software does something you did not expect it to, which is frequently.

But let's talk a little bit about the background of Isadora as a graphic programming environment for real-time manipulation of media. You made something similar with Interactor first didn't you?

Mark Coniglio:

Here's a bit of history. In 1986 my soon-to-be mentor and Interactor collaborator Mort Subotnick had just come from a residency at MIT where he was using a program called Hookup created by a student there named David Levitt. Hookup was the first program I know of that used the 'patch-cord' metaphor, i.e. modules that manipulate data are linked by virtual wires, the connection of which is determined by the user. For those in the world of early analogue, patch-cord programmed synthesizers, this was a familiar interface. Mort was using David's program to do tempo-following of MIDI instruments - this allowed him to lock hardware MIDI sequences to the tempo of the live performers. I was a composition student at CalArts at the time, and word had gotten around that I was a good programmer. So Mort contacted me to see if I could hardcode some of the ideas he had implemented in Hookup on a Mac, so that he could use them in his next performance. That program (used in Mort's 1987 multimedia work *Hungers*) would eventually become Interactor. Mort designed the functionality of the early versions, but I became more influential in the design as time went on.

Scott deLahunta:

I guess the hardware and software development of the early to mid 1980s where we saw the advent of the personal computer and more importantly the graphical user interface (marked by Apple's introduction of the Macintosh to the consumer market in 1984) created a context out of which the 'computer' could emerge as a creative instrument or tool. The electronic music field was already well advanced in analysing and exploring the formal and physical properties of music as part of compositional and performing practice, so moving to programming real-time graphic interfaces for this seems like a rather natural progression.

Mark Coniglio:

Yes, that's true and importantly a kind of creative intuition was creeping back in through the development of these new visual interface possibilities for software. Part of the thing I reacted to in Hookup was the way you could easily drop modules into the program and try things; a lot like you could do with the patch-cord synthesizers. I may not have realized it explicitly then, but this ability to program improvisationally allowed for that kind of artful

playfulness that is so important. So I set out to make a similar user interface for Interactor. The creation of Isadora was a natural outgrowth of Interactor. In 1996 Troika Ranch had a two-week residency at STEIM, where I first saw Tom Demeyer's real-time video processing program Image/ine. I first started using Image/ine in concert with Interactor, because Image/ine didn't allow the kind of complicated interactive decision-making that I was used to having in Interactor. So, Interactor would process the MIDI data from my interactive sensors, and then tell Image/ine what to do. By 1998 I was using Image/ine in a major way in my performances with Troika Ranch.

But, while I loved what Image/ine did, I wasn't fond of its table-based interface. And there were problems with crashing during performance, which is unacceptable when there is an audience. Furthermore, we were teaching our Live-I (Live-Interactive) workshops using Interactor and Image/ine, and the students (especially the ones with weak computer backgrounds) found learning both programs, and figuring out how to have them communicate with each other daunting at best. I wanted Isadora to take the qualities that made Interactor and Image/ine great, and put them together in one package that was easy to learn but still offered enough depth to satisfy 'power' users. And, I wanted it to be more affordable to members of my community, which I consider to be choreographers, because of my involvement with Troika Ranch.

Scott deLahunta:

How does Isadora compare to Max, which is probably the most successful and widely used graphic programming environment for controlling and mapping data flow?

Mark Coniglio:

Isadora and Max both inherit the modules linked by the patch-cord metaphor from Hookup. But unlike Max, each Isadora module shows the parameter names and current values for all of its inputs and outputs, and many modules give real-time graphic feedback about their operation. This is important from the perspective of helping new users understand what's going on right away. But perhaps the biggest difference is that Max is a very powerful, open-ended programming language in which you could solve any number of problems. Isadora isn't that. It is a lot like Interactor in that each module is essentially a macro that accomplishes some specific function. This approach helps people who are just beginning to do this kind of work, as it means that useful functionality is already embodied for you and it's very easy to start doing things and getting interesting results quickly (like with Image/ine). Max allows the most flexibility, but may be somewhat more difficult to program because more things have to be built up from scratch. Isadora offers somewhat less flexibility, but is still open-ended enough for the user to imprint his or her aesthetic on the result.

Scott deLahunta:

You have told me that your most important Isadora user is yourself. How do you use Isadora in Troika Ranch's performance work and in particular in connection with the MidiDancer which is the sensor system you built to get data input from a moving body.

an existing musical instrument's capabilities) or a few unique hand-orientated interfaces. But I've always thought that one would need to think quite differently to develop an appropriate system for a trained mover or dancer. I think more research is needed with various sensor input devices and maybe not always towards the aim of live stage performance, but maybe just experimenting much longer with what might emerge from the kind of feedback conditions for the senses interactive systems can generate.

Mark Coniglio:

That's why we'll be using a residency we have next year to make some changes to the MidiDancer. I want to start working with accelerometers in addition to the flexion sensors. The act of turning, or stopping suddenly, or shaking the whole body, now becomes something that can be measured. My instinct is that using this information to manipulate the media will be a more natural linkage between what the audience sees in the dancer and the resulting sonic or visual manipulation. I can then use the position of the limbs to allow the performer to enhance their level of control - but I suspect that being able to sense the impulse of movement may become the primary source of manipulation. I think that, not being a dancer or choreographer myself, I have been slow to let go of the notion of being a musician. In fact, I have often described the MidiDancer as allowing a dancer to be 'both musician and dancer'. I now think that is incorrect. I need a device that allows a dancer to be a dancer, with the media taking its cue from what it sees the dancer doing.

Scott deLahunta:

Isadora is just about finished with its public beta-testing phase during which I know you have been working with several artists who have been trying out the software for different projects and giving you feedback and suggestions for additional functions, etc. I have invited some input from some of these individuals [Part 2], but first I just wanted to ask you to say something about how long you have been working on Isadora and your decision to sell the software instead of using an open-source approach (in which software code is released for free into a collaborative development environment).

Mark Coniglio:

As I think I've indicated, Isadora has grown out of a need Troika Ranch had for a reliable relatively easy to use but also sophisticated software for both workshops as well as performance. The end result is that I have taken two plus years to develop Isadora in my spare time so it has grown quite organically. In regard to deciding to sell Isadora, I don't have much interest in starting a real business, so I am feeling out my progress quite slowly. But in the United States, arts funding is very difficult to come by, and discovering ways to supplement what we can get from the government or foundations is essential. I have always had to hold a day job, so I wanted to see if I could make a tool that would be: (1) useful to me; (2) useful to others; and (3) perhaps generate enough income to help me spend more of my time making my artwork. Obviously, an open-source model would not generate any income, and thus wouldn't help to support my artistic pursuits. As I have mentioned, it is important to me that Isadora is affordable to those in

the dance community, so I figure, for what the program does (and will do as it grows) the single licence fee is a reasonable amount. I have yet to make a final determination about site licences for schools etc, but they will definitely get a break if they purchase a five-seat licence for example. I have no idea at this point if this whole plan will work, or if the burden of supporting a growing user base will actually be more work than the day job, but I am hopeful.

Scott deLahunta:

Thanks Mark. Now, what I would like to do is to invite some comments from some of the artists who have been working with Isadora and are familiar with the history and evolution of artist software tools to reflect on some of our dialogue and to talk about how they use or could use Isadora in their work.

Part 2. Comments from Jean-Baptiste Barrière, Jern Finer, Armando Menicacci, Giorgio Olivero, and Steina Vasulka

Scott deLahunta:

The type of artist/toolmaker relationship Mort Subotnick and Mark had is an interesting one to trace back historically. Steina, you have been working as an artist and researcher in electronic media arts for over thirty years. Would you have something to say to this?

Steina Vasulka:

It is a big topic, but it would be interesting to investigate *all* artist/toolmaker relations in history: French horn, Stradivarius, the well-tempered clavier, the invention of photography, film, acrylics, video, etc. We (the Vasulkas) have almost always worked with toolmakers; analogue first, then digital and now software. On our website we have the 'Eigenwelt der Apparatewelt' exhibition catalogue (put together for the Ars Electronica Festival 1992) devoted to early audio and video toolmakers. There is a going model here: sometimes creators themselves, sometimes collaborators with artists, these toolmakers have invariably been gifted visionary individuals far removed from the industries who adapt to as well as inspire and invent within the technology environments of their time. In the early days of video, the buzzword was 'modification'; when one would go into these tools created for consumers and retrofit them for the artist. We also see developments and knowledge passed along from one tool generation to another; as Mark mentioned, the software packages of now are the synthesizers of recent past.

Jean-Baptiste Barrière:

I would just like to add here that there have been many graphical software tools created for music. One that could be mentioned, if only because of its complementary nature to more performance oriented languages, is Patchwork, which became more recently Open Music (both developed at IRCAM, Paris). It is a language based on Lisp, for computer-assisted composition, with a strong emphasis on musical notation representation. Incidentally, unlike most people think, the patch chord metaphor (first used in software by Max Mathews at Bell Labs) is not derived from analogue synthesizers. Quite the contrary: Robert Moog came to know the work of Mathews and then was inspired by it to design modular synthesizers. The

patch chord paradigm was applied to software from the experience of telephone switchboards.

Scott deLahunta:

Just for those who may not know, Max Mathews has been referred to as the 'father of computer music' who, in 1957, was the first to synthesize music on a computer; performing a 17-second piece on an IBM 704. In 1970, when fast digital chips and new algorithms made 'real time' possible Mathews developed Groove, the 'first computer system for live performance' (<http://www.csounds.com/mathews>). So, here we have the early research into systems out of which eventually software and hardware like Mark's Interactor and the MidiDancer would emerge.

Steina Vasulka:

A very interesting part of the dialogue was when Mark talks about the implications of this dancer interface, the MidiDancer; the attempt to have a dancer be a musical instrument player. When I was a kid, it was not presumed that dancers could act, that actors could sing, that singers could dance. Now they have to know it all. Interestingly, in talking about developing Isadora, Mark refers to wanting to make an interface that a choreographer or dancer can learn to use easily. The interface for Image/ine seems impossible for dancers and musicians to learn; whereas it is a piece of cake for video-makers who are perplexed by Max, etc. Another solution might be to think of multiple interfaces to a single program, like Final Cut Pro (otherwise not my favourite software), that makes the same features available in an 'effects' interface for film/video people and 'Photoshop-type' interface for computer artists.

Armando Menicacci:

Getting back to the points that Mark was making regarding the limitations of the MidiDancer for dance; what he says is very true, in my opinion. In fact, for a 'dancer to be a dancer' means not to have to show the control over media. I don't want to re-open the thread about 'Should we see the dancer's control over the media?' I think that Mark's comments are sufficient on this particular subject, to which I can add a brief comment. In my opinion, if what we want to do is 'pedagogy of interactivity' then we have to show the result of the interaction. But if what we want to do is art then we shouldn't care about the visibility of interaction, unless it is vital for a particular aesthetic project.

As regards my own use of Isadora: I am not sure, but maybe, if we don't consider Mark and Dawn's own work, I've been the first person to use Isadora in the context of a full-length dance performance on stage. We bought a copy of Isadora in the beginning of May; in my experience even the beta was very stable and we managed to use it in a way that was artistically successful. I was working with the choreographer Rachid Ouramdane in Rheims where we have a residency. We'll use it now in Dijon for the same work, titled '*+ ou - la*', and from 30 October to 4 November we show the same piece in the Grande Salle of the Centre Pompidou in the Festival d'Automne à Paris. What was interesting for Rachid, was to find particular inspiration for the choreography in the way in which Isadora transforms

digital video media. This is important to note ways in which emerging forms of composition/transformations in the digital medium can be translated to and used in mediums of the body; specifically dance. It broadens the idea of these softwares beyond just their specific functionality.

Scott deLahunta:

Giorgio and Jem, neither of you, as far as I am aware, come out of the contemporary dance field. Can you say something about your backgrounds and how you arrived at this point of working with Isadora?

Giorgio Olivero:

We (myself and Andrea Clemente) come from a background as web and graphic designers. In 2000, we started doing visuals for the club scene when we were students of the Scienze della Comunicazione faculty in Torino. We were very excited by the possibility offered by this evolution of clubbing, and we began experimenting with aesthetics and technology. We were ignorant of what was going on in other places like London, Berlin or Amsterdam, so we built up our knowledge from scratch, finding only later that similar stuff was happening elsewhere. At the beginning, we used mostly found video footage with short inserts of wild motion graphics. Now we produce (shoot, edit, and post-produce) nearly all the basic material that we use.

I had been looking at Max and NATO (a graphic programming environment similar to Max designed to handle Quicktime media) a lot in the last few months but the learning curve was so steep, I discovered Isadora by chance by following a link to the Troika Ranch website and downloaded the beta version. I learnt everything quickly (note that my previous experience with programming was self-taught action script - at a basic-medium level) and in three hours I had built a very complex patch that performed many different tasks. It's so different from the other application that we've been using. First of all you get a candy factory and not a candy packet. There are all the basic functions one could perform on digital video. And you have them in real time, which allows for much more improvisation. I can build and modify a patch as we play ... it's the Lego for video junkies, definitely. Our VJ'ing practice will shift with this tool, because now we do much less post-production and can use video that is more 'raw'. For example, in Isadora you can easily bring in live video input of clubbers dancing into the overall mix.

And we're producing a live audio-visual show that is the most interesting stuff we've been working on so far, and a shift from the work in the club environment. It's called *Città Invisibili*, and it's a multi-projection event that will be premiered at the beginning of October based on city shots taken in Tokyo, LA, London, Detroit and Barcelona. The concept is of the contemporary *flâneur* fused with the poetry of the city jungle. We're preparing many Isadora patches to play visual and audio in a very tight relation, and it will be the first time that we'll use the application without the backup of other programs. Perhaps if one is a very skilled programmer fluent with the Quicktime API (Application Program Interface) Isadora would not be so useful, but for the rest of us it is. I was a big player with Lego years ago, and I can't see the difference. I feel like I am playing while trying out things. And

after sessions of wild patch-cord dragging, I have run into consequences of a chained 'effect' that were not planned but are very interesting.

Jem Finer:

Ever since I first got hold of a computer, probably the Sinclair Spectrum in the early 1980s, I have been interested in programming them to make music. This interest continued and gained momentum to the point of my composing a 1000-year-long piece of music, *Longplayer*, in 1995. I spent a few years exploring numerous possibilities for composing such a piece: artificial life, AI, chaos theory, neural nets, interaction with the environment, etc. At first the problem was that I had no language to program in, but eventually I discovered SuperCollider, which I've used pretty much exclusively ever since (SuperCollider is an environment and programming language for real-time audio synthesis in which you can write programs to generate or process sound).

For the last two or three years I have wanted to create a visual counterpart to the music I make. My live performances are based on a symbiotic relationship between my computer, running a library of SuperCollider patches I've written, and me. The patches do various things to grabbed or streamed input and can run in parallel (up to the limit of the CPU). I want to be able to do the kind of things I do to audio to visuals, or at least to experiment with that approach. It may well be not so interesting as new things I discover. The problem has been finding an environment in which to do this. I tried Image/ine, but had difficulty with the interface, it wasn't intuitive enough for me (something Steina mentioned earlier). I tried Arkaos too (a VJ authoring tool); never tried NATO because I couldn't get a demo, and it was too expensive to buy on spec.

So when Isadora turned up it seemed an answer to a prayer. Intuitive, flexible, not too expensive and it produced good-quality images. Up to now I've had little time to explore it, but enough to know that it's worth an investment of time to get to grips with. I've just been writing simple patches to explore the objects and interaction between them. There are a few things I would like to be able to do that seem out of its range at the minute; one is to have a far greater interaction with sound. I want to be able to link things to precise frequencies, for example, which involves FFT (fast fourier transforms) stuff. The only way at the moment is to write this in SuperCollider and convert it to MIDI info to send to Isadora, which may be messy. I prefer to run just one thing if I can, but I have a feeling that I might need to use Jitter for some stuff. In that scenario I imagine using Isadora for any tasks not dependent on anything more complex than listening to sound in. It certainly requires less programming and the interface is simple and informative, really great. I love the simplicity of the stage set-up and the rendering possibilities.

Scott deLahunta:

One of my interests with writing up this discussion is to provide some insight for those who may be relatively new to software like Isadora; so I think what is important is to establish the range of different types of environments and contexts the software might be used in; from VJ'ing to installation and stage performances. However, I also don't want to misrepresent this field of possibilities by

implying that Isadora is the only or even the best programme available for everything; in fact, there are several cross-media synthesis programs that take advantage of the possibility to manipulate digital video material in real time. So, it's important that both Giorgio and Jem have mentioned other programs including the newly available Jitter, which has been created for the Max graphical programming environment. Another is Keystroke, which is a media-mixing multi-user environment and should be mentioned as it is another development of Image/ine and Tom Demeyer has been working with that team. There are links to these programs provided at the end of this article. It is beyond the scope of this conversation to delve too deeply into each one or to make any real comparisons. However, I think Jean-Baptiste Barrière may be able to offer some interesting thoughts on Isadora in relation to some of these other softwares.

Jean-Baptiste Barrière:

Well, I pretty much have them all and at least tried each extensively at some point. I consider them for their respective and different qualities and do not want to be restricted to using only one, whatever its capabilities. Until I discovered Isadora, I used Image/ine controlled by Max, starting from September 1997, for a still ongoing series of installations and performances called Reality Checks. I first used Isadora for an installation last year called *Chasing Wind: the Well of Vanities*, presented in the Abbaye of Maubuisson, an ancient convent 30 kilometres north-west of Paris. In this piece, people enter through one side of a large empty room. At the centre of this room is a sort of well where people can see their own image floating, mixed with other images. When they turn around they modify these images, as well as the sound in the room. Another image, much larger, is projected at the other end of the room on the wall. By moving about the space, people are triggering specific sequences of images and sounds, elements of texts (mostly extracted from the Ecclesiast in the Bible). Generally speaking, this is a very meditative installation piece, calling on the viewer to reflect on identity and death.

Technically speaking, first one computer is running Max with Cyclops, which is software that can detect people moving around by analysing the video image of the space. Then this information is transmitted by MIDI to another computer running Max to do the mapping between what is detected and what I call the 'interactive scenario': what is to happen for every 'situation' and succession of situations which I call 'trajectories'. This second computer controls with MIDI two others running Isadora; each one receiving the video input of a different camera: one for the well, the other for the wall. It also produces/synthesizes all the sound, and Isadora is used similarly to play previously prepared video materials (with Final Cut and After Effects), and process it together with live video capture, mostly doing keying and displace.

What I appreciate with Isadora is its clarity and straightforwardness. It is very easy to use, and all sorts of interactive ideas can be implemented with it, both very quickly and efficiently. It has been growing rapidly and intelligently from the original modularization of the Image/ine model, to become an original and unique tool. It obviously grows out of Mark's extensive dual

2. Aiming to expand critical awareness of software, a small number of cultural theorists have started to write about its development. Examples include: Ellen Ullman's *Close to the Machine: Technophilia and its Discontents*, San Francisco: City Lights Books, 1997; and Matthew Fuller's *Behind the Blip: Essays on the Culture of Software*. New York: Autonomedia, 2003 (see Fuller for references to other material).

complementary experience with music and dance composition needs. It has reached a kind of ideal balance between an application and a graphical language that is a very clear and easy one to master. Which makes a clear difference with Max for instance, and should provide it a distinct audience.

It has been a pleasure to watch it evolve and see Mark's responsiveness to users; at the moment he quite literally is collaborating with each user. I hope he will continue to be able to develop it in the same way that he has been doing until now; without losing track of his artistic projects since clearly one activity nourishes the other reciprocally. That may be difficult, while he stays the only developer or source of novelty. This is why I want to encourage him to open up the possibility for users to make their own modules and/or link external codes such as Photoshop's plug-ins or Director's xtras. Why not also have, for instance, Jitter's (Jitter is a customized set of Max objects that manipulate video media in real time) plug-ins inside of Isadora? This would be making the most of the two paradigms, would be equally profitable for Isadora and Jitter. This is the way in which I would like to see Isadora evolve: to continue to offer new ideas related to transformations, control and interface, and at the same time allow other artist programmers to insert/import specific code. This would be the most satisfying for users, and therefore help to provide a sustained development for Isadora.

Scott deLahunta:

I think this last comment will be challenging for our readers who are not so familiar with computer programming. However, it is essential to help develop the understanding amongst a broader public how a unique software like Isadora, the manifestation of Mark's creative vision and hard work, contributes to an open arena for artists to exchange ideas and materials that relate both to the tools they use as well as the artworks they will make with them. Thank you everyone, thank you, Mark for taking part in this conversation.

Part 3. Update and summary

The public beta of Isadora for the Apple Macintosh was first made available in March 2002 and the above e-mail exchanges took place in September of that same year. The software was officially released as 1.0 in December 2003, and a PC version is being developed. Over 300 copies have been distributed over the Internet, and Mark is currently the sole official provider of user support; backed up by an online e-mail list of over 200 members where problems and solutions are shared. Versions, releases and users are part of the normal cycle of software development; therefore, these statements about the progress of Isadora are almost universally familiar. However, most software production is notoriously untraceable in terms of its creators. The dialogue with Mark and the other artists indicates that when software, such as Max and Isadora, is created in artistic contexts its inventors tend to be acknowledged. This does not always take place without controversy, of course, but this historical trace of software authors seems to be less evident in other contexts, i.e. commercial, industrial, etc.²

By acknowledging the lineage of creative practice (of making software tools) he is a part of, Mark places himself in a context of evolving ideas and

concepts. At the same time, he is also the author of something original, most visibly the Isadora interface. His individuality, embedded in the software, makes him an implicit collaborator, in a broad sense, with those who are using it in their art-making practice. Jean-Baptiste Barrière also describes his connection to other Isadora users as one of collaboration in terms of direct support. While this interplay between evolution, authorship and collaboration underpins the development of Isadora, its functionality is the crucial component that changes, depending upon the needs of the artist/programmer. As a composer, a performance-maker and a teacher of workshops, Mark creates the software for his own use as well as developing it for other practitioners. In summary, while Mark understandably refers to his software programming as a support activity in relation to his art-making and does not consider Isadora a work of art itself, it seems that there is no single point at which his artistic work stops and his software programming begins.

Related Links

Further information regarding the software discussed throughout the article can be found at:

Arkaos:

<http://www.arkaos.net>

Auto-Illustrator (Adrian Ward):

<http://www.auto-illustrator.com>

Image/ine (Tom Demeyer):

<http://www.image-ine.org>

IRCAM, Paris:

<http://www.ircam.fr>

Isadora (TroikaTronix):

<http://www.troikatronix.com>

Keystroke (a real-time cross-media synthesis multi-user environment):

<http://www.keyworx.org>

Max and Jitter (Cycling 74):

<http://www.cycling74.com>

'Putting Max in Perspective' (published in *Computer Music Journal*, 1993):

<http://mitpress2.mit.edu/e-journals/Computer-Music-Journal/cmjlib/editors-notes/17-2.html>

'A Discussion of NATO.0+55+3d modular' by Jeremy Bernstein (first published August, 2000):

<http://www.bootsquad.com/nato>

SoftVNS (David Rokeby):

<http://www.interlog.com/~drokeby/softVNS.html>

STEIM, Amsterdam:

<http://www.steim.org>

Supercollider:

<http://www.audiosynth.com>

Troika Ranch

<http://www.troikaranch.org>

Interviewee details

Jean-Baptiste Barrière has made studies in the fields of music, philosophy and mathematical logic. From 1981 to 1998, he worked at IRCAM/Centre Georges Pompidou in Paris, France. Besides making his own compositions and media installation works, he has worked with other artists such as Maurice Benayoun (for whom he composed the music of several virtual-reality pieces including *Worldskin* which won the Prix Ars Electronica 1998 for Interactive Art) and Peter Greenaway. <http://www.barriere.org>

Jem Finer began playing music in the 1970s, having left university with a degree in Computer Science. In 1981, he became a founder member of the Pogues, writing, recording and touring for the following fifteen years. Recent work includes *Longplayer*, *TILT*, music for Copenhagen Town Square, various recordings for installations, films and television and *Autodestruct 1 & 2*, a live music performance. <http://www.longplayer.org> (*Longplayer*)

Armando Menicacci has a background in music and dance studies. He is the Director of Mediadanse, a research laboratory of Paris 8 University Dance Department, a member of ANOMOS and of the Rachid Ouramdane's dance company, Fin Novembre, and serves as a consultant for various art institutions and artists. <http://www.anomos.org>

Giorgio Olivero and Andrea Clemente (softly.kicking) have a background in web and graphic-design work. In 2000, they began doing real-time video performances in nightclubs and eventually won the VJ competition of the Arezzo Wave festival (the biggest free rock festival in Italy) in 2001. Their subsequent engagements included a residency with a large group of well-known Italian disc-jockeys; and playing at Fiesta des Sud in Marseille in October 2002. <http://www.softlykicking.com>

Steina Vasulka is a key figure in the field of 'video art' since its beginnings. With her husband Woody Vasulka, she has won numerous awards, and their collaborative works have been widely exhibited internationally. In 1971, they co-founded The Kitchen in New York City, the celebrated media arts theatre. Exhibitions of her individual work have been seen at festivals and institutions including the Centre Georges Pompidou, Paris; The Kitchen, New York; the Museum of Art, Carnegie Institute, Pittsburgh; and the Whitney Museum of American Art Biennial, among many others. Steina lives in Santa Fe, New Mexico. <http://www.artscilab.org>

Suggested citation

deLahunta, S. (2005), 'Isadora "almost out of beta": tracing the development of a new software tool for performing artists', *International Journal of Performance Arts and Digital Media* 1: 1, pp. 31–46. doi: 10.1386/padm.1.1.31/1

Contributor details

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'The Dimensions of Data Space'

in *Anomalie digital_arts* #3: *Interfaces:Theories & Applications*. ed. E. Quinz.
Paris: Anomalie. February 2003, pp. 72-79.

In January 2003, I received an invitation from Emanuele Quinz asking me to contribute to the third issue of *Anomalie_digital_arts*. He thought it would be a good context for the report of the December 2002 Monaco Dance Forum workshop 'Real Time and Networked: Sharing the Body' we had both been involved with. I also distributed this report to the dance-tech mailing list.¹

Anomalie digital-arts is a collectively produced bilingual English/ French annual publication. Each issue explores a different theme in the arena of the arts and the digital technologies, illustrating historical, technical and aesthetic developments..
Source: <http://www.editions-hyx.com/> (accessed 7 May 2010).

¹ <http://www.scottsutherland.com/dancetechnology/archive/2003/0064.html> (accessed 7 May 2010)

scott delahunta

the dimensions of data space

Introduction

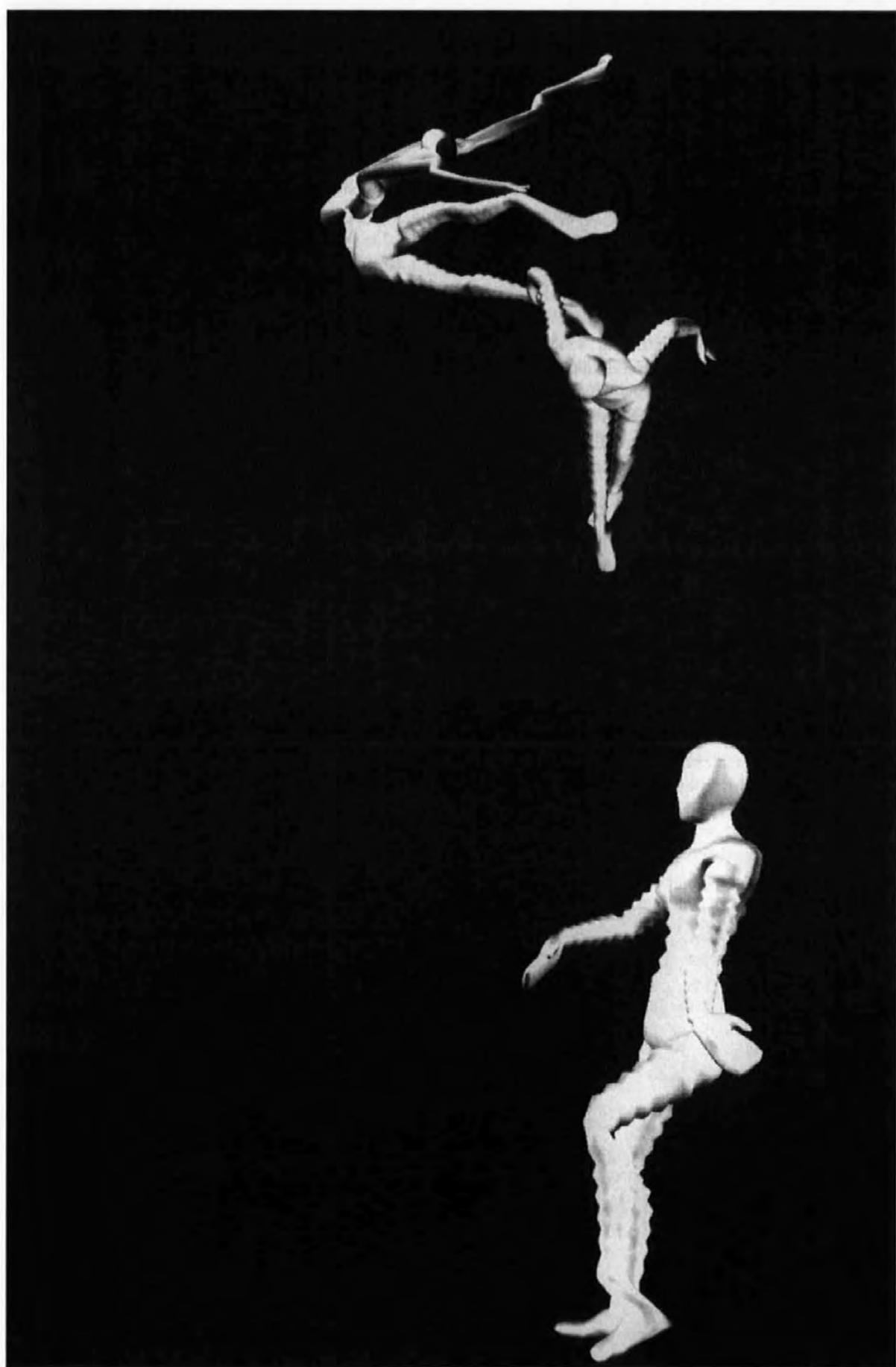
From 10-14 December 2002, the Monaco Dance Forum hosted the Motion Capture Tech Laboratory "Real Time and Networked: Sharing the Body"¹. The overall objective was to engage in an investigation led by artistic questions and processes into the use of real time and networked motion capture and computer animation systems². The core research team included dance and programming artists who are already working with these systems and have complimentary approaches. Two researchers documented the laboratory and facilitated reflection on its broader implications through interviews and group discussion. A commercial motion capture company provided systems and support and took part in all creative aspects of the laboratory. The motion capture systems used included two Gypsy exoskeletons, the Polhemus Startracker and the Motion Captor optical system³. The software was off the shelf programmes (e.g. Kaydara Filmbox) and customised code.

The research team comprised, in alphabetical order, Tania Barr (FR), Scott deLahunta (NL), Nik Haffner (DE), Maurice Kadaoui (FR), Bernd Lintermann (DE), John McCormick (AU), Thomas McManus (DE), Armando Menicacci (FR) and Emanuele Quinz (FR). Emmanuel Berriet (FR) and Mark Coniglio (USA) participated on a part-time basis. See Appendix for related URLs.

The team arrived on Sunday, 8 December to set up the spaces and continued this work on Monday⁴. Beginning Tuesday, the research laboratory was in operation from 10.00 to 18.00 hours daily. The space was generally open for those who wished to observe, and there was a formal open visiting period at the end of the day when the research team was available to provide demonstrations and explanations. The research laboratory concluded with a final fifty-minute presentation at 16.00 on Saturday 14 December to an audience of approximately sixty. This was followed by some further discussion and the formal close of the lab.

Personal Reflections

The following is a selection of three separate but related lines of thinking, inspired and progressed by the experience of the lab. The first attempts a description of motion capture systems in terms that are more cultural than technical. The second draws on the experience to make some observations on cross-disciplinary creative research processes. The third line of thinking seeks to make some relationships that might contribute to our understanding of working within computation systems. I have opted for the following self-imposed interrogative format as the best way to convey these lines of thinking that are currently incomplete and, like the research laboratory itself, exploratory.



Q & R #1:

Q: Why aren't you going to write about the technical systems? What if your readers don't understand what motion capture is?

R: I might have felt compelled to do this a few years ago, but I sense general knowledge of these systems amongst dance artists in particular has increased. There has also been growth in computing science and engineering research in the field of sampling, synthesizing and modelling motion in three dimensions. In addition, a number of small commercial initiatives (in different countries) seeking niche markets for customised motion capture solutions have emerged. The evidence for all of this seems easily available on-line, and I would like to encourage everyone to look on the Internet so that they see the contexts within which this knowledge is being developed.

What seems missing from the 90,000 plus pages that come up if you search on "motion capture" is any broad cultural analysis of this field. You do find some histories of the development of the technologies, but little else besides information related directly to building functional systems. I am speculating that this is partially because motion capture systems exist in a state of extreme instrumentality relative to the uses for which they are built. In other words, they are so tightly woven as systems to the purposes of either animation or motion analysis that they seem to be pure instruments or tools. Almost no one involved in the creation and use of motion capture systems deviates from these trajectories of purpose. If the system is not used "properly" it generates "useless" materials, and in the context of either motion analysis or animation this deviation away from utility would just be too costly in terms of both time and money. This means that it can be very difficult for artists to intervene in these systems somehow; to hack into them, twist, challenge and allow for, or cause, accidental forms to arise from them.

Q: Why, are you so concerned about motion capture systems being so purely instrumental? How would you apply this thinking to the work in the motion capture lab?



Workshop Sharing The Body, Dance: Nik Halfner, Thomas McManus. Motion Capture Systeme Animazoo. Photo: Bernd Lintermann.

R: One of the things at issue here is we need discourses that make distinctions between artistic, commercial and scientific research. They are not the same processes, and these days when we are being encouraged to collaborate across these sectors, more often, it is all the more important to develop an understanding of these differences. During the research laboratory in Monaco in more than one instance accidental data was being explored through, for example, the conscious occlusion of some of the reflectors for the optical system and the proposal to use an alternative calibration for the Gypsy. Thomas tried to 'outrun' the optical motion capture system one day to see if it could keep up with very fast movement. These are not trivial strategies; they underpin the types of investigatory processes that, in my opinion, we need to open space for in relation to motion capture systems. These are the conditions from which unexpected creative forms are going to emerge, and we were lucky to have the opportunity to explore this in the research lab.

Q & R #2:

Q: You have referred to the conditions of the laboratory as being very generative and stimulating. How would you describe this?

R: Well, it's crucial to remember that we were only together for a week and that as a group we were relatively new to each other. We needed to set up a good process for the exchange of ideas related to artistic practices. So, to begin with we did not pursue any single line of enquiry and had group discussions whenever they were necessary. These discussions tended not to determine work processes as much as respond to and guide them. This is important. It was conducive to an atmosphere of 'doing' and playfulness, trial and error, and a reliance on intuition. There were also many things happening simultaneously. So, the lab was more like a brainstorming session than following a predetermined set of designed or developmental procedures. This type of process stands in contrast to the instrumentality of these motion capture systems that I already mentioned.

It is important to note that the conditions included a primarily implicit commitment to open processes. We all know that the idea of an open (knowledge development) process has implications for intellectual property issues, in particular in the commercial and scientific marketplace, but we maintained this tacit contract between us to be as non-proprietary as possible. And this was not only amongst us, but also with all those who came to observe. It might be wise to underpin any future stages of research and development work by being more explicit on this topic; but at such a preliminary / exploratory stage it is, in my opinion, okay and maybe even better to operate in good faith.

Q: Didn't you work under the understanding that you didn't have to have an "end product"?

R: Yes, it was made clear at the start that we were not aiming for any particular "end

product". This didn't mean we would have nothing to show as the results of our research. We had plenty of things to show and discuss both during and at the end; but it helped to establish the ground from which a variety of ideas could be explored with an eye to the range of possible "end products", for example, various art works, software solutions, compositional strategies, etc.

Q: Isn't deferral the danger of such an approach? It seems you could just end up with a series of endless demonstrations of things that have potential but are not finished.

R: You are right to mention this. Heidi Gilpin and Lorne Falk in their 1995 article "Demo Aesthetics" have written an interesting critical piece on the implications of the emphasis on description and demonstration that seems to permeate a lot of artworks using new technologies.¹ They write about an aesthetics that "invokes a work of representation that is unfinished" or that is in a state of endless reformulation. They situate this in the current techno-cultural climate as a tendency to reconfigure the prototype as a product, which makes it commodifiable as such. So, it is something to be aware of.

What is required in the context of experimentation in the performing arts field, in my opinion, is something in between this pressure on the one side to prove how technologies either succeed or fail in the context of the stage performance (as an end product) and, on the other side, the value of working processes that develop a clear understanding of the terms and context of artistic research in relation to other practices that are foregrounding innovation. Both situations can end up either generating or squashing new forms of expression and ways of thinking: so it's not an either / or situation. But one thing is abundantly clear to me after observing many projects involving complicated digital technologies and live performance making. They really benefit from a generous amount of development time and being able to proceed in clear stages or phases. Each phase contains an evaluation of its own outcomes and this helps to determine the direction(s) for the next, sort of a recursive process you might say. With this in mind, I would characterize our motion capture lab in Monaco as a "preliminary research phase" that resulted in successfully establishing effective social relations and working vocabularies from which to depart.

Q & R #3:

Q: Why did you title this report "dimensions of data space"?

R: One of the major lines of inquiry during the lab was the question of "what are the properties of these motion capture systems?" In seeking to learn more about these properties we decided to spend as much time as possible just being in the systems – so that we had a constant physical experience of the dimensions of real space in relation to the dimensions of the data space. But how can we think about the dimensions of data space? One place to start is the concept of 'calibration'. Motion capture is essentially a measuring instrument and like all measuring instruments it requires calibration to align its

internal units to the real world units. Calibration manifests a level of description within which other descriptions have meaning, and all motion capture systems, optical, magnetic and exoskeletons involve different procedures for it. For instance, calibration of the gypsy aligns the exoskeleton with the body that wears it; so the dimensions of data space lie very close to the mover. Without this level of description the system has no context to recognise the data being generated by the mover.

I think this is one of the keys to developing a better understanding of the relation between physical and computation spaces, the relation between real bodies and data bodies if you will. It is partly down to the organisation of levels of description that can be understood by the mover and the information system and can travel in both directions in and out⁶. Dance practitioners in general have difficulty with imagining the dimensions of data space in any tangible and therefore potentially creative way. What underlies this is the lack of an adequate set of formalisms for describing gesture and movement in terms that not only the system can interpret, but are equally accessible to choreographers. Motion capture is an interesting technology, but uses descriptions of motion based in mathematics and invented by computer scientists and engineers, physicists, bio-mechanists and human figure animators. There is probably no need to invent new mathematical descriptions based on the needs of choreographers; but to use what exists in new and innovative combinations that can be integrated with the working processes of dance makers. This is what I meant by levels of description that can travel in both directions in and out of the system.

This is not so much a matter of teaching choreographers to be mathematicians, but in developing an understanding of a range of co-meaningful representations, classifications, algorithms, notations and codes. My feeling, affirmed by the experience of the research lab and by some promising initiatives taking place, is that we are on the cusp of seeing a shift in this area⁷. If we can encourage and support growing awareness and understanding of the properties of motion capture and other information systems amongst choreographers and dancers. This should stimulate imaginations and may quicken the emergence of these generative shared descriptions.

notes

1. Taking place for the second time (1st edition 2000) at the Grimaldi Forum in Monaco, the Monaco Dance Forum 2002 was a five-day international gathering comprising a diverse range of events including performances, exhibitions, symposia, multimedia installations, showcases and the International Dance Screen competition. <http://www.mddf.com>

2. Since the early to mid 1990s, dancers, choreographers, multimedia artists and software programmers have been collaborating in exploring the uses of motion capture technologies in artistic projects; establishing precedents for the exchange of creative ideas and practice from which current and future arts researchers can depart. For some historical information and references to some of these artworks; please refer to: "Choreographing in Bits and Bytes", January 2000 <http://www.daimi.au.dk/~sdela/bolzano/>. (Also published in *La scena digitale*, A. Menicacci and E.

QUINZ, eds. Venezia Marsilio, 2001) and *Virtual Dance: a report on the Riverbed residency* <http://www.dartington.ac.uk/staff/sdelahunta/uci/rivrep.html> (University of California, Irvine, May 2001). To read about a similar project that took place in held in Athens May 2001 see the TRANSDANCE report: <http://huizen.dds.nl/~sdela/transdance/report/>

In addition, dance education institutions have begun to invest in experimentation with motion capture systems, e.g. the Environments Lab at Ohio State University <http://www.dance.ohio-state.edu/workshops/mocap.html>

3. URLs for these systems include: Metamotion (Gypsy) <http://www.metamotion.com>; STT (Motion Captor) <http://www.simtechniques.com>; Polhemus (Startracker) <http://www.polhemus.com/>; Also see Animazoo sites for sales/ services: <http://www.animazoo-europe.com> and <http://www.animazoo.com/>

4. The list below provides a general description of the technical requirements for the laboratory: Sufficient space and type of floor for movement work / Tool Kit: screwdrivers, pliers, gaffer tape, etc. / Adaptors (various), routers, hubs, splitters, etc. / Cables (video, ethernet and power) / Tables, Stands, Chairs, etc. / Broadband Internet connection / Lighting system (simple but controllable) / Sound system to include wireless microphones, amplifiers, speakers, etc. / Blank recording media (dvd, cd rom, dv tape, etc.) / PCs and Macs (portables and desktops/ workstations and servers) with sufficient processor speed, RAM, graphics cards, hard disk space, i/o ports, cd and dvd burners, etc. / Software (2-d and 3-d computer graphic software, audio/ video editing, etc.) / Digital cameras (still and video) and tripods / Data projectors and screens / Wireless devices: transmitters/ receivers, etc. / 3-D Motion Capture Systems (optical, magnetic and exoskeleton) / Misc. input/ control devices, e.g. midi-keyboard/ slider; data glove, joystick, etc.

5. L. FALK, H. GILPIN, *Demo Aesthetics*, in "Convergence: the journal of research into new media technologies", 1:2, Autumn 1995, pp. 127-139.

6. For a relevant discussion on "descriptions of culture" in relation to digitisation see: D. GARCIA et al., *Content Integrated Research*, in "Creative User Systems. Executive Summary of the Third Annual Report" for the period December 2000 - September 2001, ESPRIT Working Group 29549. <http://www.circusweb.org/>

7. For some of these initiatives see Motion-e at the Institute for Studies in the Arts, Arizona State University (http://isa.asu.edu/projects_motion.html) and 3d-traces: an interface for choreographers project being developed by partners in the UK, Germany, France, Australia and Netherlands (<http://huizen.dds.nl/~sdela/3dt>).

Related URLs:

_ Tania Barr and Maurice Kadaoui. Directors and owners of Animazoo Europe based in France. <http://www.animazoo-europe.com>, <http://www.animazoo.com>, <http://www.metamotion.com>

_ Mark Coniglio. New York City based composer, programmer and performance maker. Co-director of Troika Ranch. <http://www.troikaranch.org>, <http://www.troikatronix.com>

_ Scott deLahunta. Researcher (Dartington College of Arts, UK) and Writer based in Netherlands. <http://huizen.dds.nl/~sdela>

_ Nik Haffner and Thomas McManus. Former dancers with Ballet Frankfurt; now independent dancers and choreographers and both members of the group "commerce".

_ Bernd Lintermann. Artist programmer currently artist and scientist in residence at ZKM, Karlsruhe, DE. <http://i31www.ira.uka.de/~linter/>

_ Maa (Emmanuel Berriet). Software explorer and president of La Graine/ The Seed. <http://www.lagraine.com>

_ John McCormick. Co-artistic director of "Company in Space" and artist in residence at RMITs interactive information institute. <http://www.companyinspace.com/>

_ Armando Menicacci and Emanuele Quinz. Lecturers, writers/ editors, researchers both working at the Paris VIII University Dance Department and with Anomos. <http://www.anomos.org>

Acknowledgements: We would like to thank the Monaco Dance Forum in particular Philippe Baudelot, producer of the multimedia projects, and the technical support team lead by Nick van der Heyden.



Workshop *Sharing The Body, Dance*: Nik Halfner, Thomas McManus. Motion Capture Systeme Animazoo. Photo: Bernd Lintermann.

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'Sightseeing on digital pathways'

in Pulse: South Asian Dance in the UK. Spring 2003, pp. 6-9.

In March 2003, I received an invitation from Pulse editor Chitra Sundaram to write an article on the basis of a presentation she had seen me give two years earlier on 'Digital Dance' at the Nehru Centre in London. She asked for "a factual recount of projects and researches, worldwide complete with opportunities for dancers, websites the works".¹ Pulse focuses on South Asian Dance in the UK and she was particularly keen that I shape the article to reflect this.

PULSE is the only magazine of its kind for South Asian Dance in the UK and internationally. The magazine is a rich source of information, opinion and insight; a vital point of contact and networking; an acknowledged reviewer of performance and a generator of debate. Source: <http://www.kadam.org.uk/pulse.php> (accessed 7 May 2010).

¹ Email to the author, 19 Mar 2003.

Sight and Sound: Following digital pathways



Scott deLahunta takes you on an expert trip through the history and dance spots of New Technology

A growing number of dance artists have been exploring the integration of 'new technologies' into their work in the last decade.¹ These explorations have produced a variety of new art works and processes, though not always as final performances for the stage. They have generated a vigorous arena for collaboration between artists and technologists and influenced both practice and theory in the performing arts. Both, the forms of collaboration and the variety of work that has emerged from them are briefly surveyed below and footnoted with references to websites for those who would like to know more.

Meeting Points (exchanging practices)

Inspired by the seemingly multifaceted potential of new technologies, dance and live performance artists have sought to collaborate with digital media artists and software programmers to explore the transformation of artistic materials, changing perceptions of the body, and new forms of mediation for and presentation to an audience. Often these collaborative relationships between artists and technologists have been initiated and sustained through short, intensive 'laboratories' or workshops.² Because these collaborative exchanges have formed the foundation from which new ideas, processes and artworks have emerged, recognising this is key to how we see the developments in the field.

The *Shadow Project*, organised in Jackson Hole, Wyoming in 1991 by Thecla Schiphorst, a choreographer and computer systems designer, and John Crawford, a theatre director and software programmer, was one of the first such creative workshops to bring dancers and choreographers together with computer programmers and electronic composers. This was followed by a series of similar North American workshops ending in 1995. In the UK, television director/producer and multimedia

designer Terry Braun, and the interactive media company Illuminations Interactive, produced the *Digital Dancing* workshops in London annually from 1994 through 1998. Several such events have taken place, with somewhat less regularity, ranging in location from Phoenix, Arizona in the US to Bergen, Norway and Athens, Greece.³

LifeForms (a critique)

Thecla Schiphorst was also a member of the original design team for LifeForms, a computer graphics software for animating a human figure in 3-D. In 1989, she began to tutor the celebrated American choreographer, Merce Cunningham, in the use of LifeForms.⁴ Cunningham had been interested in the possibility of using the computer as both a memory device and a creative tool for 'discovery' since the 1960s, as part of the extension of his exploration of how movement appeared to the camera via video and film.

LifeForms uses a fully articulated human figure that can be manipulated into any shape. Different shapes can then be arranged in a sequence along a timeline (similar to the traditional animation technique of 'key framing'). Following this, the computer software and hardware is able to generate the movement pathways between each (different) shape in the sequence on the timeline. It is thus possible to build highly detailed, realistic and complex movement phrases involving multiple figures. In 1991, Cunningham created a live dance work, *Trackers*, for which one third of the movement came from LifeForms.⁵ He continues today, in his 80s to create dances devised, to varying degrees, with LifeForms.

With this stamp of approval from such an influential dance maker and dance thinker, LifeForms gained a degree of popularity, as the software choreographers would be likely to use in making dances. However, constructing com-

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plex and realistic movement phrases in LifeForms takes a great deal of time, and the software is biased towards certain types of dance material, e.g. material which relies on a high degree of articulation in the joints. Perhaps because of his analytical approach to movement and particular dance technique or style, Cunningham has found the LifeForms software a useful creative tool. However, this has not necessarily been the case for other choreographers, and there seem to be relatively few who use it in the way Cunningham does.⁸

Topologies (complex data spaces)

Merce Cunningham continued to explore new ways of seeing and making dance using new technologies, this time in collaboration with New York City based multimedia artists Paul Kaiser and Shelley Eshkar. In 1998, they made a work entitled *Hand Drawn Spaces*, an installation based on visual material gathered using 3-D Motion Capture technologies.⁷ These are able to record the movements of a dancer in three dimensions by using reflective markers placed on several strategic positions on the body. Cameras arranged around the space in 360 degrees pick up the position and orientation of each marker in Cartesian (x, y and z or 3-D) space and send this data to the computer.

One would think 3-D Motion Capture would be an ideal technology for the choreographer – a system that records every movement accurately in three dimensions for playback on the computer screen, easier than building motion from scratch using LifeForms and better than video that leaves a movement locked up in two dimensions. But motion capture systems are technically extremely complex and require specialists skilled in a range of hardware and software knowledge. This means that access to these systems can be limited. Currently, they also require the wearing of special markers or sensors which, built as they are to serve the purposes of the entertainment, engineering and medical industries, are not designed with the specific needs of the dance maker in mind. Despite these limitations of motion capture systems, since the mid-1990s, a handful of persistent choreographers, in addition to Cunningham, have explored their artistic potential and set a number of important precedents.⁸ It seems inevitable that developments will continue, as evidenced by an increasing number of dance organisations (mostly in the USA and UK so far) able to invest in 3-D motion capture systems.⁹

Combining 3-D motion capture, computer gaming environments and choreography, *Topologies L'Instant* (2002) is a fascinating installation work by French choreographers Norbert and Nicole Corsino. In the piece, the viewer/participant navigates freely throughout the five levels of a 3-D computer graphics environment using a standard handheld game controller to accelerate forward or backwards and turn left or

right. The space is comprised of largely flat landscapes, desert-like, where one encounters surreal sculptured video walls, modernist semi-transparent multi-level buildings and strange empty structures. Scattered amongst these are dancing figures animated by movement sequences recorded using 3-D motion capture. One can approach these figures from any direction and pause or slow their movement down. This world is there to explore in one's own time from any perspective. It is a significant achievement and a sign of things to come.¹⁰

Isadora (with dancers in mind)

While 3-D motion capture systems are still out of reach for the majority of dance artists, today the standard, off-the-shelf, portable notebook computer is powerful enough to sample and synthesize 2-D video, sound, graphics and text in real time. In addition, a number of motion tracking or monitoring devices are available that can be connected to this personal computer, making it possible for movement to trigger/control a range of visual, lighting, sonic and/or robotic effects in the space. Much of the software to make this happen can be downloaded easily from the Internet, and this collection of digital tools is being used in a wide range of creative work under the heading of, what some refer to as, the emergent form of 'interactive art'.¹¹

There are several artists working with these increasingly accessible technologies who consider the domain of their interactive art to be the stage and, their main 'interactors', their dancers. Few have worked for a longer period with more dedication and commitment than Troika Ranch, a multidisciplinary performance company founded in 1993 with its current base in New York City. The co-directors of the company are choreographer Dawn Coniglio and composer/artist programmer Mark Coniglio who has written much of the software code that supports their work. Some years ago, Mark began to develop a program that would combine the functionality of different software he was using in their work and be simple enough for the non-programmer to work with creatively after only the briefest of introductions. The result is his new software program, *Isadora* (after the modern dance pioneer). While it was made and priced with the dance maker in mind, *Isadora* is so well-

Troika Ranch, 'Future of Memory' performer Sandra Tilletand



PULSE SUMMER 2003



Logo: Ballet
Photos: Ravi Desprez



designed and multifunctional that it is used by many artists working in interactive installation and performance, sound art, mixed media and club culture.⁶ A trial version of *Isadora* can be downloaded from the Troika website.⁷

Alpha (dance via the net)

In 1991, computer scientist and system designer Timothy Berners-Lee invented the underlying structures for the network of hyperlinked multimedia documents that we know as the 'world wide web' and 'websites'.⁸ The Internet itself had existed for many years, but after 1991 and in particular since about 1994, there has been an explosion of artistic activity taking advantage of this new platform for multimedia creative expression. Several choreographers and performance makers joined this wave of artists exploring the 'telematic' spaces of the network, engaging on-line audiences and building relationships with venues around the world to produce perform-

ances in separate locations at the same time.⁹ Other choreographers have used the Internet as a means of gathering performance material or delivering dance education at a distance.¹⁰

One recent use of the Internet for dance education purposes was an initiative of Random Dance Company and choreographer Wayne McGregor.¹¹ In March 2003 Random premiered *Alpha*, a new work for children ages 8 to 11 that is touring venues throughout the UK. With substantial support from NESTA (the National Endowment for Science, Technology and the Arts), Random Education Officer, Jasmine Fitter, and her team developed a unique supporting programme that used the Internet to offer teachers and pupils an alternative way to access the company in rehearsals and performance. Throughout February and March 2003, twenty-five schools in the UK took part in twice-weekly web-cast classes where participants' choreographic skills were developed and they were able

Notes (all URLs accessed 4 May 2003)

1. New technologies generally refer to those information and communication technologies that are dependent upon the development of the modern digital computer and include software and hardware.

2. To keep abreast of workshop activities in the UK and abroad, join the dance-tech email list via <http://art.net/~dtz/maillist.html> and the Digital Arts Network via <http://www.digitalartsnetwork.org/>. Keep an eye on the Dance and Technology initiative of Essex Dance, the regional arm of the Arts Council of England on <http://www.dancetech.co.uk/> and the Future Physical website, <http://www.futurephysical.org>.

3. For example: Cellbytes 2000, Phoenix, AZ (<http://isa.hc.asu.edu/cellbytes/>); Hot Wired Live

Art, Bergen, NO (<http://www.notamo2.no/motherboard/hwla/hwla.html>); Transdance, Athens, GR (<http://huizen.dds.nl/~sdela/transdance/report>)

4. For Merce Cunningham on Life Forms, see http://www.merce.org/technology_lifeforms.html; Life Forms demo software is available on <http://www.lifeforms.com/>.

5. For more information on Trackers see: Thecla Schiphorst, 'Merce Cunningham: Cyber Dances with Life Forms', circa 1992 (<http://www-personal.umich.edu/~marchant/XPoseDance/Thecla%20Folder/thecla.html>).

6. There are some, such as London-based choreographer Sue MacLennan, who create dances in Life Forms that are never intended as material for performance, but are meant to be viewed on the screen. Another London-based choreographer, Wayne McGregor, has in the

past used Poser, also a human figure animation program (<http://www.curiouslabs.com/>), more extensively for creative inspiration. One can often find Life Forms listed in the curricula of dance education programmes, and researchers in North America are working on a link between Labanotation software and Life Forms.

7. Paul Kaiser's website is rich with information about their motion capture/animation projects with Bill T. Jones and Merce Cunningham (<http://www.kaiserworks.com/>).

8. For references to some of these works see: 'Choreographing in Bits and Bytes', published in *La scena digitale*, A.MENICACCI, E.QUINZ (eds.), Venezia Marsilio 2001 (<http://www.daimi.au.dk/~sdela/bolzano/>).

9. For example, the dance departments of the University of California Irvine (<http://dance.arts.uci.edu/>) and Ohio State



to watch the creation of *Alpha*.¹⁰

Random has also developed an *Alpha* website to provide additional support and background information between web casts.¹¹ The partnership of Random and NESTA in the use of the Internet is a potent one. Of all the contemporary dance companies in the UK, Random has one of the strongest reputations for working with young people and using technologies as a way to inspire them to be interested in dance. *Alpha* is a fine example of how a well-conceived and generously supported project can combine dance and technology in effective and productive ways.

Thinking Forward

The examples I have given above for the relation between dance and new technology have focussed less on the technology, and more on the human relations and exchanges that underpin this connection. It is here that meaningful developments will take place; in particular

where practitioners from different disciplines and domains find ways of working creatively and productively together. The results may or may not appear to involve new technology (chances are they will, you just may not see it) or even dance for that matter, but in the end perhaps this should not be the criterion by which they are deemed important.

If efforts such as these are supported and nurtured, then the future should be an exciting one in which different software is developed to help in creating dances (not only *LifeForms*) and easy to use digital performance tools continue to evolve. Choreographers' imaginations will soar with the possibilities inherent in three-dimensional digital spaces; educating via computer and communications networks, dance will further flourish, stimulating people of different ages and backgrounds to appreciate, in all of its increasingly hybrid cultural forms, the art of the moving body.

University (<http://www.dance.ohio-state.edu/>). In the UK, Essex Dance (<http://www.dancetech.co.uk/>) has recently invested in a Motion Capture system custom built for them by Hypervision (<http://www.hypervision.co.uk/>).

10. N&N Corsino have done some of their past research in association with CICV (Centre International de Création Vidéo - <http://www.cicv.fr/>). For more information about the Corsinos' work search via Google (<http://www.google.com/>).

11. For a brief, but useful history of interactive art see Söke Dinkla's 1994 article on-line on http://www.kenfeingold.com/dinkla_history.html; Visit the site of David Rokeby's "Very Nervous System", a popular video motion tracking software (<http://www.interlog.com/~drokeby/vns.html>); Max/MSP is another popular software for use in interactive art making

(<http://www.cycling74.com/>).

12. For a longer on-line article about *Isadora* with input from some of the artists using the software see <http://huizen.dds.nl/~sdela/sfd/isadora.html>.

13. Download a trial version of *Isadora* from <http://www.troikatronix.com/>; Troika Ranch's website is <http://www.troikaranch.org/>.

14. For a short on-line history of the web by Berners-Lee visit <http://www.w3.org/People/Berners-Lee/ShortHistory.html>.

15. British artist and theorist Roy Ascott is often credited with having coined the term 'telematic art' in the 1980s. See his new book *Telematic Embrace: visionary theories of art, technology and consciousness*, University of California Press, 2003.

16. For some examples of 'telematic' performance and other uses of the Internet by dance artists see: World Wide Simultaneous Dance (<http://www.wwsd.org/>); Maggie's Love Bytes (<http://www.notamoz.no/~amandajs/>); Webbed Feats (<http://www.webbedfeats.org/>); and the Hands-On Dance Project (http://www.satorimedia.com/hands_on/).

17. Random has conducted several projects involving a range of technologies; for more information about these and ALPHA visit their site at <http://www.randomdance.org>.

18. For NESTA's vision and perspective on the project: <http://www.nesta.org.uk/mediaroom/newsreleases/3364/>.

19. The ALPHA website is <http://www.alphadance.org>.

'Choreography and Cognition: A joint research project'

in Art and Science: Proceedings of the XVIII Congress of the International Association of Empirical Aesthetics. eds. J. P. Fróis, P. Andrade & J. F. Marques. Lisbon: IAEA2004. 2004, pp. 169-173.

In February 2004, I received the invitation "to submit a four-page paper" for the proceedings of the Empirical Aesthetics Conference from Sydney-based cognitive psychologist Kate Stevens who had convened and invited me to participate in the symposium "Choreographic Cognition" to be held at the Conference in Lisbon Sept 13-16, 2004.¹ The panel provided a first opportunity to interact with the significant body of research work Stevens and her colleagues had been conducting in Australia titled 'Unspoken Knowledges' on topics very similar to mine.²

¹ Email to the author, 25 Feb 2004

² Documentation site: <http://www.ausdance.org.au/unspoken/background.html> (accessed 7 May 2010).

CHOREOGRAPHY AND COGNITION: A JOINT RESEARCH PROJECT

DELAHUNTA, Scott

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Introduction

The Choreography and Cognition project began a few years ago as a discussion between London-based choreographer Wayne McGregor (director of Random Dance) and myself about finding new ways of understanding the choreographic process that might lead to alternative creative and collaborative approaches to making dances. Starting from a mutual interest in artificial intelligence, our discussion eventually led us to develop a project for exploring potential insights into the choreographic process that might emerge from the interdisciplinary research context of cognitive science. For Phase One, we organised a series of meetings in November 2002 with cognitive scientists in the United Kingdom and France. Positive reactions to these inspired us to continue with another set of exchanges, and we were able to secure funds from a new arts and science research scheme that enabled us to continue working with five of the individuals from our original series of meetings. (1) In addition, we invited James Leach, a social anthropologist doing fieldwork on creativity and knowledge exchange within the context of arts and science collaborations. This Phase Two was planned as a six-month project from September 2003 to the end of February 2004. (2)

Project Objectives/ Initial Meeting

In preparation for Phase Two, we developed three objectives intended to establish the conditions out of which specific lines of enquiry or starting points could emerge.

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1. *shared objective: to seek connections between choreographic processes and the study of movement and the brain/ mind that are scientifically and artistically interesting.*

2. *artistic objective: to integrate the participation and contribution from the scientists into the fabric of the choreographic process while maintaining the integrity of the modes of looking and questioning pertaining to their respective research areas.*

3. *scientific objective: to start to formulate specific questions and research methodologies that arise from the individual interests in this project in the context of the creative choreographic process.*

On 7 and 8 November 2003, we met together in the Random Dance rehearsal studio in London to witness McGregor and his dancers work with some new exercises and scores to generate movement material. Our schedule consisted of watching these making sessions in the morning and holding discussion sessions in the afternoon during which the scientists were invited to present responses and questions to what they had seen based on their individual areas of research. We had set aside two weeks in December and one week at the end of January when they could return to the studio to continue whatever line of questioning might have emerged for them; and we were aiming by the end of the second day for some starting points for potential experiments. At the same time, McGregor was working on the integration of some of their approaches into his creative practice.

Project Experiments

Alan Wing and Kristen Hollands from the Sensory and Motor Neuroscience Centre, University of Birmingham took as their starting point a broad set of questions such as: what frames of reference are dance movements controlled in? Are the movements guided in space with respect to features of the room or with reference to the midline of the body? What are the crucial sensory systems for describing these frames of reference? How might selected disruptions or perturbations help to test this? In order to investigate these questions, four dancers learned and performed a movement sequence passing through three arbitrarily selected spatial reference points around the body. They were recorded performing these sequences using an optical motion capture system that records the timing and position of movement in a three dimensional space at a very high degree of resolution. Various disruptions or perturbations were introduced, e.g. performing with eyes closed and different parts of the body, at different speeds, in reverse and with mirrored and rotated reference points, etc. The collected

data has undergone a preliminary analysis that points towards some possible benefits ranging from: an increase in the scientific understanding of how movement is planned and executed; to offering an improved or enhanced understanding of how to encourage artistic variability of movement and expand movement vocabularies.

Dr. Rosaleen McCarthy from the Department of Experimental Psychology, University of Cambridge was also interested in the notion of disruption, but took a very different approach from Wing and Hollands. Her interest was in exploring the cognitive «toolkit» of each of the dancers in order to gain a better understanding of the communication taking place between choreographer and dancer in the context of the choreographic process. She posed the following questions: how does the choreographer stimulate the dancers' creativity along the desired lines? How do they understand what he says? Is creativity assisted or hindered by any tensions in communication? Drawing on her expertise in neuropsychological methods for the investigation of cognitive representations, she set up some simple dual task experiments with the dancers using imagined movement (in *imagio*) as a means of approaching these questions. Dual task experiments assume that if one does two things at once there is a general loss of efficiency in cognitive terms and a specific loss if there is an overlap in the tools required. By asking the dancers to imagine a short known movement sequence and timing them without any interference and then asking them to imagine the same phrase while performing varying tasks, e.g. haptic/spatial, verbal/spatial, static visual, etc. she began to gather information that may be useful to McGregor in communicating movement generating exercises differently to his dancers; i.e. what sort of instruction/stimuli he might choose to give and in what order, etc.

Tony Marcel and Phil Barnard from the Cognition and Brain Science Unit, Cambridge started with the premise that larger sequences of movement are constructed from smaller units. This makes it possible in the creative process to pull sequences apart so that components can be recombined. They wanted to investigate what the perceived units of movement would be in an experimental setup. Would perceived units differ for different kinds of viewers? Would perceived units differ for sequences generated under different instructions, for example lower level instructions (passing through points in space) versus higher level instructions (verbal/emotional)? In order to obtain reliable experimental measurements to relate to these questions, they asked McGregor to give the dancers two different types of exercises to generate very short movement phrases. These phrases were videotaped and from these recordings a total of eight were selected for viewing and «unitising» by McGregor and the

ten dancers. They recorded their individual responses (lengths and numbers of units) in data collection forms, which have since undergone a preliminary analysis. Based on what the dancers each perceive to be single units, some of the initial results give interesting indications about how perceptions can be compared in relation to different types of instructions for generating movement material as well as giving a comparative picture across the entire company. While it is noted that the experiment forces a more analytical viewing stance and does so in relation to limited scope movement sequences, interesting questions nevertheless emerge from looking at the results about what is and isn't noticeable, and this may be something that could contribute to the collective making process.

Alan Blackwell from the Computer Lab, University of Cambridge studies the cognitive dimensions of design and notation systems in collaboration with a research community who adopt analytic methods from a range of fields including experimental psychology and design research. He collected notebooks and scores from McGregor and four of the dancers and used some of these analytic methods to try and discover where they might experience the limitations of these design tools. The aim of this project is to see how McGregor might improve on the use of notations in the context of his creative process.

Summary

The data collected from all of these sessions is still being analysed and published papers are anticipated. Other forms of project documentation and analysis will be disseminated via a website in the near future, a further application for funding to continue the work has been submitted, and McGregor is premiering a new choreography in London in June 2004 that has been influenced creatively by the above exchanges. (3) What this project has effectively demonstrated so far is that a radical cross-fertilisation of ideas using shared research approaches can enhance innovative thinking in both choreography and cognitive science; and that connections can be discovered and sustained between choreographic processes and the study of movement and the brain/mind that are both scientifically and artistically interesting.

Endnotes

(1) The pilot Arts and Science Research Fellowships scheme was jointly funded by the Arts Council England and the Arts and Humanities Research Board.

(2) Phase Two participants: Alan Wing and Kristen Hollands, SyMoN, University of Birmingham; Rosaleen McCarthy, Department of Experimental Psychology, University of Cambridge, UK; Anthony Marcel and Phil Barnard; MRC Cognition and Brain Science Unit, Cambridge; Alan Blackwell of Crucible/ Computer Lab, University of Cambridge; James Leach, Research Fellow in Kings College Research Centre.

(3) Choreography and Cognition: <http://www.choreocog.net>; Random Dance <http://www.randomdance.org>.

e-mail: sdela@ahk.nl

'Transactables'

Co-authors Wayne McGregor & Alan Blackwell. in On The Page: Performance Research. 9:2. 2004, pp. 67-72.

In August 2003, inspired by work with choreographer Wayne McGregor on his 'graphic scores' and computer scientist and cognitive psychologist Alan Blackwell on the 'cognitive dimensions' of the use of notation, I sent in a proposal for this article to Performance Research for their themed issue 'On the Page' which called for material "about modes of making registers of creative activity – forms of description in the traces".¹ The writing of this coincided with the formal start of the 'Choreography and Cognition' research project in November 2003.²

Performance Research is a specialist journal published by Routledge that promotes a dynamic interchange between scholarship and practice in an expanding field of performance. Interdisciplinary in vision and international in scope, its emphasis is on research in contemporary performance arts within changing cultures. Source: <http://www.tandf.co.uk/journals/titles/13528165.asp> (accessed 7 May 2010).

¹ Email to the author, 1 Jul 2003.

² Documentation site: <http://www.choreocog.net/> (accessed 7 May 2010).

Transactables

SCOTT DELAHUNTA, WAYNE MCGREGOR
AND ALAN BLACKWELL

BETWEEN BODIES *Scott deLahunta*

Contemporary choreographers and dancers make use of the page as a site for creative drawing, writing and sketching. Often but not always accompanied by video registration, they employ the page as a toolkit for self-reflection/examination, for the collective documenting and sharing of creative ideas, scripts and scores, capturing the dynamics of gesture and recording notes for future reference. As such the page becomes an interactive object inextricably linked with the processes of dance making.

Whichever of these is the primary function of the page, whether part of a generative process or used for storing information for future retrieval, the choreographer's drawing or sketchbook also tends to be bound up with the making of a specific work - as temporary in usage as the performance itself is impermanent. Some evidence of the process is contained in the miscellaneous markings - the curves, boxes, lines, arrows, words and symbols - but usually with little annotation or explanation that would make them meaningful to anyone not part of the creation. Meanings may even be lost over time to those who have made the drawings originally, to be rediscovered in the rehearsal of a movement, action or gesture, suggesting a connection between mark making, memory and the sensorimotor systems.

Looking at a particular choreographer's notebooks over time, there will be certain stylistic consistencies related to habits or use of familiar graphic forms, etc., but essentially these

representations are freed from formal conventions. Unlike more comprehensive notation systems, such as Labanotation and Benesh, drawing and sketching will be deployed by particular choreographers and dancers to serve their needs; they are contingent upon and contiguous with the making of specific choreographies and are perhaps best understood as dynamic influences in the process, as marks and traces to be used as triggers and stimuli, as a catalyst to artistic creation. In this context, as the emphasis of its significance shifts to usage or interpretation and re-expression in a movement, action or gesture, the page becomes less a static site for symbol depiction and more of an interactive object. Importantly, the page should not only function in this capacity for its choreographer/dancer author, but also as a shared site for others who may be collaborators on the artistic team, for example other dancers, composers, designers, and so on.

There have been a large number of studies over several decades into understanding the use of graphic representations that are not part of formal notation, language or symbol systems.¹ They have tended to focus on the static versions of these representations, seeking across them for formal properties and meta-nomenclature that might be useful in helping visual designers intent on effective communication in different contexts; but there has been little or no study of their use in choreographic practice.

Ellen Schwartz, in her introduction to a little-known book entitled *Tracking, Tracing, Marking*,

CHOREOGRAPHY AND COGNITION is a joint research project initiated by Scott deLahunta and Wayne McGregor to engage practitioners from the field of cognitive science in seeking connections between creativity, choreography and the scientific study of movement and the mind. Phase Two (September 2003 through February 2004) comprised several research sessions involving members of Random Dance and collaborating scientists from the Universities of Cambridge and Birmingham. This article is informed by some of this research. (<http://www.choreocog.net/>)

¹ For example: Willard C. Brinton's *Graphic Methods for Representing Facts*, New York: McGraw-Hill Book Company/ The Engineering Magazine Company, 1919; Rudolph Arnheim's *Visual Thinking*, Berkeley: University of California Press, 1969; and the collections of Edward Tufte: *The Visual Display of Quantitative Information*, 1983; *Envisioning Information*, 1990; and *Visual Explanations*, 1997; all published by Graphics Press, Cheshire, CT.

Pacing published as part of an exhibition of choreographers' drawings she curated in New York City in 1982, breaks these up into two categories: 'functional' consisting of systemic and free-form drawings; and 'non-functional' in which the relationship between the mark and the movement is more 'oblique'.² But beyond this she says little about the relation between the drawing and the nature of the movement with which it may have been associated. In the introduction to her edited book *Traces of Dance*, dance scholar Laurence Louppe comes closer to articulating this coupling of the corpus of the written and the danced by posing questions and impossibilities such as how to make sense of marks on the page that are not part of a formal notation system without its dancing author.³ She summarizes what survives in the archive of choreographic drawings and notebooks as 'unfinished writings' that 'exist but halfway, in the absence of the body that alone can read you'.

One of the questions we asked in the context of the Choreography and Cognition project was how are notebooks and scores used by Wayne and his dancers in the process of making a new dance work. We were interested in the practical and functional possibilities of a systematic approach that perhaps Louppe is less inclined to recognize in her view on the limits of writing and the absences of bodies.

LIVING SCORES *Wayne McGregor*
Yesterday - Jan 1992 to Jan 2004

Over the past 12 years of creating I have accumulated many 'diaries' or notebooks of the intimate act of dance making. They are objects of the process of generating each individual piece, and contain ideas which are exposed and made visible through text, drawing, mathematical problem-solving, spatial geometry and generally engaging questions about the nature of form and content translated through tasks and onto the page.

Today - 1 Feb 2004

Recently, on re-reading the notebook entries as a part of facilitating a shared understanding of

my choreographic process to the group of neuroscientists involved in the Choreography and Cognition project, I started to question my own assumptions about my dance making practice. This framework for reflection has allowed me time to better understand the complex and complicated interventions of thought translated to paper, and indeed the need for me to have this tool, the page, to dialogue with: not at all as straightforward documentation, a simple record of the dance piece, or a notation in the traditional sense of the term where the 'diary' could be used to reconstruct the piece, but an active, living, ideas score. The notebooks are a space full of sets of information, geographies, territories of exploration, where side by side they start to describe process as a continuum of investigation where each piece seems to signify a marker in time rather than a completed and final destination.

In different ways, there does seem to be a systematic development in the entries, not in terms of an aspiration for a formula of making, but a clarity of intention and attention. Tasks are modulated, reformed, reinterpreted at various points in one process, to be then rediscovered or at least revisited in a much later one. Ideas which are rejected in one piece are energetically excavated in another, and this is explicitly illustrated in the specifics of the choreographic tasks which are invented to suit the new questions. In other words, there is a dynamic interplay between knowledge(s) of the past, with concepts of the future being researched within the boundaries of the present.

It was surprising to see when analysing my own notebooks that detailed information related to the body in motion, the body in space, the body in time, the body at all, is an *exceptional* entry. It's as if these choreographic intelligences do not need the syphon of the page to be articulated or discussed in any other space than the studio itself - concepts of the body mediated directly in real time and space intimately and in person with the individual dancers themselves.

The page facilitates a notion of an alternative

² Ellen Schwartz (ed.), *Tracking, Tracing, Marking, Pacing* (catalog from movement drawing show), NYC: Pratt Institute, 1982. The exhibition contained material from the sketchbooks of many choreographers including Lucinda Childs, Elizabeth Streb, Melissa Fenley and Remy Charlip.

³ Lawrence Louppe (ed.), *Traces of Dance*, Paris: Editions du Voir, 1994.

body (or is it 'mind?') to collaborate with, outside of yourself, yet at one with your line of enquiry. We often describe dance as an exemplar of non-verbal communication but I have realized that the 'product' may be without words but the process of creativity is heavily reliant on them. Here, on the page, there is no verbal exchange, no explanation necessary, but a tablet for physicalizing thought without full-bodied dancing. It's a visceral experience though: bold mark making, animating descriptions of ideas, noting confused number sequences, the workings out of mind into matter, matter transformed into art. The page allows you to discover elements of yourself and the notebooks become the honest (bio)grapher.

Tomorrow - 3-5 June 2004 Sadler's Wells

The experiences of analytical, conceptual and challenging thinking from the Choreography and Cognition project have provided a vibrant catalyst for change. This change has been affected by the type of questions asked of the art-making process, which have been framed far outside my normal considerations in creating dance. It is this intervention that has most activated growth and this disruption to conventional ways of doing things which has inspired me to unlearn. This unlearning is reflected in the design thinking for my new work *AtaXia* where our aspiration is to uncoordinate our foundations of aesthetic knowledge - no more so than in the use, content and form of my Living Scores.

As part of the process for this piece, each dancer will have their own generative score which they can annotate, draw on, extend and individually breathe life into. In collaboration with designer John Warwicker the initial illustrated scores have been developed in a series of complexities. These are points of departure for choreography. What fascinates about the content of the given score is as much the information that is invisible as visible. There is an absence of complete form which generates a loss of control in reading. The meaning(s) of the primary stimuli are ambiguous and it is one of the

jobs of the creative process to uncover a plural approach to understanding the grammar and syntax of this new graphic language. In a semi-otic sense, what are the signs and symbols of this material that communicate meaning(s)? How can we utilise them, translate them and exploit them to say something new about the body, interpersonal relationships and life?

Looking differently at sets of information stimulates creativity, and when this is harnessed with 'operational' tasks for translating this data into movement, a very special chemistry occurs. The scores themselves, accompanied by instructions on 'how to look', provide a dynamic imaginative space from which improvisational and generative tasks can take place. These ideal conditions set up a safe and engaging environment in which to play with movement, often inspiring a physical behaviour or language which is unnatural, uncommon for the body to execute. It is in this sense of generating the unexpected that the living score excels.

HOW IS IT POSSIBLE TO DISCOVER THE FORM OF AN IDEA? *Alan Blackwell*

Choreographers, like architects, engine designers and computer programmers, transform mind-stuff into tangible products - our artificial world. For these and many other design disciplines, it is marks on a page that mediate the process of transformation. We know that complex design practices require media for communication - blueprints, scores or specifications - but these are substitutes for shared experience, and documents of the creative act. The notational conventions of such media divide the 'sentential', language-like conventions in which a series of symbols are read off the page like the words in a sentence, from the 'pictorial', mappings of observed experience onto the marked plane. We are familiar to the point of unconsciousness with the nature and function of such notations as a communicative score, acting as surrogate when the designer is no longer present, and allowing performers or manufacturers to interpret a (more or less) authorized work.

Yet the designer's page need not be simply a medium for communication. Sketches and private working documents often participate in a more intimate process. Where a work in progress has many parts or properties, a 'computational offloading' employs the page as a surrogate for short-term 'working' memory. This process results in many blurrings between the sentential and the pictorial. Where working memory might consist of a mental language of words and phrases, or snapshot visual images, sketches combine these elements in more elaborate or ambiguous ways. The designer engages in a dialogue with the page, externalizing, then looking to see something new. The page becomes a site for encounters of cognition and creativity, and also a fertile ground for research into the philosophy of mind.

Many fields of technology design are sufficiently new that they are still inventing their first notations – at a level of historical development that might be compared to 12th-century musicians, 17th-century dancers, or prehistoric rock deer hunters. It was the gradual realization of how I was reinventing these wheels that distracted me from my career in high technology, entering psychology research in order to understand the formal properties of markings on the page, and the human experience of making and seeing such notations. I now collaborate with a small international research community dedicated to the study of diagrammatic reasoning and visual languages. We adopt analytical methods from mathematics, philosophy, semiotics, experimental psychology and design research to describe the properties of existing notations, and anticipate the best choices for novel notational systems.

The results of these investigations can be applied also to the contemporary practice of traditional arts such as music and dance. Better understanding of the use of notation liberates both performers and composers, enabling compositional and interpretive innovation. In the Choreography and Cognition research project referenced in these pages, the results of nota-

tion and design research are being used to structure interviews with dancers and choreographers. Leading choreographers like Wayne McGregor develop new conceptual structures in part on the page, bringing great potential for adopting notational elements from other design disciplines. We facilitate this transfer of experience through structured taxonomies of the language of graphics, and through patterns of experience in the way that notations either encourage or obstruct particular profiles of design activity.⁴

We have used the Cognitive Dimensions questionnaire to discover the respects in which Wayne experiences the limitations of his design tools.⁵ A great deal of his notational activity is concerned with 'accounting' processes, applying dance and spatial resources within a conceptual impetus. From our cross-disciplinary design perspective, we can imagine ways in which even mundane conventions from the world of professional accounting might be transfigured or subverted toward the innovative demands of contemporary dance. We are also able to contrast the personal styles of dancers who employ abstract representation when inventing notational devices, versus those who emphasize verbal or spatial operations. Dancers in the Random Dance company use paper as a problem-solving medium in which to solve and record improvisational exercises, but do not want to be distracted by the detail of the compositional process, or material that abstracts expressive movement away from the body. Balancing demands of these kinds is the art of the notation design researcher, and the challenge for the next phase of our work.

⁴ References include: A. F. Blackwell and T. R. G. Green, 'Notational Systems - The Cognitive Dimensions of Notations framework', in J. M. Carroll (ed.) *HCI Models, Theories and Frameworks: Toward a Multi-disciplinary Science*, San Francisco: Morgan Kaufmann, 2003, pp. 103-34; Y. Engelhardt, *The language of graphics*, PhD thesis, University of Amsterdam, 2002; T. R. G. Green and M. Petre, 'Usability Analysis of Visual Programming Environments: A 'Cognitive Dimensions' Approach', *Journal of Visual Languages and Computing* (1996): 131-74.

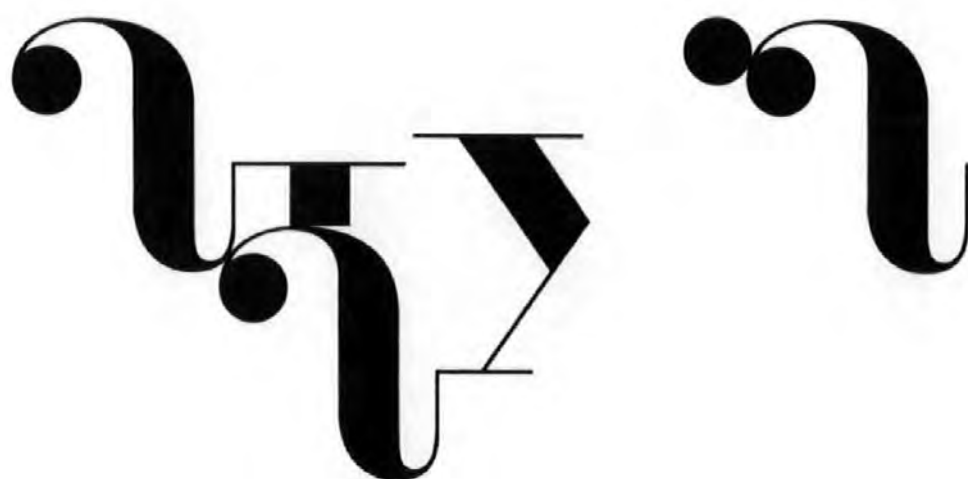
⁵ A. F. Blackwell and T. R. G. Green, 'A Cognitive Dimensions Questionnaire Optimised for Users', in A. F. Blackwell and E. Bilotta (eds), *Proceedings of the Twelfth Annual Meeting of the Psychology of Programming Interest Group*, 2000, pp. 137-52 (<http://ppig.org/papers/12th-blackwell.pdf>).



AtaXia scores by John Warwicker with annotations interpreted by dancers Laila Diallo (*left*) and Claire Cunningham (*lower page*).

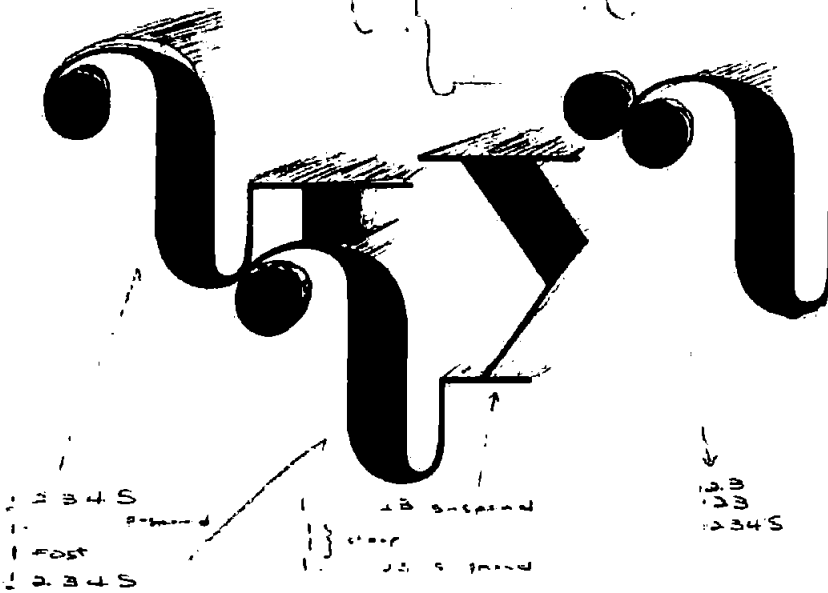
...Eventually, the living score becomes a detailed reference, a map of investigation, a memory of intention. It will be personalized, made individual, unique, but at the same time collective, shared and coherent. Everybody will read and interpret their own score with their remembered understanding of the process, a private testament to our particular contribution to the work, the piece itself the public face of a collaborative endeavour.

WAYNE MCGREGOR

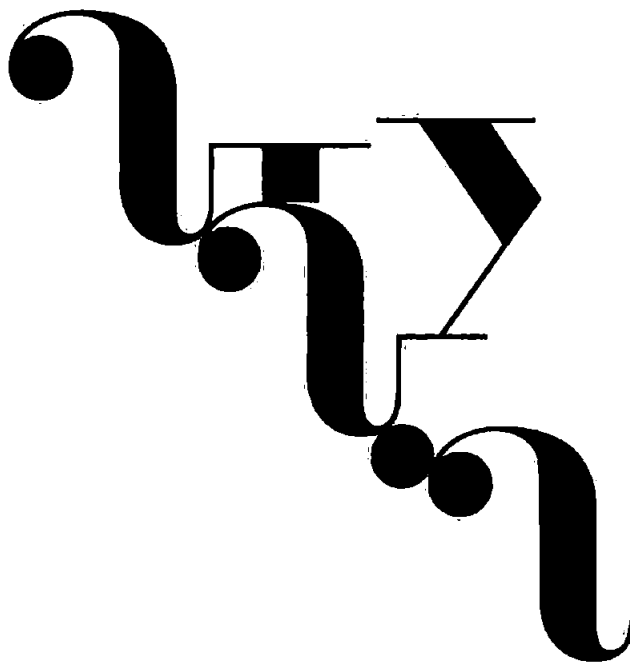


② translate to 3D (parallel)
depth, retreating
and point of view

① accessible not desirable (small)
copy/sketch/outline
(old hand of 'a' rock work on page)
- balance of movement
- simplicity of line



③
the moving of the line
the moving of the line
the moving of the line



'Separate Spaces: some cognitive dimensions of movement'

This is the pre-translation version. The published version appeared as:

'Espaces distincts: quelques dimensions cognitives du mouvement' in

Scientifiquement danse: Quand la danse puise aux sciences et réciproquement:

Nouvelles de Danse. Bruxelles: Contredanse, No. 53. 2006, pp. 150-162. (See Appendix pp. 399-412)

This work was originally commissioned in June 2003 by Giles Lane as part of the DIFFUSION eBook series and published on-line in June 2005.¹ I was approached by Florence Corin, editor of Nouvelles de Danse in April 2005 to submit something for an upcoming issue on "dance and sciences".² Publishing in Nouvelles de Danse means translating the work to French and I was keen to disseminate the 'Choreography and Cognition' project through it, and she agreed to publish the DIFFUSION piece.

Nouvelles de Danse is a contemporary dance journal published in French by the Brussels dance association: Contredanse. Contredanse uses publications, a documentation centre, a newspaper and this site to support and stimulate choreographic creativity. Source: <http://www.contredanse.org/> (accessed 7 May 2010).

¹ <http://diffusion.org.uk/?tag=scott-delahunta> (accessed 7 May 2010).

² Email to the author, 19 Apr 2005.

Separate Spaces: some cognitive dimensions of movement

(This is the pre-translation English version as submitted for publication in October 2005. Illustrations in and the referencing system of the published French version are used.)

Cognitive Mapping:

Cognitive science is usually described as an interdisciplinary study of the mind or intelligence drawing together a set of key fields such as computer science, philosophy, neuroscience, linguistics and psychology. One of the projects of cognitive science has been to research and develop new understandings and descriptions of the organisation and processing of information in the biological correlate of the mind, the brain.

In the early 19th century, phrenologists developed the first theories relating areas of the brain to some of the basics of cognition.¹ Developed without a scientific method, these early theories were exposed as fundamentally incorrect, but the phrenologists still have a place in the history of mapping the brain/ mind. This continues today with non-invasive brain imaging techniques that began with the invention of the PET (positron emission topography) in the mid 1970s.² While these techniques are still in the early stages of development and give rise to more questions than answers, the resultant images with colours and graphics depicting corresponding local activity areas continue the tradition of the phrenologists in developing theories of brain/ mind space.

Some cognitive scientists don't refer directly to images of the brain, but chart out the dynamic systems of thought through references to abstract spaces and processes that are no less real. The concept of 'mental spaces' is attributed to Gilles Fauconnier, Professor in the Department of Cognitive Science, University of

California San Diego, who writes in an unpublished article summarising the work he began in the mid 1970s, "Mental spaces are very partial assemblies constructed as we think and talk, for purposes of local understanding and action." These spaces are dynamic territories that unfold during conversation, their creation guided by language in a process where "thought and discourse... are connected to each other by various kinds of mappings".³

Another scientist, Margaret Boden, Professor of Cognitive Science, Sussex University uses the term 'conceptual spaces', in her book *The Creative Mind*, first published in 1990. Referring to maps of the mind as "generative systems that guide thought and action", Boden describes these spaces as ones that can change themselves, and cites several examples of new conceptual space being created by both artists and scientists using different exploration processes.⁴

This brief introduction of various approaches to the idea of cognitive mapping provides a frame for the remainder of this article in which I will describe aspects of the *Choreography and Cognition* project; a project that combined the exploration of mental spaces in the context of creating movement in physical ones.

Choreography and Cognition (introduction):

A few years ago London-based choreographer Wayne McGregor (artistic director of Random Dance) and I began a discussion about finding new ways of understanding the choreographic process that might lead to alternative creative approaches to making dances. Starting from a mutual interest in artificial intelligence and neural nets, this conversation eventually led us to develop a project for exploring insights that might emerge from the interdisciplinary research context of cognitive science.

For a first phase, we organised a series of meetings in November 2002 with individuals working in the field of cognitive science in the United Kingdom and

France, and positive reactions to these inspired us to continue with another set of exchanges. We were able to secure funds from a new arts and science research scheme that enabled us to continue working with five of the individuals from our November 2002 meetings: Alan Wing, SyMoN (sensory motor neuroscience research group), University of Birmingham; Rosaleen McCarthy, Department of Experimental Psychology, University of Cambridge, UK; Anthony Marcel and Phil Barnard, MRC Cognition and Brain Science Unit, Cambridge; and Alan Blackwell of Crucible/ Computer Lab, University of Cambridge. In addition, we invited James Leach, a social anthropologist doing fieldwork on arts and science collaborations, to participate.⁵

This Phase Two of the *Choreography and Cognition* project was scheduled into a six-month period from September 2003 to the end of February 2004.⁶ We began with a two day shared session for all participants over a weekend in November 2003 in the rehearsal studio in London. Our daily schedule consisted of observing McGregor and his dancers work with some new exercises to generate movement material in the morning and holding discussion sessions in the afternoon. During these discussions, the scientists were invited to present responses to what they had seen based on their individual areas of research. We had set aside two weeks in December and one week at the end of January 2004 when they could return to the studio to continue whatever line of questioning might have emerged for them. Our goal for the end of the two days was to define some starting points for the research to take place during these return visits.

Problem Solving:

During the mornings of this shared session, McGregor generated movement material by giving tasks or problems to the dancers to accomplish or solve through the creation of short dance sequences. These exercises were invented by him and usually communicated to the dancers through some form of description and

instruction involving both language and images (graphic or pictorial) either from outside sources or as drawings made during the generation session. After these instructions, the dancers were given a period of time to come up with their sequence of movement. Generally developed individually, these short sequences, no more than a minute or two long, could be kept, discarded or parsed into smaller units for future recombination. This resulting pool of movement material begins to constitute, in McGregor's terminology, the 'vocabulary' for a new choreography.

Inviting the scientists to observe these morning sessions and then present responses based on their individual areas of research in the afternoon was to make room for differences in perception, terminology and understanding to emerge not only between the 'scientists' and the 'artists', but equally importantly between the five of them as individual researchers. While referring to themselves generally as psychologists each differs from the other along the lines of their specific focuses within the domain of psychology. These differences are in some cases quite radical: Alan Blackwell with qualifications in professional engineering and experimental psychology studies the cognitive dimensions of design and notation systems; Alan Wing's research is focused on sensory motor function in reactive and predictive control of movement; Phil Barnard has been developing a theory called Interacting Cognitive Subsystems towards understanding "how the different components of the mental mechanism are configured... and the overall dynamics of their interactions in real time"; Roz McCarthy has a background in the use of neuropsychological and neuropsychiatric methods for the investigation of cognitive representations in memory, space and perception; and Anthony Marcel takes an integrative approach to the study of aspects of consciousness.⁷

The problem solving in the morning gave way to a different form of problem solving in the afternoon, the difference partly marked by the shift from a space in which movement was valued as a means of exchange to one in which the conversation

was of primary importance. Used to describe, instruct, explain, narrate and interrogate language was essential in both contexts. However, whereas the problems posed in the morning sessions gave rise to what could be referred to as choreographic solutions expressed in physical space; the primary problem to be solved in the afternoon was to figure out what was going on in the mind of the choreographer and the dancers. This initiated the exploration of their mental spaces; a process that would be fine-tuned and further developed throughout the project.

The Dancer's Mind:

The afternoons were organised for each scientist to chair the discussion for twenty minutes to describe in their own terms what they had observed in the movement generation sessions and to freely query and seek clarification from each other, McGregor and the dancers.⁸ Alan Blackwell, drawing upon his research in design and notation systems, began with how he viewed McGregor's use of sketches and charts during the morning movement generation sessions. Blackwell made a distinction between the "inside" of the choreographer's head and the space of the page used as a device to assist the creative process. The implication that the space of page could be used to help free up space in the head introduced the notion of internal and external representations. The word representation is used widely in the context of cognitive science partly to describe the interplay between mental and external spaces. There is, however, much debate about the nature of these internal representations, e.g. that the implication of a visual image in the brain conceals "subtle forms of dualism" (the belief that mind is separate from the physical world).⁹ This is a debate we did not take up directly in our own discussions, although it was clearly implicit throughout the project.

(See **Illustration** in the published French version: Thesis Page 403: Comparison of notebook pages of dancer Liala Diallo on right and Wayne McGregor on left by Alan Blackwell.)

Questions and responses from the group arising from Blackwell's initial proposal helped to clarify McGregor's perspective and his intentions in relation to the creative process and collaboration with the dancers; as well how this view resonated with the research of others. Phil Barnard commented that he had difficulty knowing how to approach understanding the generative procedures he had seen in the morning because for him it was clear that far more of the design process was going on in the mental spaces of the choreographer and dancers than could be represented in notations on the page. Eventually, Barnard and Anthony Marcel would work together to devise research approaches to systematically obtain more information from the dancers and McGregor about the cognitive dimensions of their creative process (see the Parsing experiment described below).

The conversation continued with each scientist taking a turn to present his or her responses to the morning sessions. While the topic of what was going on in the mind of McGregor and the dancers was a prevailing one, it was not the only focus of the wide-ranging discussion. Marcel and Barnard both posed questions related to the larger social cultural context within which McGregor's choreographic works might be viewed and interpreted. Marcel brought up the concept of "immersion and non-observational awareness of one's actions" in reference to the dancers' experience of performing. Alan Wing, whose research into sensory motor function and control makes use of highly specialised motion tracking systems, commented that he makes a distinction between the movement that one perceives or is aware of (the percept) and movement in terms of forces, positions and timing (physics). His response to the morning sessions focused on the relation between unconscious and conscious movement control and implications for variability in relation to the creative process. Wing's descriptions of how he was thinking of the things he had seen in the morning session provoked Marcel to comment that the physics he was referring to are the "foundational aspects of mind" too often ignored by psychology.

(See **Illustrations** in the published French version: Thesis Page 405: Top: Kristen Hollands and Alan Wing. Bottom: Liala Diallo and Alan Wing during research session at Sadler's Wells. Photos: James Leach.)

Roz McCarthy returned to the concepts of internal representation and wondered what kinds of prior information were the dancers and McGregor bringing to the process of generating movement vocabulary. She asked how McGregor's problem solving exercises were informed by the imagined aesthetic output to which he responded that at this early stage in the creative process he tries just to stick to the task. Eventually, this line of questioning would lead to her designing some simple experiments to explore the mental space of the dancers and its underlying representations.

These conversations continued the afternoon of the second day after another session observing McGregor and his dancers work with a very different set of exercises to generate movement material.¹⁰ As mentioned earlier, three weeks in the rehearsal studio had been reserved for the scientists to return, and our goal for the end of this shared session was to define some starting points for the research that would take place during these return visits. The final afternoon discussion began with McGregor responding to what he had found of interest in the observations and work of the scientists. For example, how neuroscience research might help him invent movement generation exercises that would disturb normal patterns of perception and motion control.

The Experiments:

By the end of the final afternoon, we arrived at three main lines of enquiry that had implications for McGregor's creative process and could at the same time be explored from different scientific starting points, i.e. cognitive, neurological,

psychophysical and biomechanical: [1] perturbations – the introduction of disruptions and selective interference to danced movement as a creative strategy; [2] parsing – the perception of segmentation of dance sequences; and [3] representation – the examination of choreographic design processes involving external representations (notations) and associated behaviours.

(See **Illustration** in the published French version: Thesis Page 407: Leo Lerus and Rosaleen McCarthy at the University of Birmingham. Photo: Scott deLahunta.)

Before the scheduled research studio time in December and January, these three themes were revised and expanded upon. Alan Blackwell, following the third line of enquiry, Representation, collected notebooks and scores from McGregor and four of the dancers and used interview techniques and analytic methods drawn from his research into the cognitive dimensions of notation systems to discover where they might experience the limitations of these as design tools. The aim of this project is to see how McGregor might improve on the use of notations in the context of his creative process.

Marcel and Barnard took the Parsing line and began with the premise that larger sequences of movement are constructed from smaller units; which makes it possible in the creative process to pull sequences apart so that components can be recombined. What would these units of movement be and how would they be selected or perceived? Would perceived units differ for different kinds of viewers, e.g. dancer, choreographer or audience? Would perceived units differ for sequences of movement generated under different instructions, for example lower level instructions (passing through points in space) versus higher level instructions (verbal/ emotional)? In order to obtain reliable experimental measurements to relate to these questions, they asked McGregor to give the dancers two different types of exercises to generate very short movement phrases. These phrases were

videotaped and from these recordings a total of eight were selected for viewing and 'unitising' by McGregor and the ten dancers. They recorded their individual responses (lengths and numbers of units) on data collection forms, which have since undergone a preliminary analysis. Based on what the dancers each perceive to be single units, some of the initial results give interesting indications about how perceptions can be compared in relation to different types of instructions for generating movement material as well as giving a comparative picture across the entire company. While it was noted that the experiment forced an analytical viewing stance and did so in relation to limited scope movement sequences, interesting questions about what is and isn't noticeable emerged from looking at the results, and this could be something that might contribute to the collective making process.

Alan Wing and his Research Assistant Kristen Hollands took as their starting point a broad set of questions such as: what 'frames of reference' are dance movements controlled in? Are the movements guided in space with respect to features of the room or with reference to the midline of the body? What are the crucial sensory systems for describing these frames of reference? How might selected disruptions or perturbations help to test this? In order to investigate these questions, four dancers learned and performed a movement sequence passing through three arbitrarily selected spatial reference points around the body. They were recorded performing these sequences using an optical motion capture system that records the timing and position of movement in a three dimensional space at a very high degree of resolution. Various disruptions or perturbations were introduced, e.g. performing with eyes closed and different parts of the body, at different speeds, in reverse and with mirrored and rotated reference points, etc. The collected data has undergone a preliminary analysis that points towards some possible benefits ranging from: an increase in the scientific understanding of how movement is planned and executed; to offering an improved or enhanced understanding of how to encourage artistic variability of movement and expand movement vocabularies.

Roz McCarthy was interested in those aspects of the first person cognitive experience she could reveal through a careful disruption of selected perceptual processes, and she proposed that this exploration of the cognitive 'toolkit' of the choreographer and dancer might lead to a better understanding of the communication between them during the choreographic process. She posed the following questions to frame her approach: how does the choreographer stimulate the dancers' creativity along the desired lines? How do they understand what he says? Is creativity assisted or hindered by any tensions in communication? Drawing on her expertise in neuropsychological methods for the investigation of cognitive representations, she set up some simple dual task experiments with the dancers using imagined movement as a means of approaching these questions. Dual task experiments assume that if one does two things at once there is a general loss of efficiency in cognitive terms and a specific loss if there is an overlap in the tools required. By asking the dancers to imagine a short known movement sequence and timing them without any interference, and then asking them to imagine the same phrase while performing various tasks, e.g. haptic/ spatial, verbal/ spatial, static visual, etc. she began to gather information that may be useful to McGregor in communicating movement generating exercises differently to his dancers; i.e. what sort of instruction/ stimuli he might choose to give and in what order, etc.

Conclusion(s):

Most of the information or data gathered by the five scientists is still in the process of being analysed. To observe and design experiments is only a part of the scientific process; the analysis and interpretation of the results takes up a much larger proportion of time in relation to its collection. This is perhaps the most significant difference in the research practices and procedures of choreographer and cognitive scientist. McGregor is premiering a new choreography in London in June 2004 that has been influenced creatively by these shared exchanges; it will be months before

final results are available from Alan Wing's project for example. However, Phase Two of the *Choreography and Cognition* project has come to a close and the consensus is that all three objectives have been met (see reference #6). The project has demonstrated that connections can be discovered and sustained between choreographic processes and the study of movement and the brain/ mind that are both scientifically and artistically interesting.¹¹ Valuable and productive relationships emerged from the intersection between the different perspectives, vocabularies and understandings we have shared during this project, and these can greatly inform creative thinking in a range of practices if the opportunities for such exchanges continue.

Dance and dance making involves a unique blend of physical and mental processes; multiple interacting dimensions of mind, brain and body spanning sensation, perception, cognition, emotion and movement control.¹² The powerful story of cognitive science as a field is that no single discipline or domain can come up with the complete picture of how all of these processes interact. It is only through radical and shared interdisciplinary research that we can gain knowledge of these interactions and continue to advance our comprehension of our own understanding. This also points towards the fundamental conundrum of the cognitive sciences: how to merge understandings of mental and physical spaces in which our descriptions of these are a product of the spaces themselves. The *Choreography and Cognition* project while solving many problems along the way has not attempted to come up with a solution to this, but we have considered the minds of the dancer in relation to choreographic practice in ways that have been conditional and flowing through a range of physical, mental and conceptual spaces.

Preferring at this stage an open-ended and perhaps deferred knowing, our project hasn't tried to construct a theory of choreographic cognition as has been attempted by a similar project based in Australia.¹³ The choreographic mind we have been

considering would resist such explanations at this stage. It may be more appropriate to refer to choreography as physics having cognitive dimensions of the sort Wing's and Holland's work suggests. Or to imagine the shared cognitive space of the dancers as implied by the Parsing project with its comparative framing of a collective perception. And what might happen if the dancers and choreographer had a better understanding of each other's cognitive 'toolkit'; or if our uses of notations could be enhanced through an improved awareness of connections between internal and external representations? Physical and mental spaces are still separate and there is no danger of one collapsing into the other. However, our understanding of the complex interrelations between them is evolving well beyond forms of dualism, and this seems the ideal project to involve joint research by choreographers and cognitive scientists.

Scott deLahunta Amsterdam, May 2004 (October 2005)

With thanks to Susan Rethorst for editing assistance

Endnotes (all URLs accessed 06/05/04):

¹ Gazzaniga, Michael S., Richard Ivry, George Mangun. *Cognitive Neuroscience: the Biology of the Mind*, 2nd Ed. New York: W.W. Norton & Co. 2002. pp. 2-3.

² Raichle, Marcus E. 'Brain Imaging'. In: *Conversations in the Cognitive Neurosciences*. Ed. M. S. Gazzaniga. Cambridge, MA: MIT Press. 1997. p. 16.

³ Fauconnier, Gilles. 'Mental Spaces' (on line article summarizing and reproducing parts of earlier work: 1985, 1997, 2002). pp. 1-2. URL: <http://cogsci.ucsd.edu/~faucon/151/mental%20spaces.pdf>

⁴ Boden, Margaret. *The Creative Mind: Myths and Mechanisms* 2nd Ed. London: Routledge. 2004. p. 59.

⁵ The pilot Arts and Science Research Fellowships scheme was jointly funded by the Arts Council England and the Arts and Humanities Research Board.

⁶ In preparation for Phase Two, we developed three objectives intended to establish the conditions out of which specific lines of enquiry or starting points could emerge: (1) shared objective: to seek connections between choreographic processes and the study of movement and the brain/ mind that are scientifically and artistically interesting; (2) artistic objective: to integrate the participation and contribution from the scientists into the fabric of the choreographic process while maintaining the integrity of the modes of looking and questioning pertaining to their respective research areas; (3) scientific objective: to start to formulate specific questions and research methodologies that arise from the individual interests in this project in the context of the creative choreographic process.

⁷ Some of the scientists have websites with quite a bit of material about their research areas: Phil Barnard <http://www.mrc-cbu.cam.ac.uk/personal/phil.barnard/>; Alan Wing <http://www.bham.ac.uk/symon/people/alan.htm>; Alan Blackwell <http://www.cl.cam.ac.uk/users/afb21/>.

⁸ The ten core dancers of Random Dance Claire Cunningham, Laila Diallo, Fred Gehrig, Khamlane Halsackda, Odette Hughes, Léo Lerus, Ngoc Anh Nguyen, Matthias Sperling, Hilary Stainsby and Amanda Weaver were all involved to varying degrees in the project.

⁹ Berthoz, Alain. *The Brain's Sense of Movement*. Cambridge, MA: Harvard University Press. 2000. p. 21. & Clark, Andy. *Mindware: an Introduction to the Philosophy of Cognitive Science*. Oxford: Oxford University Press. 2001. p. 162.

¹⁰ Whereas the first morning McGregor had given a task that related to points in space around the

body, on the second morning the task involved instructions more explicitly emotional and narrative in connotation and reference.

¹¹ For information about the work of Wayne McGregor see the Random Dance website:

<http://www.randomdance.org>. Other forms of project documentation and analysis will be disseminated via a website <http://www.choreocog.net>, and a further application for funding to continue the project via a network has been submitted to the EPSRC (Engineering and Physical Sciences Research Council) in the UK.

¹² Phrasing of this sentence taken from the EPSRC proposal mentioned above in reference #11 drafted by Alan Wing and Kristen Hollands.

¹³ Stevens, K., S. McKechnie, S. Malloch, & A. Petocz. 'Choreographic Cognition: Composing Time and Space'. *Proceedings of the 6th International Conference on Music Perception & Cognition*. 2000. <http://www.ausdance.org.au/unspoken/research/cognition.html>.

'The Human Walking Apparatus: a technological episteme'

This is the pre-translation version. The published version appeared as:

'L'Appareil de Locomotion: une Épistémé Technologique' in Interagir: avec les technologies numériques: Nouvelles de Danse. Bruxelles: Contredanse. No. 52. 2004, pp. 36-49. (See Appendix pp. 413-426)

In March 2004, I was invited by Nouvelles de Danse editor Florence Corin to write a text that would "recall the historical development of the interactivity in the dance performance?"¹ I wrote back that "my own research takes me away from only historical artistic trajectories to look at where sciences and arts/ dance were running concurrent experiments. I am more interested to trace a certain similar view on the body that has influenced certain dance trajectories and certain machine trajectories --but not always overlapping." She accepted this proposal.

Nouvelles de Danse is a contemporary dance journal published in French by the Brussels dance association: Contredanse. Contredanse uses publications, a documentation centre, a newspaper and this site to support and stimulate choreographic creativity. Source: <http://www.contredanse.org/> (accessed 7 May 2010).

¹ Email to the author, 2 Mar 2004.

The Human Walking Apparatus: a technological episteme

(This is the pre-translation English version as submitted for publication in June 2004. Illustrations in and the referencing system of the published French version are used.)

Introduction:

In his history of *Art of the Electronic Age*, Frank Popper proposes that the direct influence of technology on art begins at the end of the 19th century when the effects of the Industrial Revolution "entered everyday life...".¹ The 1950s and 60s are considered important in the history of technology and performance arts for the shifting relations between audience and performers taking place during this period, for example in the 'Happenings', that paved the way for the new media genre of 'interactive art'.² The 1960s and 70s then saw the emergence of 'post-modern dance' overlapping with the early days of Computer Art, and choreographer Merce Cunningham first envisioned the computer as a creative tool; twenty years before *LifeForms*.³ Clearly these were important times that have influenced contemporary practices involving emerging technologies and dance and other performance arts. But one could also look further back to discover how, for example, perceptions of bodies and movement are informed by particular technological/ scientific developments.⁴

Put another way: contemporary views on the body and movement are technological in the sense that they are informed by scientific understandings of the body as a system, seen to be functioning variously as an organ, an instrument, a sensor and a mind. This is evident in key texts that will be familiar to readers of *Nouvelles de Danse* such as Bonnie Bainbridge Cohen's *Sensing Feeling and Action* and Lulu Sweigard's *Human Movement Potential*; both often used in many contemporary dance practice and education settings. Cohen, with 'Body Mind Centering', and

Sweigard, with 'Ideokinesis', have developed singular approaches to the exercising of body and mind that foreground self-observation and awareness. Both are sometimes referred to as part of a set of techniques for mind-body training or therapy known as somatics or psychophysical education.⁵ These techniques are often seen to have roots in Eastern philosophy in the ways in which they regard mind-body connections, but they are equally informed by thinking about bodies that has evolved within the context of Western philosophy and science.

This suggests the existence of an epistemology, or theory of knowledge, that affects body-based practices and renders a picture of how technology arrived in the 20th century already integrated in minds, bodies and the way movement is seen and understood; and hence has had an implicit role in the development of contemporary dance. It is not possible to fully develop this view in such a short essay; but one can begin to sketch in some of the possible details of a bigger picture. In this *technological epistemology* of the body, the machine (mechanism, apparatus or instrument) holds a central position as a metaphor for its functioning. The remainder of this essay will provide a partial exposition of the implications of this notion by focusing on a salient point in the history of movement science that should inspire us to consider the ramifications of the machine-body relation further.

(See **Illustrations** in the published French version: Thesis Page 415 from top to bottom. Top: Showing division of the gait cycle of a child by David Sutherland who established one the first motion analysis laboratories in San Diego in 1974. Bottom: A different division of the gait cycle of a child by David Winter who founded first clinical gait laboratory in Canada in 1969. Source: <http://www.univie.ac.at/cga/history/modern.html>)

(See **Illustrations** in the published French version: Thesis Page 417 from top to bottom. Top: Novel locomotion study tools: the "glass cage" and "simplified glass

cage" described by Charles Duroquet in his book *Walking and Limping: A study of Normal and Pathological Walking*. JB Lipincott Co. 1965. Bottom: Exoskeletal goniometer examination of lower limb motions during walking at different speeds From Larry W. Lamoreux, 'Experimental Kinematics of Human Walking', Ph.D. Thesis, University of California at Berkeley, 1970. Source: <http://www.univie.ac.at/cga/history/ww2.html>)

Our fascination with how we move can be traced from Aristotle's studies of animal locomotion around 350 BC to the modern day analysis of gait. From this classical period to the 18th century 'Age of Enlightenment', a handful of scientists and philosophers are credited with contributing crucial research toward the theory of human movement. This always overlapped with concurrent discoveries in other areas, but 17th and 18th century insights into the laws of physics in particular constituted a major theoretical support still significant today. Since the turn of the 20th century there has been a rapid expansion of knowledge in the field of movement studies, due in part to the invention of new instruments for recording movement. Today biomechanics and kinesiology (both referring to the study of human movement) are applied across a wide range of disciplines ranging from sports and dance science to ergonomics, biomedical engineering and occupational therapy.

But it was in the 19th century in 1836, that the Weber brothers, Wilhelm and Eduard, published their treatise *Mechanik der Menschlichen Gehwerkzeuge* (Mechanics of the Human Walking Apparatus); cited as the first "comprehensive theory of the kinematics of walking and running, based on systematic experiments".⁶ Published again in German in 1894, *Mechanik der Menschlichen Gehwerkzeuge* was translated to English in 1992, a testament to its historical importance for the field. Combining rigorous experimental methods and techniques innovative at that time, optical instruments from the collection of physics in Göttingen and experiments with

cadavers from the Anatomy Institute of Leipzig, the Webers initiated the modern study of human movement. With these methodological innovations and relatively "primitive equipment" (clocks and measuring tape), they were able to infer much about the mechanics of walking. Even today's sophisticated 3-D motion capture technology has not been able to produce a "correspondingly large contribution to our knowledge of this complex phenomenon."⁷

In a review of their own treatise, Wilhelm Weber states that previous attempts to measure and analyse human movements had been "mostly unsuccessful".⁸ He cites the work of the iatromathematicians, a school of Italian physicians who in the 17th century attempted to apply the laws of mechanics and mathematics to the human body. Weber writes "they stirred up hope of disclosing (...) the inside of the wonderful workshop of the human body as insight into the world's systems had been based on the brilliant discoveries of Galileo, Kepler and Newton."⁹ Their failure to do so did not mean that mathematics were not useful for movement science. The Webers themselves relied on being able to calculate the forces effecting walking and running, as did others.¹⁰ But what had been missing was a new way of looking at movement and in particular 'seeing', that which could not be seen. Having invented techniques for doing this, the Webers systematically refuted the efforts of researchers before and during their time, from Aristotle to P.N. Gerdy (who published a dissertation on the human gait in 1829) citing data collection methods that relied on *general observations* insufficient for revealing the mechanics underlying even basic movements.

The brothers' criticism of general observation are summed up in the following series of remarks,

"It is clear that the methods which have been used so far did not and will not provide clear concepts of these movements. The multiplicity and variety of movements in walking and running if all parts of the body are to be considered at the same time are too considerable to distinguish, just by looking, the essential from the non-essential (...). To attain this end one is forced to pass from simple observations to

experiments. Instead of restricting oneself to looking at walking and running people in general, one must use the available means to resolve the combined phenomena into their simple components and to study these components and their interrelations. One must study the size, shape and links of the different parts. (...) Finally, one must measure time, space, masses and forces in walking itself. These experiments must be repeated many times successively to acquire the measurements, which cannot be made all at once. The experiments must vary to distinguish in these movements what is constant and what is not, and for the variables one must find the law of their dependence."¹¹

The Webers determined that artists also suffered from the limitations of general observation and the inability to 'see' movement mechanics correctly. Because relations between the different parts of the body change too quickly to be "completely imprinted on the senses and in the memory instantaneously" those artists who draw and paint the human figure lack the means "directly to perceive in Nature (...) the true circumstances as they actually take place".¹² This remark in the book leads them to explaining their main discovery that had a direct bearing on artists drawing the human body; the correct inclination of the pelvis at the base of the spine. Previous investigations of anatomists and movement researchers had never, according to the Webers, revealed the extent to which the pelvis was inclined forward so as to support the lower lumbar curve of the spine; both essential to human locomotion. This inspired them to 'redraw' history by adjusting one of the illustrations of the well-known German anatomist Bernard Albinus published in the *Tabulae sceleti et musculorum corporis humani* (Tables of the skeleton and muscles of the human body) in 1749. The Webers write that their copy of the Albinus image, which tilts the pelvis forward by an angle of 21 degrees, is "aimed at showing how erroneous this picture is (...) although currently considered one of the best."¹³

(See **Illustration** in the published French version: Thesis Page 419: A copy of the original Albinus plate showing the incorrect upright position of the pelvis and diminished lumbar curve. From: *Albinus on Anatomy*. R.B. Hale, T. Coyle, Dover, New York.)

(See **Illustration** in the published French version: Thesis Page 420: The measurement of the correct positional tilt of the pelvis. From: *Mechanics of the Human Walking Apparatus*. Berlin, Heidelberg, New York: Springer-Verlag, 1992)

Albinus was well known for using a variety of measuring instruments and combining meticulous attention to detail with overlapping observations, and his illustrations were considered the "new norm eventually replacing the Vesalian images that had been the mainstay of anatomical illustration for over two hundred years."¹⁴ It is an indication of the confidence they had in their research that the Webers could correct what was practically dogma at the time. Presumably emboldened by the extent of their discoveries, the brothers also speculated on a rather extraordinary possibility. They imagined that their discoveries might enable someone in the future to build walking machines "which will replace camels and other animals even in impracticable countries where [wheeled] vehicles cannot be used." They speculated that,

"if it can be demonstrated (...) that walking and running are such mechanical movements able to be predicted by calculation that a voluntary act of will is not needed (...) then the possibility arises of a machine, for instance moved by steam, going by itself on two, four, six or more legs."¹⁵

More practical was their proposal that some of their work might find an "application in the marching of troops".¹⁶ Locomotion studies were considered particularly valuable in the eighteenth and nineteenth centuries when they were, according to historian Mary Mosher Flesher, the key to success in battle. In 1997, Flesher published an article on the relationship between 'marching theory' as developed in the context of Prussian military science and the Webers' locomotion studies.¹⁷ She asserts that the brothers' research was oriented towards the concept of "natural self-regulation", which was different from the strict precision training the military had been using, quite successfully, with their infantry up to that point. Flesher then observes that the direction of the Webers' research began to merge with changes in military strategy in the 19th century as the emphasis in battle moved to smaller

clusters of men skirmishing rather than marching en masse across the battlefield. Therefore, despite the Webers' own proclaimed "lack of knowledge" in the field of military science, according to Flesher their locomotion research was to prove important to it.¹⁸

(See **Illustration** in the published French version: Thesis Page 422: The zoetrope, invented in 1834 by William Horner. Source: <http://www.thebigcamera.com.au/Zoetrope.html>)

The above mentioned use of optical instruments to collect data for the development of their theory seems to have mainly comprised a telescope affixed with a glass scale, making it possible to survey and accurately record measurements of a person moving.¹⁹ The Webers also provided some verification for their theories by using the zoetrope, although never referring to it as such, a new device that could produce the illusion of a moving image from a series of drawings. Invented in 1834 by William Horner, the zoetrope is considered one of many 19th century animation inventions leading up to cinema at the end of the century. The Webers write: "It is interesting to illustrate the space and time data determined absolutely according to the theory, by building and drawing the position of the limbs at each moment of walking and running regularly" and gluing the resulting series of pictures onto the "internal surface of a cylinder or of a drum".

"The length of the construction must be equal to the length of a double step. The drum is rotated at an even speed during the time of the double step. The figures are observed through slits opposite in the wall of the drum. (...) Their movements show a surprising similarity with the movements of a man actually walking or running."²⁰

Forty to fifty years later, the invention of photographic techniques to capture still images in rapid succession would usher in a new phase of locomotion science. It was partly photography that made it possible for the "correction and completion" of the Webers' walking and running research by Braune and Fischer in Leipzig who

published their work in a series of papers from 1895 to 1904 in the *Proceedings of the Royal Saxon Society of Sciences*.²¹ Eventually these would be assembled, translated and published as a book in 1987 under the title *The Human Gait*.²² While the Webers' *Mechanics of the Human Walking Apparatus* has a special place in the history of movement science, it is the revising of their research by Braune and Fischer that is today more scientifically significant. Just as the Webers used the latest research methods and instruments to correct the errors of their predecessors, including the redrafting of Albinus' famous skeleton; Braune and Fischer were similarly able to further unlock and reveal the secrets of locomotion, partly by using crucial tools and information the Weber brothers lacked.

Conclusion:

The *Mechanics of the Human Walking Apparatus* is one piece of evidence that our machine-body relations and the tendency to look technologically at bodies began far before the start of the 20th century. Based on an understanding of the physical forces acting on it and objectified as both mechanical and apparatus-like; the body as constituted by their research seems very close to that of their imagined walking machine. The Webers made many discoveries, some still accepted as correct, and their research remains epistemic* in the sense that it was and remains a body of ideas that determined certain knowledge at a particular time. The fact that some results have been revised by subsequent research does not diminish their impact on how moving bodies are imagined, and this imagination, the primary domain of the arts, is still under the influence of this body (of ideas) from the early 1800s.

Today, theories of movement overlap with theories of mind. Despite radical developments in the science of physics, we still live on a daily basis in Newton's world and the problem for the body of inertia and his explanation of that problem remain the same. However, the complex movement system of scrutiny today is more the brain than the levers and fulcrums comprising the mechanical body of the

Weber brothers. Researchers now model complex relations between action and perception to better understand how movement is the result of cooperation and anticipation amongst many senses.²³ Movement analysis today is accomplished with a complicated array of new instruments, hardware and software that can capture and process increasingly higher resolutions of data. As the science and culture of informatics plays a greater and greater role in helping to handle the experimental data that has resulted; the metaphor has evolved from a machine to an information body, more of an abstraction than an apparatus.

As mentioned at the start of this essay, many important histories of the relation between art, dance and technologies are to be found in the 20th century. This close, if brief, look at the *Mechanics of the Human Walking Apparatus* suggests how the technological arrived already integrated into our perception of bodies and movement; and is thus another perspective on the basis of these histories that follow.

Scott deLahunta

Amsterdam, 28.06.2004

(with thanks to Susan Rethorst for editing assistance)

Endnotes: (all URLs accessed as of 28 June 2004)

¹ Frank Popper. *Art of the Electronic Age*. London: Thames and Hudson, 1993. p. 10.

² Noah Wardrip-Fruin and Nick Montfort, eds. *The New Media Reader*. Cambridge, MA: MIT Press, 2003. p. 83. "The 'Happenings' are a touchstone for nearly every discussion of new media as it relates to interactivity in art."

³ See: Scott deLahunta. 'Periodic Convergences: Dance and Computers'. In *Dance and Technology: Moving towards Media Productions* (eds. Söke Dinkla and Martina Lecker). Berlin: Alexander Verlag, 2002. pp. 66-87. Merce Cunningham. *Changes: Notes on Choreography* (ed. Frances Starr). New York: Something Else Press, 1968. no page number. "Dances can be made on computers, pictures can be punched out on them, why not a notations for dance that is immediately visual?"

⁴ See: Hillel Schwartz. 'Torque: The New Kinaesthetic of the 20th Century'. In *Incorporations (Zone, vol. 6, eds. Sanford Kwinter and Jonathan Crary)*. Cambridge, MA: MIT Press, 1992. pp. 70-127.

⁵ Bonnie Bainbridge Cohen. *Sensing, Feeling and Action: the experiential anatomy of Body-Mind centering*. Northampton, MA: Contact Editions, 1993. Lulu Sweigard. *Human Movement Potential: Its Ideokinetic Facilitation*. New York: Harper & Row, 1974 There are many websites with somatics content. For one that discusses somatics in the context of western medicine see: Jeffrey Ives and Jacob Sosnoff. 'Beyond the Mind-Body Exercise Hype'. in *The Physician and Sportsmedicine*. vol. 28: no. 3, March 2000. URL: http://www.physsportsmed.com/issues/2000/03_00/ives.htm

⁶ Paul Maquet. In the 'Translators Preface'. Wilhem Weber and Eduard Weber. *Mechanics of the Human Walking Apparatus*. Berlin, Heidelberg, New York: Springer-Verlag, 1992. [*Mechanik der*

Menschlichen Gehwerkzeuge. Dieterich'sche Buchhandlung, 1836; Berlin: Verlag von Julius Springer, 1894)].

⁷ Aurelio Cappozzo and John P. Paul. 'Instrumental Observation of Human Movement: Historical Development'. In *Three-dimensional Analysis of Human Locomotion*. P. Allard, A. Cappozzo, A. Lundberg and C. Vaughan, eds. New York: John Wiley & Sons, 1997. p. 7.

⁸ Wilhem Weber and Eduard Weber. *Mechanics of the Human Walking Apparatus*. Berlin, Heidelberg, New York: Springer-Verlag, 1992. p. 226.

⁹ Ibid.

¹⁰ One later example was in the 1930s when Russian physiologist Nikolai Bernstein developed the first differential equations to describe motor function in his research into movement coordination. For an interesting discourse on this in relation to the evolution of Rudolf Laban's work see: Hans-Christian von Herrmann. 'Movement Notation: An Examination of Rudolf von Laban's Kinetography around 1930 in the Context of the History of Science and Media History'. In *Dance and Technology: Moving towards Media Productions* (eds. Söke Dinkla and Martina Leeker). Berlin: Alexander Verlag, 2002. pp. 134-161.

¹¹ Weber and Weber. p. 216.

¹² Ibid. p. 3.

¹³ Ibid. p. 222.

¹⁴ See: Fisher Rare Book Library, Digital Collections, University of Toronto. 'A Brief History of Anatomical Illustration'. In *Anatomia 1522-1867*. <http://digital.library.utoronto.ca/anatomia/> and http://eir.library.utoronto.ca/anatomical_plates/application/history_illustration.cfm

¹⁵ Weber and Weber. pp. 1-2.

¹⁶ Ibid. p. 4.

¹⁷ Mary Mosher Fletcher. 'Repetitive Order and the Human Walking Apparatus: Prussian Military Science versus the Webers' Locomotion Research'. In *Annals of Science*. September 54(5), 1997. pp. 463-487.

¹⁸ Weber and Weber. Foreword, p. VIII.

¹⁹ Cappozzo and Paul. p. 4.

²⁰ Weber and Weber. p. 218.

²¹ Paul Maquet. In the 'Translators Preface'. Wilhem Weber and Eduard Weber. *Mechanics of the Human Walking Apparatus*. Berlin, Heidelberg, New York: Springer-Verlag, 1992.

²² Wilhelm Braune and Otto Fischer. *The Human Gait*. Translated from the original German papers (1895-1904) by P. Maquet and R. Furlong. Berlin, Heidelberg, New York: Springer-Verlag, 1987.

²³ See: Alain Berthoz. *The Brain's Sense of Movement*. Cambridge, MA: Harvard University Press, 2000.

'Blurring the Boundaries: interactions between choreography, dance and new media technologies'

in *Interface Cultures: Artistic Aspects on Interaction*. eds. C. Sommerer, L. Mignonneau, D. Gestrich. Bielefeld: transcript. 2008, pp. 225-235.

In early 2004, I received an invitation from Leire Llano to contribute an essay "related with dance and new technologies" to an online Spanish journal she was setting up. I proposed to develop a presentation I gave in April at METU (university) in Ankara into an article for her and she agreed. The article was published soon after in April 2004 as: "Blurring Boundaries/ a theory of the artwork" [parts I and II]. in: COMPAS: virtual dance magazine bcn.¹

Three years later, in April 2007, I was invited to take part in a lecture series organised by Christa Sommerer and Laurent Mignonneau, directors of the Interface Culture Program at the University of Art and Design Linz. In October 2007, I was invited by Dorothée Gestrich to develop my lecture for a publication they were preparing out of that series along one of two lines, "on Interactive Media Technologies and/or The Choreographic Resource: Software for Dancers".² As I had already proposed the piece on 'choreographic resources' to Performance Research, [see No. 27], I suggested to rework the "Blurring the Boundaries" for their publication, and they agreed.

¹ <http://www.compasbcn.com/> (accessed 7 May 2010).

² Email to the author, 3 Oct 2007.

**BLURRING THE BOUNDARIES -
INTERACTIONS BETWEEN CHOREOGRAPHY, DANCE
AND NEW MEDIA TECHNOLOGIES**

SCOTT DELAHUNTA

The connections between dance and technologies can be looked at from five fundamental perspectives:

- Historic: Separate but often overlapping contemporary arts practices; modern/ post-modern dance having evolved alongside the electronic and media arts
- Creative: An artistic tool in particular in the form of the digital computer; technology integrated into a variety of genres such as music, film, graphic arts, etc. and to an increasing extent in the creation of dance
- Inter-disciplinary: A field that encourages collaborations between programmers, media and performing artists to which radically different skills and approaches are brought
- Aesthetic: adding to the lexicon of contemporary arts practice concepts such as ›real-time‹ and ›interactivity‹ which link technologies and performance
- Symptomatic: As rapid societal changes, information and communication technologies provoke questions and interactions that may be reflected in performing arts practices.

In this paper, I draw on only some of these connections: primarily on the notions of creative/artistic tools and interdisciplinary practices to examine what might constitute an artwork in which both dance and technology may feature. Using examples of several practicing artists, I hope to elucidate a diverse field of arts practice defined neither by adherence to tradition/convention nor its opposite avantgarde/ experimental, but more by the capacity for switching between modes of practice and artistic media/ materials. This capacity is one that I will refer to as *blurring boundaries*.

The Artwork **imagining a set of open-ended relationships**

To illustrate how artworks that involve dance and technologies might occupy various positions within this concept of blurring boundaries I will use some of the following works of artists Klaus Obermaier, Mark Coniglio, N&N Corsino, Rosemary Lee/ Nic Sandiland, Prue Lang, Scott Snibbe, Marie Sester and Blast Theory.

Body Scenography: Klaus Obermaier transforms our perceptions through media performance

The performing arts have traditionally relied on a clear separation between the stage and the spectator; where the performers remain on one side of the proscenium arch (or the idea of this arch) and the audience on the other. The integration of media technologies in the framework of this convention is dependent at least partly on the knowledge of how projections and lighting work together on stage scenographically. The work of Vienna based director/composer Klaus Obermaier provides us with a good example of this.¹ Obermaier has developed and produced two unique dance works that have used the dancer's body as the primary video projection surface. The first of these, *D.A.V.E.*, which premiered in 2000, was created with collaborator/dancer Chris Haring and has toured in over fifteen countries. However, despite many audience members being convinced they were seeing a ›interactive‹ media dance piece, the production of *D.A.V.E.* involved no such technology. Obermaier intended only that the relationship between body and projected image would successfully drive the linear narrative of the piece on stage. The timing and location of the projections on the stage is all pre-choreographed, so for the visual effects of the ›moving body projection‹ to work, Haring has to be able to perform the same movements at the same place on stage every performance.

Following the success of *D.A.V.E.*, Obermaier and Haring created another piece using body projection titled *Vivisector*. Obermaier's aim this time was to generate a more abstract perception of the body in the mind of the audience, so *Vivisector* uses fewer literal images projected on the body, often using the projector only as a light source.

1 Klaus Obermaier website: <http://www.exile.at/> (April 14, 2008).

Figure 1: Klaus Obermaier: *D.A.V.E.* (2000).



Credit: Klaus Obermaier.

As with *D.A.V.E.*, the success of the piece relies on the performers/dancers being able to be in the correct place on the stage at the right time to become canvasses for the projections. *Vivisector* also takes the 'moving body projection' concept further by working simultaneously with four dancers on stage rather than one. And, as with *D.A.V.E.*, the aim of the work is not to emphasize the wonders of technology but to foreground the body in a media landscape, and, in *Vivisector*, to reflect something fundamental about the nature of perception.

For the next work in this series of moving body projection projects, Obermaier collaborates with technology specialists of the Ars Electronica Futurelab to develop a piece for the stage that uses sophisticated motion tracking and real time video synthesis and projection technologies to enable the performers to move freely about the stage while still serving as the surface for the image. The result of this collaboration premiered at the Ars Electronica Festival in September 2005.²

Isadora Software: Mark Coniglio puts interactive media creation in the hands of the dancer

Partly due to the technical challenges of the project, partly because of his artistic approach, Obermaier's interactive project for the stage relies on a successful collaboration between specialists in specific domains. Until

² Obermaier's new work is partially supported by DAMPF, a European joint performing arts/ technologies research project: <http://dampf.v2.nl> (April 14, 2008).

recently, dance and technology projects nearly always required collaboration between dance and new media artists/computer scientists partly because the software for complicated interaction and real time digital media processing could take a long time to learn to use. Now that the standard more affordable desktop and even portable computer is powerful enough to be integrated as an artistic tool into a variety of arts genres there are many more choices of creative software available, some of which has been designed for use by the non-specialist. The most important addition to this area is the contribution of performance and media artist/ programmer Mark Coniglio of a non-specialist software programmed specifically for the dance and theater maker named *Isadora*.

Coniglio is co-director with choreographer Dawn Stoppiglio of the multi-media performance company *Troika Ranch*, based now in New York City.³ Founded in 1993, *Troika Ranch* integrates interactive real time systems into their performance work, and Coniglio has written most of the software to support this. Some years ago, he began to develop a program that would combine the functionality of several existing softwares he was using and be simple enough for the non-programmer to work with creatively after only the briefest of introductions. The result is the software program *Isadora* (after the modern dance pioneer).⁴ While it was made and priced with the performing artist in mind, *Isadora* is so well designed and multifunctional it is used by many artists working in interactive installation and performance, sound art, mixed media and club culture.

Figure 2: *Isadora* used in *Troika Ranch's 'Future of Memory'* performance, performer Sandra Tillet.



Photo Credit: Richard Termine.

3 Troika Ranch's website; <http://www.troikaranch.org/> (April 14, 2008).

4 Download a trial version of *Isadora* from <http://www.troikatronix.com/> (April 14, 2008).

Isadora features the module and patch cord interface that would be familiar to users of more difficult to learn software (such as *Max/MSP*)⁵, but Coniglio has developed sophisticated labeling that explains clearly through text and graphics what each module is doing. This makes it relatively easy for the non-software specialist to quickly and intuitively integrate digital media into his or her creative process. It is this ease with which *Isadora* makes it possible for the choreographer or theater maker to independently make edits and changes to the media in the context of the rehearsal process that makes this software a unique and notable addition to the field of creative software tools for the performing arts. By breaking down distinctions based on expertise and through its increasing use by artists working in different genres, *Isadora* contributes to blurring the boundaries of what constitutes the making of an artwork.⁶

**Choreographers making installations
N&N Corsino choreograph for 3-D computer
environments; Rosemary Lee and Nic Sandiland compel
viewers to dance; and Prue Lang transforms the space/
time of choreography via other means**

Artworks involving dance and technologies do not always manifest in performances for the stage, but may involve the audience as participants or performers. These projects have tended until recently to be created by those specializing in interactive media, but today one can point towards choreographers who are blurring the boundaries of their disciplines by making non-stage based, installation works.

Combining 3-D motion capture, computer gaming environments and choreography, *Topologies L'Instant* (2002) is an installation work by French choreographers Norbert and Nicole Corsino.⁷ In the piece, the viewer/participant navigates freely throughout the five levels of a 3-D computer graphics environment using a standard handheld game controller to accelerate forward or backwards and turn left or right. The

5 Max/ MSP is popular but complicated to learn software for use in interactive art making: <http://www.cycling74.com/> (April 14, 2008).

6 For a longer online interview with Mark Coniglio about *Isadora* and artists using this software see: <http://huizen.dds.nl/~sdela/sfd/isadora.html> (April 14, 2008).

7 N&N Corsino have done some of their past research in association with CICV (Centre International de Création Vidéo – <http://www.cicv.fr>). (April 14, 2008).

space is comprised of largely flat, desertlike landscapes where one encounters surreal sculptured video walls, modernist semi-transparent multi-level buildings and strange empty structures. Scattered amongst these are dancing figures animated by movement sequences recorded using 3-D motion capture. One can approach these figures from any direction and pause or slow their movement down. This world is there to explore in one's own time from any perspective. It is a significant achievement and a sign of things to come.⁸

Recently commissioned by the Arts Council England through the innovative Capture series supporting choreographers to work in the field of screen based and interactive media, choreographer Rosemary Lee and electronic and media artists Nic Sandiland have created and premiered a new interactive installation based artwork titled *Remote Dancing* (London premiere, February 2004). As described in the brochure the piece is »A video installation where the interaction of the viewer and on-screen dancer becomes an intimate pas de deux. Remote Dancing is an ingeniously simple concept. Rich in possibilities it uses new technology and allows each viewer to experience their own compelling and unique dancing partnership.«

The installation is built around a long corridor that uses ultrasonic sensors to determine the participant's exact distance from the video projection at the corridor's end and uses this information with the *Isadora* software to control the position or key frame of the video image. Imagine you are the viewer/participant: the image on the screen is of a single person dancing towards you as you walk (or dance yourself) down the corridor. When you move all the way to the rear of the corridor it triggers the video to play back the image of another person dancing towards you on the screen. As can be seen in the following picture taken from the publicity for the installation, the dancers are from different generations and if you stay in the corridor long enough you will see all six. As you move forward and back you can slow, speed up or pause the dancers in the middle of a jump or leap. Their exuberant movement encourages an unusually strong empathic connection to the projected image that elicits sympathetic movements from the viewer/participant that begs the question where lies the choreography in this work – with the dancers on the screen or the »dancer« in the corridor?

The following artwork from emerging choreographer Prue Lang, a performer with Williams Forsythe's Ballet Frankfurt, does not use

8 For more information about motion capture technologies used with dance projects see some of these reports on line: <http://huizen.dds.nl/~sdela/mcrl/>; <http://www.dartington.ac.uk/staff/sdelahunta/uci/rivrep.html>; <http://huizen.dds.nl/~sdela/transdance/report/> (April 14, 2008).

interactive technology, but is worth mentioning because of its contribution to the growing phenomenon of dance artists making installation based work. Lang's Infinite Temporal Series is referred to as »a choreographic installation [...] inspired by the writing of Jorge Luis Borges, the work explores performance via experimental narrative structures of simultaneous temporalities«. The set is described as a self-contained performance space consisting of a row of five adjacent rooms each with its own dancers and with a bench for audience seating. From this bench the audience members (maximum 30) are not only sitting in a very close relationship to the performers in their room, they can also see through windows cut into each of the walls to the subsequent rooms. »Spectators can move freely from room to room during the performance to construct their own individual and multi-perspectival experience of the work.«⁹

Media Artists making choreographies: Marie Sester and Scott Snibbe design and merge politics, play and movement

In the non stage-based work mentioned above dance artists explore the freedom to move between roles and genres in the search for the appropriate space/time contexts to situate artworks. But when the relations between these different components of the artwork are mutable then why not reconsider not only what might comprise the dance element of the work (as was the case with *Remote Dancing* mentioned above), but also who might take up the role of the choreographer.

Marie Sester and Scott Snibbe are interdisciplinary artists whose work features not in performing arts contexts, but in interactive media art events such as the annual Ars Electronica festival in Linz, Austria. Neither would refer to themselves necessarily as choreographers, and yet both of the following artworks (which were exhibited at the Ars Festival September 2003) elicit playful and physical responses from those who take part in them.

Marie Sester's *Access* (2003) is described as »a public art installation that applies web, computer, sound and lighting technologies in which web users track individuals in public spaces with a unique robotic spotlight and acoustic beam system. The robotic spotlight automatically

⁹ Ibid.

follows the tracked individuals while the acoustic beam projects audio that only they can hear.¹⁰

Figure 3: Marie Sester: *Access*, Ars Electronica Festival 2003.



Photo: Marie Sester.

Sester's intention with this work is partly to explore and raise awareness of the politics and implications of surveillance systems through connecting the actions of an anonymous group of web users to a public unaware they are being seen on line. These aims can be understood by taking the work as a whole into consideration. However, much of what takes place only in the focus of the spotlight is spontaneously playful and filled with motion. The spotlight seemingly locks onto someone in the public space, making him or her the center of attention (and the performer). The beam can be difficult to 'escape' which inspires all manner of energetic and evasive movements. If there is no one on line, the system reverts to a default automatic system. In both circumstances, it is possible to 'fool' the system by moving very close to someone else in the space making the beam jump to them. From this playfulness with the moving beam emerges an unpredictable but conditional choreography partly authored by the machine and/or by the participants on the web and partly by the participants in the public space.

Scott Snibbe's *Deep Walls* (2003) installation similarly inspires playfulness from the participants and this engagement is Snibbe's

10 Marie Sester: website: <http://www.sester.net/> (April 14, 2008).

primary aim. He describes his work as consisting »primarily of electronic media installations that directly engage the body of the viewer in a reactive system.« *Deep Walls* is based on a simple but effective concept. It involves the projection of a single frame within which there are sixteen smaller frames. As the viewer moves in front of the screen his or her moving shadow silhouette is recorded and played back in one of these sixteen smaller frames after the viewer moves out from in front of the screen. One after another, each of the sixteen smaller frames is filled with shadow recordings continuously looping until all the small frames are filled, at which point the first to have been filled is replaced and a new cycle begins.

It is possible either alone or with others to enter this installation space and build up a complex choreography that will exist in the relations between the sixteen frames. This can be done to varying degrees by chance; but is likely to evolve into a design choice as one is quickly inspired to fill the small frames with a chosen gesture or movement to interact with those that have already been left. It is possible to watch movements as they are being created or enter at some point when no one is in the space when the recordings of the last group of spontaneous dance makers are still looping in the frames.

Both of these artworks blur the boundaries and beg the question what constitutes choreography and who is the performer and who is the dance maker.

Choreographing the city: Blast Theory challenge and then raise our expectations for artworks involving choreography and new technology

It would be negligent to write about artworks that blur boundaries of practices involving performing arts (dance/theater), media artists and computer programmers and not mention the work of the devised theatre company *Blast Theory*. Based in the United Kingdom, Blast Theory has been stretching the definitions of theater and choreography for over a decade. In 1997, they had the initial meeting that lead to a long-term collaborative relationship with the *Mixed Reality Lab* (MRL) at the University of Nottingham out of which several successful artworks have emerged. The first was *Desert Rain*, which premiered in Nottingham in November 1999. This work is often described as a combination of

installation, theater and computer game and was created for an audience of six people at a time.¹¹

But it is the collaboration after *Desert Rain* between *Blast Theory* and the *MRL* involving mobile and wireless technologies that I wish to mention briefly here in the context of this article. *Can You See Me Now?* is a game/performance that happens simultaneously online and on the streets. First played/performed in the city of Sheffield, UK in December 2001, the game involved members of the *Blast Theory* company on the streets of Sheffield using wireless mobile computers equipped with the global positioning system to pursue on line players who were visible on the virtual map of Sheffield shared by both groups. The objective was for the online players to evade the *Blast Theory* runners for as long as possible. The runners on the ground communicated and shared pursuit strategies with each other using walkie talkies, and this audio stream was available to the online players.

A more detailed description of the work can be found on the Equator website listed in the references, but what is important to consider in the context of this article is the choreography in the city that emerges during a game/performance of *Can You See Me Now?*, one in which both virtual and real participants flow together in patterns of movement constituted by a communication system involving audience, viewers, participants, performers and players.¹²

In this paper, I have examined some examples of artworks in which both dance and technology feature and by implication help to constitute these works now and in the future. In some of these examples, we observe that interactive and media technologies suggest spaces and times that do not conform to the standards and conventions of the stage, contributing to a shift in relations between maker, audience and performer. Now what might be added to this field of blurring is the freedom for the choreographer or media artist to conceive of themselves as makers of and within new realms (sites, spaces and models) rather than solely specialists within a particular domain.

11 You can easily find materials about this work online; in addition to Blast Theory's own site (<http://www.blasttheory.co.uk/>) I recommend the following links: DEAF discussion notes: <http://huizen.dds.nl/~sdela/dr/>; eRENA report site: <http://www.nada.kth.se/arena/desert.html>; and deliverable: <http://www.nada.kth.se/arena/doc/aD7b3.html> (April 14, 08).

12 »Can You See Me Now« archive website for the first staging of the work in Sheffield in December 2001: <http://www.canyouseemenow.co.uk/>; Equator website with reports and documentation: <http://www.equator.ac.uk/index.php/articles/c62> (December, 2007).

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'What's in a Phrase?'

Co-author Phil Barnard. in *Tanz im Kopf / Dance and Cognition*. eds. J. Birringer & J. Fenger. Jahrbuch der Gesellschaft für Tanzforschung 15. Münster: LIT Verlag. 2005, pp. 253-66.

In June 2004, I received an invitation from Johannes Birringer to make a contribution to a book he was co-editing for the German Association of Dance Research on the subject of "dance in the mind/dance in the brain".¹ I proposed to co-author a submission with cognitive psychologist Phil Barnard and use it as an opportunity to write up the results of the Parsing experiment we had conducted during the 'Choreography and Cognition' project.² Barnard was slightly concerned that if we put "core data in that, it could potentially make it difficult to get it into a (science) journal subsequently."³ We went ahead partly on the basis there was insufficient data for a formal science paper.

The Annual Journal of German Dance Research has been published since 1990. It serves to publish lectures that were held during the current year and brings together current theory of dance with contributions from international authors. Source: <http://www.gtf-tanzforschung.de/html/5.htm> (accessed 7 May 2010).

¹ Email to the author, 30 June 2004.

² Documentation site: <http://www.choreocog.net/online.html> (accessed 7 May 2010).

³ Email to the author, 1 Oct 2004.

What's in a Phrase?

Introduction

The concept of a *phrase* derives from music composition and comes into view in the context of dance defining itself as a unique art form in the early 20th Century.¹ Subsequently, it can be traced through a variety of discourses related to choreographic methods from the seminal "Art of Making Dances" by Doris Humphrey, published posthumously in 1959, through more recently published interviews with choreographers.²

Doris Humphrey addresses the organization of movement in time as the "theory of the phrase". The key claim of this theory is that

"the good dance should be put together with phrases, and the phrase has to have a recognizable shape, with a beginning and an end, rises and falls in its over-all line, and differences in length for variety".³

This is a theory not all contemporary choreographers after Humphrey were prepared to accept, and some have worked in direct opposition to it by attempting to make dances from which the phrase was removed. This was made explicit in the work of 1960s dance experimentalist Yvonne Rainer in her performance of "Trio A" and in her published survey of some "minimalist" tendencies in which she proposes to "eliminate or minimize" dance phrasing.⁴ In the early 1970s, under the influence of Eastern mysticism, another American choreographer, Laura Dean, and two other dancers would perform Dean's choreography "Spinning Dance" for one hour during which the only movement is a "high speed, non-stop turn" with one stop and change of direction

¹ See Elizabeth Seldon: *Elements of the Free Dance*, New York 1930 (much of this book is dedicated to distinguishing dance as a unique art form).

² Doris Humphrey: *The Art of Making Dances*, New York 1959. Please see footnotes 5 and 11 for examples of published interviews.

³ *Ibid.* p. 68.

⁴ Yvonne Rainer: "The Mind is a Muscle: A Quasi Survey of Some 'Minimalist' Tendencies in the Qualitatively Minimal Dance Activity Midst the Plethora or an Analysis of Trio A", in: *Work 1961-73*, Halifax (NY) 1974, p. 63.

after 30 minutes.⁵ It was not only the work of the American minimalists that broke with Humphrey's concept of phrasing necessary to constitute a good dance; it could be argued that the use of repetition in the work of German tanztheater choreographer Pina Bausch also strongly contradicts Humphrey's dance theory. And as recently as the late 1990s, in an interview with British choreographer Jonathan Burrows, Meg Stuart, an American choreographer living and working in Europe makes the statement that she has always

"rejected dance phrases. I hoped to eliminate the word or the concept of phrase altogether. [...] I am more interested in a physical state, emotional state, a task, so I try to find other ways to structure a piece."⁶

Despite these alternative and at times antagonistic approaches to Humphrey's idea of the phrase; as all movement is composed of temporal subdivisions, whether referred to as phrases, units, segments or parts, phrasing in dance making may be unavoidable. In the same interview cited above, Meg Stuart says: "I can't say I don't use phrases, I mean I think it's a bit inevitable." For some choreographers making use of the phrase or seeing movement as possible to divide into smaller time units was crucial to their creative process. For example, the choreographic approach of American choreographer Merce Cunningham had a major influence on the functional use of subdivisions of movement in time by beginning, in the 1950s, to use chance methods. Throwing dice to determine the position of a temporal subdivision created combinations or strings of units or phrases that did not always seem to go together naturally. Cunningham found this way of ordering a sequence of phrases required one to discover new ways of moving. He is quoted in the 1985 book *"The Dancer and the Dance"* as stating that the chance method "absolutely rearranged my idea of what coordination was."⁷ His use of this method is often cited as having called into question aesthetic and philosophical questions related to originality and authorship. For Cunningham this ap-

⁵ The reference to Eastern mysticism is from Deborah Jowitt: *Time and the Dancing Image*. Berkeley, Los Angeles 1998, p. 371. The quoted description of the work is Laura Dean's from an edited transcript in: Anne Livet (ed.): *Contemporary Dance: an anthology of lectures, interviews and essays with many of the most important contemporary American choreographers, scholars and critics*. New York (NY) 1978, p. 99.

⁶ Jonathan Burrows: *Conversations with Choreographers* (Meg Stuart, Lunacafe, Brussels 12/3/98) London 1999, p. 9.

⁷ Merce Cunningham: *The Dancer and the Dance* (conversations with Jacqueline Lesschaeve), New York, London 1985, p. 80.

proach also created a more fluid and complex relationship between movement making and composition.

Another following this line of choreographic thinking was the ballet choreographer William Forsythe who, beginning in the mid-1980s, developed a set of improvisation techniques his dancers used to generate phrases or units of movement material that could be fragmented, subdivided and then recombined spontaneously in the context of a performance. In an interview one of his dancers, Dana Caspersen, describes performing within the layered improvisation structure of "ALIE/N ACTION" (premiered in 1992):

"Well, say my thing is I'm supposed to go over to the upper left hand corner, and in the meantime I was supposed to accomplish some part of my gestural phrase, but then I had to help somebody move one of the benches which were on the stage. My time might be up before I'd complete the task, and then I'd have to just make a gesture or stomp in the direction of the unfinished task and then run back to the bench."⁸

As with Cunningham, Forsythe's experimentation with how phrases could be deconstructed into ever-smaller units of movement challenged his dancers mentally and physically, ultimately reshaping their bodies to accommodate these new ideas.

These reflections provide insight into the diverse ways of thinking about the design of movement in time, and unique uses of temporal subdivision in the making of a dance. The divergent phrase/anti-phrase views suggest that how the concept of the phrase is interpreted by a choreographer, its meaning, is as important as its existence as a unit of time. However, for those professions requiring a closer means of viewing and analysing the process and product of choreography – e.g. the dance teacher, critic and theoretician – the concepts of phrasing and temporal sub-divisions prove to be important as ways of looking at and understanding dances. British scholar Janet Adshead engages with the question of whether or not "identifiable principles and practices of choreography exist"⁹ by considering how theoretical articulations can emerge from a close study of a varying range of existing contemporary choreographies. So rather than advocating for the application of one set of principles from which a good dance should derive (vis-à-vis Humphrey), Adshead calls

⁸ Burrows: op. cit. (William Forsythe & Dana Caspersen, Ballet Frankfurt, 6/3/98) 1999, p. 25.

⁹ Janet Adshead (ed.): "Choreography: Principles and Practice (Issues in the Principles and Practice of Choreography: the Area of Study)", in: *Proceedings: Study of Dance Conference 4*, University of Surrey, 4–7 April, 1986, p. 11.

for a closer interrelation between the watching, analysis and making of dances.

One of the primary points at which separations occur between choreographers/dancers and scholars/critics is at the point where analysis and language are brought into play. There is a vast difference (we propose) between what is in a phrase that is articulated through verbal explanation and what is in a phrase that may be grasped at a more intuitive level by other cognitive or sensorial means. One possible way of exploring this difference is to provide a means of reviewing movement with and without verbal articulation. An example of this is William Forsythe's multimedia project "Improvisation Technologies: A Tool for the Analytical Dance Eye".¹⁰ This tool combines short sections of moving with simple animations and the possibility for the viewer to closely review at will shorter or longer movement segments through an interactive interface. There are verbal explanations of his movement theories but one can also see the same ideas performed without explanation. Forsythe describes the tool as one that

"doesn't teach you anything other than how to observe motion. [...] It shows just some of the ways of thinking about analyzing motion."¹¹

The obvious wider question to ask concerns what sources of variation underlie observations and interpretations of dance as it evolves over time. Our own interdisciplinary study, involving London based choreographer Wayne McGregor, ten dancers from his company, *Random Dance*, and psychologists from the *Cognition and Brain Science Unit of the UK's Medical Research Council in Cambridge*, addressed this question on at least two levels. What modes of thinking/analysing with or without verbal articulation occur in the context of different "parsings" (viewing movement sequences and segmenting them into smaller units)? And what value might be gained from tool-supported observation?¹²

¹⁰ William Forsythe: *Improvisation Technologies: A Tool for the Analytical Dance Eye* (CD-ROM and booklet), Ostfildern 2000.

¹¹ Ibid., p. 20.

¹² The interdisciplinary study upon which this article is based took place in the context of Phase II of "Choreography and Cognition", a joint research project initiated by arts researcher Scott deLaHunta and choreographer Wayne McGregor to engage practitioners from the field of cognitive science in seeking connections between creativity, choreography and the scientific study of movement and the mind, <http://www.choreocog.net>

The Viewing and Parsing Exercise

The study took place during the early stage of making a new choreography when Wayne McGregor typically gives his dancers a range of improvisation tasks or assignments in order to generate a large amount of movement material from which the *language* of the new choreography is eventually distilled.¹³ Following two different sets of specific instructions provided by McGregor, four dancers from the company generated eight short movement sequences (two each) specifically for the viewing and parsing exercise. Four were developed following a set of points in space/location instructions and the other four following instructions that were more graphic and image based.¹⁴ These were created and set (not improvised) then each was performed immediately three times and videotaped; with one performance of each sequence to be selected for the viewing exercise. The final eight sequences that were selected varied in duration from 25 to 120 seconds and were converted to a digital video format that allowed presentation during the viewing exercise using Quicktime™ software (Figure 1).

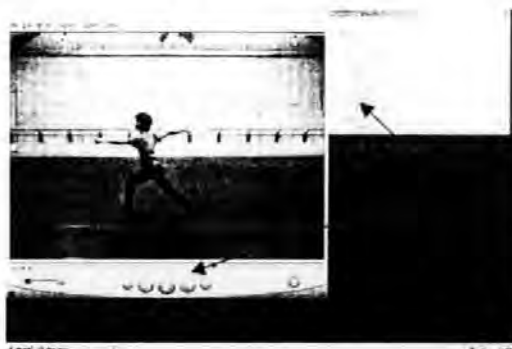


Fig. 1: The Quicktime™ software used for the viewing exercise.

¹³ For more information about Wayne McGregor's approach to choreography see: Jo Butterworth/Gill Clarke (eds.): *Dance Makers Portfolio: conversations with choreographers*. Bretton Hall 1998, pp. 105–113; Jo Butterworth: "Teaching Choreography in Higher Education: a process continuum model", *Research in Dance Education* 5 2004 1, pp. 60–62.

¹⁴ For more information about McGregor's use of instructions and scores see Scott deLa-hunta/Wayne McGregor/Alan Blackwell: "Transactables", *Performance Research* 9 2004 2, pp. 67–72.

This made it possible for the viewers to directly control playback using the control buttons, cursor keys or direct manipulation via the playback head. In addition the movie information window showed the time associated with the current frame being displayed, and the soundtrack was deleted to leave only motion cues for the viewers.

In the viewing and parsing exercise, McGregor and the ten dancers were shown the sequences in a two-stage procedure. In the first stage they were simply asked to familiarise themselves with the full set of the eight selected sequences – simply viewing each in turn without pausing. The viewing order of the eight clips was randomised separately for each viewer. In the second stage they dealt with each piece in turn and did so in four passes through the procedure:

- In the **first pass**, they were again asked to watch the particular sequence without pausing.
- In the **second pass**, they could pause the action or move about the piece using the player controls.
- Only on the **third pass** were they asked to *parse* or divide the sequence into units of their own choosing.
- On a **fourth and final pass** they were asked to review and confirm their unitisation. At this point they were also asked to take a subset of the sequences and make brief notes about the bases of their unitisation.

The key pass was the third one when they were asked to *parse* or divide the sequence into smaller units. We did not wish to presuppose anything about phrases or structure so our instructions left it entirely up to them to determine what a *unit* was; they were simply asked to specify the time at which a unit began and ended. We even left it open for a whole sequence to be marked as an indivisible single unit. Start and end times were read from the Quicktime movie information window and entered onto a pre-prepared response sheet. The response sheet was organised into three columns (marked a, b & c) and this allowed for units to be organised hierarchically or using different bases for subdividing the same sequence. Once again it was left up to the participants to decide if they wanted to use a single basis for unitisation or multiple ones.

The dancers did the exercise in two groups and each group took well over two hours to complete the process. The first afternoon McGregor participated in

the viewing exercise and the second afternoon happened to include three of the dancers who had also created the sequences. At the end of each afternoon that day's participants were debriefed and invited to comment upon and discuss what they felt they had got out of viewing the sequences in this way and the discussion was tape-recorded and transcribed.

Quantitative and Qualitative Results

The viewing and parsing exercise provided a rich source of both quantitative and qualitative data. The core quantitative product took the form of a graphical representation of the distribution of units identified over time. An example of such a distribution for one sequence is shown in Figure 2. This has time running along the horizontal axis and the lines of check marks represent the start-end transition points (which blur together if in close proximity) marked by a particular individual, each of whom is identified by initials on the vertical axis. Notice that the top eight lines are individuals who elected to use only one basis for unitisation while the lower lines show three individuals who elected to use double bases (a, b) or triple bases (a, b, c) for unitisation.¹⁵ The collected qualitative data comes from the brief notes they were asked to make about the bases of their unitisation and the post-session discussions mentioned above.

The data shown in Figure 2 derives from individuals who were more or less familiar with McGregor's methods for generating movement material. As such they might be expected to produce similar results from the viewing exercise. And yet, like a microcosm of the wider evolving choreographic debate about the importance and nature of phrase(s), what is most striking from this particular Figure is not the points where a larger or smaller number of participants agree on the presence of a transition, but rather it is *the extent of variation* in placement of start and end points. The possible sources of this variation are as complex as dance itself, which, in its full staging, involves many dimensions in multiple sensory modalities (vision, audition, emphatic movement) as well as in the knowledge it activates and the interpretations and emo

¹⁵ We have also explored the potential for a second quantitative product to provide more formal statistical evidence about how different methods of movement generation can systematically alter perceived "properties" of movement sequences (such as the number and duration of units), but we will reserve a discussion of this aspect for another paper.

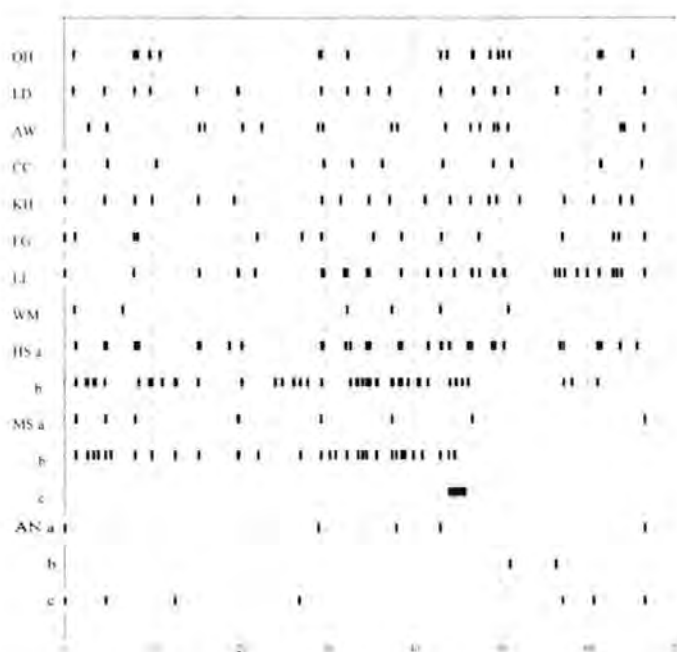


Fig. 2: Graphical representation of units identified by McGregor (WM) and the ten dancers: Claire Cunningham (CC), Laila Diallo (LD), Fred Gehrig (FG), Khamlane Halsackda (KH), Odette Hughes (OH), Léo Lerus (LJ), Ngoc Anh Nguyen (AN), Matthias Sperling (MS), Hilary Stainsby (HS), Amanda Weaver (AW). This graph is the result of viewing a sequence that was generated using the graphic/imagery instructions.

tions it stimulates. Nonetheless, several generic points related to modes of thinking/analysis do emerge from this rather more constrained exercise.

Table 1 extracts a few comments from the participants concerning how they approached the task. All comments are indexed in what follows by Table and entry (e.g. 1.3). Key points are highlighted in boldface. Given the overt request to identify starts and ends, the twin threads of change (1.2, 1.3, 1.4) and flow/coherence (1.2, 1.5) are to be expected as are readily articulable attributes of motion like energy/activity/dynamic/direction (1.2, 1.3, 1.4) or ideas (1.2) and motifs (1.5). A core feature of why phrasing is problematic pervades

their discourse. Parsing and structure is accomplished in relation to some attribute or coherent sets of attributes as they evolve in time.

Index	Comments on overall approaches	Source
1.1	<i>"With some I watched the whole sequence and I would see that as one unit really. Then it became much more of a decision-making process. Then I had to make decisions about what my units would be and keep those to try and be as strict as possible with those. And with others, it came more naturally. I felt I could do it more spontaneously."</i>	Laila Diallo (Dancer)
1.2	<i>"So () partly wherever I found a stop in the dynamic flow or a new idea coming in, or anywhere that I could make a set that was distinct from the rest. And then also partly looking in that way of trying to think about the task that the dancer is doing and when a new idea is coming in, when there's a change of dynamic or there's a change of activity. When it looks like there's a new idea coming in where one thing is finished and another thing begins."</i>	Matthias Sperling (Dancer)
1.3	<i>"There are three ways of breaking down that I was thinking about. The first one was when the task was apparent in the phrase. So you've got a section where you're extending lines or moving parallel lines, and that's very easy to break down. Then there are the more random ones that weren't so clear what the task was, that there was a natural stream of consciousness and it was quite clear where that ended. Sometimes it was obvious with something like a pause or a change of energy or change of dynamic. Then the third was very much like if you were trying to learn something or teach somebody something, where you would automatically break it down into parts that you could re-member. So that kind of thing of when we teach each other phrases and stuff like that."</i>	Claire Cunningham (Dancer)
1.4	<i>"I think one of the clear ways to break something down was when something changed in level or direction, because it was such a definite change. Whether someone's up here and then they're down. Or if they're going that way and then all of a sudden they change direction. Because it was a clear change, that made either the beginning or the end of something, or the end and the beginning of something. That made it easier to read."</i>	Kham Hallsackda (Dancer)
1.5	<i>"The things I kept in were things I felt were in some way articulate choreographic motifs. They were things that existed with a framework and a kind of a sensibility and a cohesion. The things that exist as a thing in their own right."</i>	Wayne McGregor

Tab. 1. Five observations on approaches

Since it is not possible to parse concurrently in relation to all attributes, it is necessary to invoke decision processes and schemes not just for the division of time but also to accommodate multiple perspectives such as the role of the task (1.2, 1.3), learning/teaching (1.3), and exactly what to attend to in dynamic bodily configurations. One dancer for example, paid little attention to the upper body and focused almost exclusively on the feet and legs. Another actually tested phrasal entities by overtly moving her upper body whilst

seated at the computer in order to decide whether a unit "felt right". While the dancers unitized the full sequence, McGregor, the choreographer, tended to select only a few units of choreographic interest, leaving other segments of movement, labelled "choreographic waffle", unparsed. His approach was fundamentally evaluative and critical – a feature that also emerged in the debriefing comments of others but not as a core basis of their temporal subdivisions.

Index	Comments on the bases of unitisation	Source
2.1	<i>"When you asked us to go back to describe why it was a unit, that was really interesting. When I started off the exercise and I was just writing down what I thought was unit, it was almost quite natural. Because I'm so used to looking at movement and doing movement, I just felt like I knew. My brain registered it as a unit. I wasn't explaining to myself why that was a unit. It just was, I could tell. So it's interesting to go back and then look at what I broke down and then actually describe why they were units. I thought that's really strange. To actually justify it to myself why that was a unit."</i>	Kham Halsack-da (Dancer)
2.2	<i>In response to the question about making notes: "Were you uncovering things that you think you knew, or were you trying to invent a reason or some rationale for something?" Phil Barnard "I think the reasons were there or you wouldn't have made the choice in the first place. It was just actually looking at it and pulling it out of our mind, if you know what I mean, to put it into words. Like an instinct sort of thing I think."</i>	Amanda Weaver (Dancer)
2.3	<i>"A part of me was doubting whether my choice for making that whatever it was, into a unit because once I'd described why it was a unit, I thought to myself, well that makes sense to me, but I'm sure that won't make sense to anyone else. So maybe this is where it comes in. Where you're saying we all understand it in our own way, but perhaps because we don't ever do anything like this where we share the reason why. Why is that the end of a phrase. Who have you ever asked? We've never asked each other that kind of question before."</i>	Kham Halsack-da (Dancer)

Tab. 2: Bases of unitisation and their articulability/communicability.

Another source of variation clearly involves a tension between implicitly knowing that something is recognisable as a unit, and being able to articulate what makes it a unit. This particular theme, a feeling of intuition, understanding or just knowing spontaneously (1.1, 2.1, 2.2) on the one hand, and on the other hand the ability to justify (2.1), put into words (2.2), or communicate it to someone else (2.3), was shared by many participants. Other dancers resolved the problem intellectually from the outset – determining highly ana-

lytic and articulable schemes and perhaps laboriously (one managed to complete only five of the eight sequences in the whole afternoon) sticking to them throughout. Interestingly two of the dancers who approached it this way used two or three levels of unitisation (MS and HS in Figure 2).

The observation that several of the dancers found articulation and communication of their bases of unitisation challenging will be of no surprise to those knowledgeable about what is implicit in craft skill as opposed to taught knowledge. However, the activity of producing detailed unitization of movement sequences in the context of the viewing and parsing exercise clearly differs in a number of ways from how the choreographer and dancers who participated in this study normally *view* the content of dance – either in the making or in the performance. The exercise focused their attention on movement elements at varying levels and across several different but related sequences. It led either to the articulation of detailed parsing schemes based around a range of temporal and non-temporal aspects and/or to a recognition that much of what is *in* a phrase normally goes unarticulated. It provided the participants an unusual opportunity for both individual and collective reflection on movement and produced a number of interesting insights as indicated in Table 3 below.

Index	Comments on insights attained	Source
3.1	"I'd look at Kham and before I knew the way he moved and the quality that he would use in his dancing, but now (doing the parsing exercise) I can see the way he phrases it more. If you watch both of them (Kham's phrases) they're quite similar. I think it does make you look at it in a different way and notice more about people."	Amanda Weaver (Dancer)
3.2	"as the exercise went on, also I felt my perspective of how I was looking at the exercise started to change a bit. I think I started off feeling like a unit to me in the beginning was more of a chain of movement. Then eventually it became not only just a chain of movement but perhaps looking at the intention of where the movement was coming from I guess that came out through the quality of what was happening. So it wasn't just about starting and stopping and starting and stopping. There is another level that comes into it. After a while, after you really watch it again and again and again."	Kham Haisackda (Dancer)
3.3	"I think for me it was like empathising with Wayne a little bit, because we're looking at from his perspective, when you're looking at it on the screen. You're looking at what choices people are making to decide whether it's going in the right direction or not. It's a bit like I imagine he has to be in the studio. So we were kind of on the other side today."	Claire Cunningham (Dancer)

Tab. 3: Some insights gained from the viewing and parsing exercise.

Both the qualitative and quantitative products reveal wide variation in the detail of how temporal organization can be grasped – and we have yet to complete the process of identifying what if any features are most likely to be associated with the highest agreement on major transitions. The products also reveal generic themes of inherent analytic ambiguity in the very nature of parsing and uncertainties in what is and isn't readily communicable. Not unlike Forsythe's CD-ROM described in the introduction our task for the dancers made possible alternative modes of watching/analysing and reviewing movement with or without verbal articulation. Our viewing *tool* also generated visual by-products such as Figure 2 to stimulate further discussion/reflection and as such might contribute to the domain of dance education not only in terms of acting as a forcing function for developing a more intricate understanding of what is known or familiar (2.1), for grasping different attributes by changing perspectives (2.2) and for understanding and perhaps facilitating communication among the roles of dancer, teacher and student (1.3) and what the choreographer might be seeking within the making process (3.3).¹⁶

Perhaps most challenging is the question of how viewing exercises of this type might sit in relation to evolving discussions of what constitutes a dance phrase; in relation to watching, analyzing, thinking and theorizing about dance practice and dance composition. Janet Adshead argues that to develop a theory that more robustly supports the variety of extant choreographic practice one needs to get closer to the detailed structure of dances by a "variety of means".¹⁷ Just as when different lenses or filters alter the structure of a photographic image and therefore how it is perceived, the viewing and parsing exercise provided an unusual means of looking at the detailed structure of movement. This was partly because the recording of units could be performed without recourse to explanation initially through the use the software as a viewing *tool*. In doing so the exercise reveals sources of variation whose respective roles are open to clarification, evaluation and debate. Rather than focussing on the significance of isolated features, configural inter-relationships or patterns across sources and levels of variation (ideas, intentions emotional correlates and movement attributes and granularity of temporal scaling) may

¹⁶ For some choreographers and dancers it may be of little or no value to take part in a study such as the one we carried out with Wayne McGregor and *Random Dance*; in particular if they have taken the position of rejecting the dance phrase like Rainer and Stuart. Could it be that a different type of viewing exercise could be designed that would correspond to these other value systems?

¹⁷ Adshead: op. cit. 1986, p. 13.

emerge as the most fertile ground to prosecute such debates. In addition, it is well known that prior to the development of algebraic notations, mathematical reasoning based on lengthy verbal exposition was intellectually cumbersome.¹⁸ Seeing configurational patterns of potential theoretical significance in the domain of contemporary dance could ultimately prove to be facilitated by the development and use of empirically grounded notations such as those of Figure 2 appropriately tailored to support and develop the natural vocabulary of, and alternative perspectives on, choreographic discourse.

Seen from this perspective, the viewing and parsing exercise could provide an explicit and replicable methodology for addressing Adshead's call for a closer interrelation and interaction between the watching, analysis and making of dances. However, we have yet to test the use of this viewing *tool* on a different group of individuals or to expose it extensively to other members of either the dance or the psychology community.

In writing this article together, we hoped to partially accomplish this as well as explore some of the possibilities and limits of the arts and science collaborative research we have been involved with. Interested in continuing to debate and work out answers to some of the questions that have come up in this project, we have put the viewing and parsing exercise on-line where anyone can undertake the procedure and bring their own experience and knowledge to bear on the question "what's in a phrase?"¹⁹

The authors wish to acknowledge the crucial contribution of Anthony Marcel to the design of the viewing and parsing exercise.

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¹⁸ For examples of the value of notations see Henrietta Midonick: *The Treasury of Mathematics*, Harmondsworth 1968, pp. 202-203 or Thomas R. G. Green: "Programming as a cognitive activity", in: Hugh T. Smith/ders.: (Eds). *Human Interaction with Computers*, London 1980, pp. 274-275.

¹⁹ The On Line Viewing and Parsing Exercise can be found at: <http://www.choreocog.net/>.

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'Densities of Agreement'

Co-authors Phil Barnard, Ian Nimmo-Smith, Jennifer Potts & Cristina Ramponi.
in Dance Theatre Journal. 21:3. 2006, pp. 17-23.

In June 2005, I proposed this article to Martin Hargreaves, editor of Dance Theatre Journal, where I am also an Associate Editor. I asked if he would be interested in a short piece co-authored with one of the cognitive psychologists who worked with us on the 'Choreography and Cognition' project that would be accessible and would expose the journal to "this area of arts/ science collaboration". He accepted and commented after receiving it that it, "carefully and clearly details the research in a way that should make it easily accessible to readers."¹

Dance Theatre Journal is the UK's leading magazine for dance and live art. Published four times a year, Dance Theatre Journal contains reviews, features, interviews and in-depth discussions by leading dance writers and artists, as well as talented new writers. It also includes up-to-date listings of dance performances and workshops throughout the UK. Source: http://www.laban.org/home/publications/dance_theatre_journal.phtml (accessed 7 May 2010).

¹ Email to the author, 17 Nov 2005.

DENSITIES OF AGREEMENT: MAKING VISIBLE SOME INTAN- GIBLE PROPERTIES OF DANCE

Scott deLahunta, Philip Barnard, Ian Nimmo-Smith, Jennifer Potts and
Cristina Ramponi

INTRODUCTION

Human movement analysis is a research field pursued by different disciplines in both art and science. Approaches include the physiological study of walking, anthropological research into non-verbal communication and the practice of choreography when it involves observing, describing and representing dance. The shared aim is to break down movement into parts that can then be re-described in relationship to some whole. As a part of this process, movement analysis makes use of various instruments or tools for recording movement from the humble pencil to 3-D digital motion capture technologies.

The recording process results in representations ranging from individual drawings to numeric signs and standardised notation symbols. Any of these will contain some selected subset (features, properties or affordances) as a product of the analysis process. These representations of movement work at differing levels of abstraction, fulfil different functions and the degree of standardisation and usage varies greatly, even within disciplines. An abstraction will be referred to as notational at the point that it tends towards becoming part of a larger syntactic system. Some representations undergo a further process of analysis eventually becoming diagrams meaningful within a particular expert area, e.g. biomechanics. The process of dance analysis and notation eventually may result in a score that is usually assumed, as with a music score, to be awaiting translation back into the live performance.

Despite various disciplines sharing this research interest in movement analysis; no method or approach has passed the threshold of usage or achieved the cultural status to make its notational representations a 'universal' standard; as has occurred with music, mathematics and language.

Instead we have a proliferation of different approaches to movement analysis, some competing some complimentary. One discipline may even try to borrow ideas from another. For example, French philosopher and architect Paul Virilio was interested in whether dance notation could provide alternative measurements of architectural space, a tool for an architect to 'qualify volume' instead of only measuring spatial surfaces.¹ Choreographers may seek to collaborate with specialists in computer-based machine learning building notational structures as part of research into human gesture.

Even without a single accepted standard, the different disciplines do ask similar fundamental questions and share senses of possibility for achieving a better understanding of the complexities of human movement. In addition to adding to current knowledge such as orthographic refinements of an existing notation system, what researchers in this field aim for are innovations that give rise to new thinking. These may range from the development of a new motion capture technology to the creation of an interactive multimedia educational platform such as choreographer William Forsythe's *Improvisation Technologies* CD-ROM, subtitled 'a tool for the analytical eye'. The overall picture here is one of ongoing adaptation and change, trial and error, inquiry and creativity.

This context frames our interdisciplinary 'viewing and parsing' exercise in movement analysis, recording and representation involving choreography specialists, ten dancers, psychologists and a statistician. In a previously published essay, we discussed this exercise and its results in relation to a question many in the dance field have been exploring for some time: 'what is in a dance phrase?'² In this essay, we will focus on new graphic visualisations/ representations of the exercise results and how they might support

discussions surrounding contemporary dance analysis and notation, as well as augment the choreographic process itself. We also draw attention to the potential of tool-supported observation to stimulate new modes of thinking about movement.

MEANINGFUL REPRESENTATIONS

To be meaningful, the results of movement analysis and recording, whether drawings, measurements or standard notation, must be interpretable and enable productive developments whether in thinking, experiments and instrument refinement, writing or on the stage. Both these terms, meaningful and productive, have different implications across disciplines, e.g. sciences such as physiology, biomechanics and ergonomics use notations to support computer modelling of human movement. Architects superimpose movement representations onto site models looking for new approaches to incorporate gesture and locomotion into space-making. In cognitive neuroscience schema detailing the cortical areas involved in vision and processing biological motion further our understanding of the perception of movement. And visual anthropologists have experimented with inventing, however controversial, their own systems of movement analysis and representation, e.g. Kinesics and Choreometrics.

As creative progress in choreography in the early 1900s expanded the range of dance movements beyond the fixed conventions of ballet, notation systems such as Labanotation and Benesh aimed to be able to record every possible kind of movement. One of the outcomes is that these notation systems, while meeting these aims quite comprehensively, are themselves complex and difficult to read and write. They are interpretable and productive only after a long period of study, and then only within a limited community of 'users'. This time commitment is disproportionate to the practical use of the system in the context of contemporary dance. Unlike music notation, to which it is often compared, dance notation systems are rarely used for the creation of a new choreography or the real-time generation of performance (the equivalent in music to sight-reading). It appears that the complexity of the systems themselves diminishes their practical functional value for dancers and choreographers.

This does not reflect, however, a lack of enthusiasm amongst choreographers to engage in acts of indi-

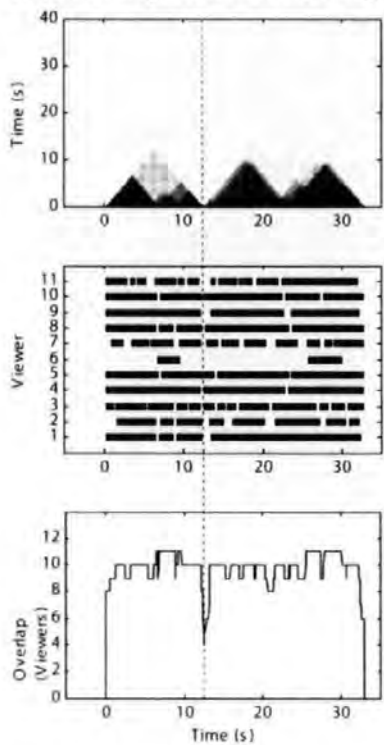
vidual representation in the drawings and sketches they may generate in the context of making dances. While not producing a transmittable record of the dance as standardised notation systems do, some would declare these sketches equally if not more meaningful than standardised systems because they bear the mark of the individual maker. However, within our definition as stated above, to be meaningful these drawings and sketches must contribute to the productive development of the choreography. They can do this by stimulating and supporting the creativity of the individual choreographer as well as collaborative making processes. As a record or documentation of the creative process, the choreographer's drawings are occasionally made available to a public via an exhibition or publication, but generally there is little access to their significance in relation to the making of the dance itself. In this case, these drawings become aesthetic objects in their own right devoid of any productive or meaningful function in the sense we use them here.

Complex notation systems and choreographer's sketchbooks mark out the two main areas where varying approaches to movement analysis and representation are explored and tested in the dance field.³ It is in the context of this field that we will discuss the outcomes of the 'viewing and parsing' exercise in relation to a set of questions. In what ways do the representations we will discuss support discourse about dance and dance making? Do they support discussion that other representations don't? If other approaches to notation, drawing and representation are not supporting certain discussions, what are the possibilities to invent new ones? Can dance be representing systematically, retaining and rendering complexity and variability visible and yet still be meaningful/ readable with a minimum learning effort? Can this support choreographers and dancers to understand themselves and their audiences better and thus enable the creative process?

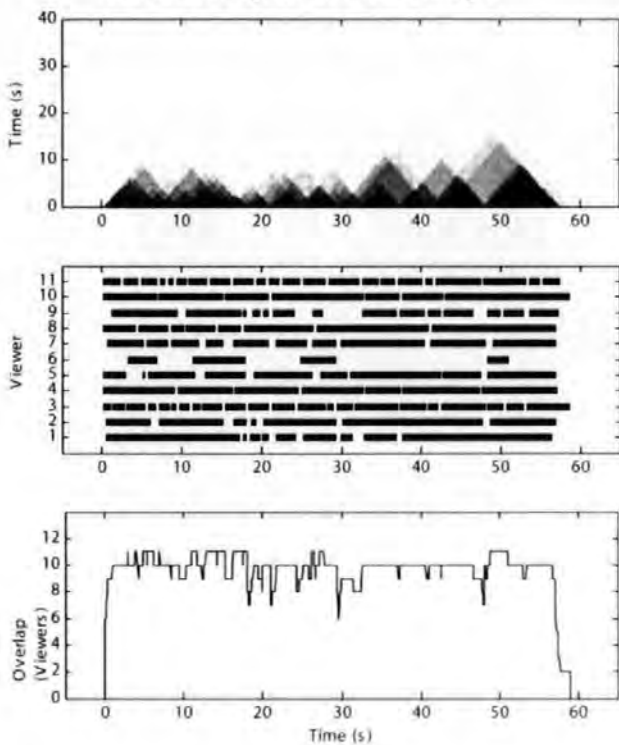
THE VIEWING AND PARSING EXERCISE

This interdisciplinary exercise involved London based choreographer Wayne McGregor, ten dancers from his company, Random Dance, psychologists and a statistician from the Cognition and Brain Science Unit of the UK's Medical Research Council in Cambridge.⁴ Following two sets of specific instructions provided by McGregor, four dancers from the company generated eight short movement

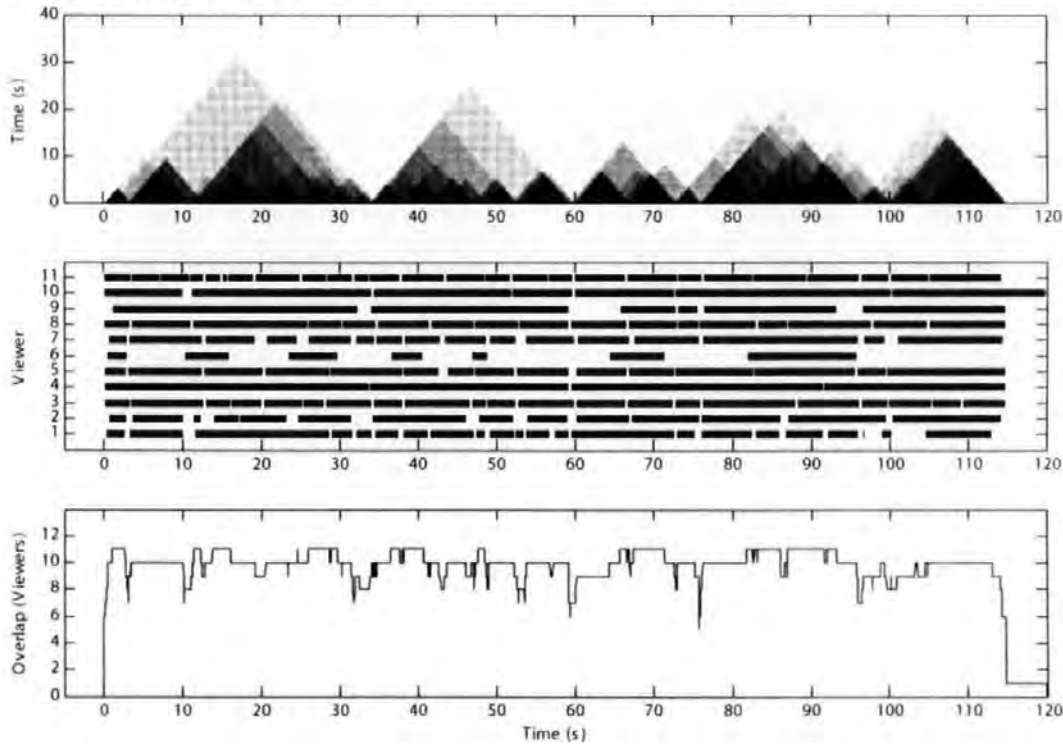
(a) Points in space instruction - eg 1



(b) Points in space instruction - eg 2



(c) Graphic instruction example



sequences (two each). Four sequences were developed following a set of points in space instructions and the other four from instructions that were graphic and image based. First created and set (not improvised) by the dancers, each sequence was performed immediately three times and videotaped; with one performance of each sequence selected for the viewing exercise. These eight selected sequences varied in duration from 25 to 120 seconds and were digitised in a video format to be viewed using Quicktime software. This made it possible to directly control playback using the control buttons, cursor keys or direct manipulation via the playback head. In addition the 'movie information' window showed the time of the current frame being displayed, and the soundtrack was deleted to leave only motion cues for the viewers.

After this digitisation, McGregor and the ten dancers were shown the eight sequences in a two-stage procedure. In the first stage they were asked to familiarise themselves with the sequences – simply viewing each in turn without pausing. The viewing order of the eight sequences was randomised separately for each viewer. In the second stage they dealt with each piece in turn in four passes. In the first pass, they were again asked to watch the sequence without pausing. In the second pass, they could pause the action or move about the sequence using the player controls. Only on the third pass were they asked to 'parse' or divide the sequence into units of their own choosing. On a fourth and final pass they were asked to review and confirm their unitisation. At this point they were also asked to take a subset of the sequences and make brief notes about the bases of their unitisation.

The key pass was the third one when they were asked to 'parse' or divide the sequence into smaller units. We did not wish to presuppose anything about phrases or structure so our instructions left it entirely up to them to determine what a 'unit' was; they were simply asked to specify the time at which a unit began and ended. Start and end times were read from the Quicktime 'movie information' window and entered onto a pre-prepared response sheet. The response sheet was organised into three columns (marked a, b & c) which allowed for units to be organised hierarchically or subdivided using different bases. Once again, it was left up to the participants to decide if they wanted to use a single basis for unitisation or multiple ones. The dancers did the

exercise in two groups and each group took well over two hours to complete the process. The first afternoon McGregor participated in the viewing exercise and the second afternoon happened to include three of the dancers who had also created the sequences. At the end of each afternoon that day's participants were debriefed and invited to comment upon what they felt they had got out of viewing the sequences in this way, and this discussion was tape-recorded and transcribed.

PYRAMIDS, PIANO ROLLS AND OVERLAP TRACES

The collected data from this exercise specified start and end times for 'units' of movement, the brief notes the participants were asked to make and their tape-recorded post-session discussion comments. The latter are extensively discussed in the aforementioned published essay 'What's in a Phrase?'. These start and end times (as numeric signs) can be used to do certain basic calculations – average durations of 'units', for example. Such calculations could tell us something about whether varying instructions systematically alters what the dancers made; or at least how what they have made is perceived. A typical scientist might want to know if the points in space instructions gave rise to units of shorter or longer duration than the more graphic instructions. A typical choreographer might then justifiably ask how this question might influence the making process or precipitate engaging discussion of the products of making. We invited a statistician, Ian Nimmo-Smith, to analyse the collected numeric data. The results of his work, the graphic visualisations shown on the following page, contain interesting answers for both scientist and choreographer.

The page of illustrations shows representations derived from three different sequences. The upper half of the page relates to two sequences of 30 and 60 seconds duration that were generated from the points in space instructions. The lower panel shows a single sequence of 120 seconds duration generated following the graphic instructions. For each of these sequences, a group of three separate representations (referred to here as pyramids, piano rolls and overlap traces) are presented that capture different facets of how the movement was 'seen.' The representations that are most direct are the piano rolls that appear in middle of each group. Here there are eleven horizontal black lines depicting the individual coherent units identified by each viewer/

participant (one choreographer and ten dancers). We know from the collected qualitative data (the brief notes and the post-session discussions) that different strategies were used. Some viewer identified units at multiple levels and for simplicity we have not included these here. One viewer (line number 6 in the piano roll) was the choreographer, Wayne McGregor, who used a highly selective viewing strategy as evident from the white space in his line. 'The things I kept in were things I felt were in some way articulate choreographic motifs. They were things that existed with a framework and a kind of a sensibility and a cohesion.'¹⁰ For McGregor the black sections represent more than a simple unit, for him they demarcate a unit of particular interest.

The piano rolls emphasise variation; clearly no two viewers saw exactly the same units in a given sequence. However, our analysis of the qualitative data (in the previously published essay) indicated an interaction in the unitisation procedure between the dance and the viewing exercise itself. The selections the viewers made were clearly influenced by the specific task context of the exercise involving a rigorous viewing process. In looking at and analysing movement away from this context, the dancers may not be aware of some of the properties that made a particular unit cohere for them during the exercise. Thus, the piano rolls reveal variation as a product of a specific discovery process.

Immediately below the piano roll depiction is a continuous trace. Here the vertical axis represents the number of viewers who agree that two adjacent frames of the video are part of the same unit. This visualisation emphasizes the fundamental continuity in movement over time; and shows that the vast majority of the time most viewers (between 8 and 10) were 'seeing' continuity rather than discontinuity. Since most are agreeing there is little scope for this to rise further. Most downward fissures are of modest size, indicating that a particular bounding property is agreed by rarely more than one-half of the viewers, and the more extreme fissures are likely to capture gross rather than subtle changes (e.g. a period of stillness).

The third form of visualisation appears as pyramids or a mountain range stretched out over time. Here the vertical axis represents time and the darkness of shading also represents the number of viewers who agree

that two adjacent frames of the video are part of the same unit. The key attribute here is that time is on both axes of the graph. The shades of grey are what give this visualisation its unique property; it emphasizes the densities of agreement. A completely black triangle of 5 seconds duration on both axes says everyone agrees that this is a coherent unit. (This does not mean that all viewers agree on where the unit starts and stops.) The pyramids provide what amounts to a statistical phrase structuring (hierarchical organisation) for movement sequences. They show all the different parsings simultaneously and via density indicate where there is major or minor agreement over the temporal extent of all the units in the piano rolls.

The pyramids also capture essential attributes of both of the other visualisations. The deep fissure in the trace for 'points in space e.g. 1' (at approximately 13 seconds) is very clearly reflected in the division between pyramids at the same point in time. Longer undivided segments in the piano rolls can typically be mapped directly to the lighter grey triangles in the pyramidal visualization. But it is not just the mapping; inspection of the three different examples shown in the figure reveals that there are time zones with different characteristics where the darker pyramids are simply embedded in lighter ones, or where there are left-branching or right branching structural decompositions, and combinations of all these.

Of course, in any particular instance we could speculate about the particular property (i.e. change in dynamic, intention, level or direction) that the individual viewer happened to be paying attention to in making his or her selection; and we could return to the original video to investigate this. However, this is not necessary for the pyramids, piano rolls and overlap traces to stimulate a discussion about dance analysis and representation as well as choreographic construction. For example, would different populations of viewers (e.g. non-dancers, audience members, etc.) select units differently and, if so, might exercises such as ours reveal meaningful differences? What might a participating choreographer learn from his or her selections in relation to others? There would be a range of answers to any such enquiries, and we discuss some of these below.

SUMMARY

One thing of key importance at this stage is that these visualisations capture features of the move-

ment sequences in a way that could not readily be described in words or numbers. One can look at many possible structures at once and grasp an instant picture of their relationships as well as helping articulate organisational properties of perceived movement structure in time. And they are readable with a minimum of explanation; one of our requirements for a broader and more practical significance across the dance field than currently is the status of dance notation systems.

However, it is clear that these representations are not notational in the syntactic sense; nor do they resemble marks usually found in the choreographer's personal sketchbook. For the choreographer, they might function more as a single lens of variable focus on the movement itself. Choreographers may describe basing their choices on the idea that they 'recognise something when they see it'. What these representations do is make information available that might stimulate the choreographer to ask him or herself questions about what determines these 'recognisable' changes in movement dynamic or form and their impact on the viewer. These graphic visualisations enable the choreographer to engage independently from his or her own assertions as to intention and to gauge whether what he or she considered salient was reflected in the selective attention of an audience (the viewers). They render explicit the otherwise intangible; and they do this in an unusual way.

Another aspect of what is unique about these representations is that they capture multiple perceivers simultaneously. The pyramids in particular constitute a single representation of one movement sequence as seen through the eyes of eleven viewers. Due to the visual layering, these are more evocative than the piano rolls or trace. This integration of the perception of a subset of viewers is something existing forms of dance notation and representation do not do. Normally, the practice associated with the dance notation systems discussed earlier foregrounds the score as an accurate depiction of a dance produced by the objective eye and hand of the notation expert. The choreographer's individual sketchbooks are more likely to represent a subjective perception; but this will tend towards being that of the individual artist and not the audience. In general, contemporary dance practitioners lack tools for systematically discussing the perceptions of their audience; something our representations make possible.

This simultaneous representation of viewers might have interesting consequences for someone taking a course in choreography. The student maker may be encouraged not to get lost in the detail and to maintain an overview of the range of possible meanings of any one particular moment in a dance phrase. Our representations imply that while viewers are unlikely to agree on particular moments; they do agree quite a lot in more general ways and that these overlaps of agreement can be featured hierarchically. The additional information derivable from the pyramids makes it possible to discuss more than one level of 'seeing' or noticing and how different levels happen simultaneously in any one viewer or viewing group.

As mentioned in our introduction, aspiration towards a better understanding of the complexities of human movement drives research innovation across many disciplines. In the sciences, this has led to the development of advanced visualisation methods using computer animation; some of which could be applied to our representations. For example, the pyramids could be animated in real time the same way speech signatures can be viewed on particular timescales. (6) A thirty-second summary window could dynamically represent the emergence and dissipation of alternative 'parsings' as the piece progressed. These could additionally be marked by colouration reflecting other attributes (space traversed/ energy expressed). However, such a project would require time and money; and it is speculation if this would be effective and for whom. At the outset of this paper, we expressed our concern with the need for meaningful productivity to be associated with movement analysis and representation. Sophisticated computer visualisation methods might be applied, but to be meaningful and productive in a choreographic context, these methods should relate directly to the development of dance and how it impacts potential audiences.

It could be that small-scale research exercises such as ours might reap more immediate benefits. Increasing the overall value of our project is the fact it emerged from an unusual interdisciplinary collaboration between artists and scientists. This essay itself is the manifestation of that unique mixture, a rare convergence of ideas from very different domains of practice.

The authors wish to acknowledge the crucial contribution of Anthony Marcel to the design of the viewing and parsing exercise.

ENDNOTES (all URLs accessed 11 November 2005)

- (1) see: Paul Vinlio (interview with Laurence Louppe and Daniel Dobbels) 'Gravitational Space' in Louppe, Laurence, ed. *Traces of Dance: Drawings and Notations of Choreographers*. Paris: Editions Dis Voir, 1994. pp. 35-59.
- (2) Scott deLahunta and Phil Barnard. 'What's in a Phrase?' in: *Tanz im Kopf: Jahrbuch 15 der Gesellschaft für Tanzforschung*. Wilhelmshaven: Florian Noetzel-Verlag, Autumn 2005. pp. 253-266.
- (3) For an in-depth development of these two concepts in relation to each other see: Laurence Louppe. 'Imperfections in Paper' in Louppe, Laurence, ed. *Traces of Dance: Drawings and Notations of Choreographers*. Paris: Editions Dis Voir, 1994. pp. 11-33. It is interesting to consider how these two areas relate to movement analysis in the context of Dance Science, an evolving field concerned with the overall health, treatment and prevention of illness and injuries in dancers and drawing on fields such as biomechanics and psychology. See <http://www.iadms.org/>.
- (4) The exercise took place during Choreography and Cognition, a joint research project initiated by Scott deLahunta and Wayne McGregor to engage practitioners from the field of cognitive science in seeking connections between creativity, choreography and the scientific study of movement and the mind. See <http://www.choreocog.net>.
- (5) From 'viewing and parsing exercise' transcripts of the post-session discussion, 27 January 2004.
- (6) See the auditory image modeling work of Roy Patterson, Centre for the Neural Basis of Hearing, Physiology Department, University of Cambridge, UK. See <http://www.mrc-cbu.cam.ac.uk/~roy/>.

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Ian Nimmo-Smith is Head of Methods Research at the MRC Cognition and Brain Sciences Unit where he has looked after the diverse statistical and mathematical needs of many research projects over 30 years. <http://www.mrc-cbu.cam.ac.uk/~ian/>

Jennifer Potts and Cristina Ramponi are on the research staff of the MRC Cognition and Brain Sciences Unit in Cambridge. Jennifer is at the University of East Anglia training to be a clinical psychologist; Cristina works in the Emotion group and specialises in studies of human memory. <http://www.mrc-cbu.cam.ac.uk/~cristina/>

APPENDIX

Representations of Segmentation Data (explanations contributed by Ian Nimmo-Smith)

Segmentation Data

A segmentation of the interval $[0, T]$ is a sequence of sub-intervals $S = \{[s_1; e_1], [s_2; e_2], \dots, [s_m; e_m]\}$ for some positive m , where $0 \leq s_1 < e_1 \leq s_2 < e_2 \leq \dots \leq s_m < e_m \leq T$. m is called the length of S . The i th segment $[s_i, e_i]$ starts at s_i and ends at e_i . The interval $[e_i, s_{i+1}]$ is called the i th gap, which may have length 0.

In the present study each of 11 viewers was asked to generate a segmentation of a videoed dance sequence. Ses denotes the segmentation data from viewer e on sequence s , and mes its length.

We have used three graphical methods to represent different aspects of this structurally rich dataset. These are described in the following sections. Each graphic is constructed out of the set of segmentations for just one dance sequence.

Piano Rolls

The piano roll is the simplest graphical representation, and is equivalent to the raw data. Each viewer's segmentation is represented on a separate horizontal line. Each segment $[s, e]$ is drawn as a solid bar between the points $s+e$ and $e+e$. Here e is a small positive number that enlarges each gap by $2e$ in the segmentation to make it visible. In the graphics that have been generated this corresponds to 8 frames or just over 0.25s.

Overlap Traces

In the overlap graphic we graph against time the number of viewers who put that time point into a segment. The overlap function is bounded below by 0 when everyone is agreed on a frame which is outside any segment, and above by 11 (or 10) in the case that all agree it lies in a segment. Rises in the overlap function correspond to starts, and falls to ends.

Pyramids

The pyramid graphic is a two-dimensional density plot. It is generated by assigning to each segment $[s, e]$ a triangle $D(s, e)$ with height $e-s$ (i.e. the segment's length) and base the interval $[s, e]$ and density 1. These are then summed and rendered as a graphic using a gray scale (or some preferred colour scale) to indicate the density. The minimum for the pyramid function is 0 (rendered white) and the maximum is 11 (or 10) (rendered black). The pyramid function combines information about the starts and ends of segments, the length of segments, and the extent to which they overlap with other segments.

'Moving Ideas: questions for the dancing mind'

in ballettanz. October 2005, pp. 20-23.

In July 2005, I received an invitation from Arnd Wesemann editor of ballettanz asking if I would like to make a contribution based on my current research. I had just given a presentation at the 'Description and Creativity conference: Approaches to collaboration and value from anthropology, art, science and technology', July 2005 at Kings College Cambridge.¹ The title of my talk had been 'Choreographic Executables', a short illustrated paper how "notation, software, markings, drawings, texts, video and audiotapes, artefacts, objects, sketches, concepts and systems" might be carriers of "choreographic information". Wesemann agreed to the proposal and the following short publication is the result.

ballettanz, Europe's biggest ballet and dance magazine, keeps you informed about all aspects of the classical and contemporary dance scene. ballettanz covers international premieres, profiles and interviews dancers and choreographers and examines current artistic and political developments in essays and reports. Published in German and English. Source: <http://www.ballet-tanz.de/> (accessed 7 May 2010).

¹ This conference was convened by one of my collaborators James Leach [see Critical Appraisal footnote 24]. Documentation site: <http://www.jamesleach.net/dnc/> (accessed 7 May 2010).

Kader Belarbi, Étoile of Paris Opéra Ballet, working in his "The Beast And The Beauty," which will be premiered by Les Grands Ballets Canadiens in Montréal, October 20
Photo © Anne Deniou, Esquisses © Valérie Berman

moving ideas

Some good questions for the dancing mind
By Scott deLahunta

Imagine a selection of drawings, scores, instructions or sketches created by choreographers during the process of making dances, e. g. Trisha Brown, Yvonne Rainer, Dominique Bagouet, Remy Charlip, Mary Wigman, William Forsythe and Elisabeth Streb. How might we conceive of these as representations of choreographic thinking or as carriers of moving ideas? How would one describe a moving idea to someone who is not a dancer or choreographer? These questions compel us to ask: then what is a moving idea? How is it generated, where is it stored and how is it accessed? If this moving idea is at least partly produced through thinking choreographically, what is the relationship between movement, dance and thought? Within what contexts might we consider dancing to be thinking?

As a means of furthering this investigation I invite you, the reader, to perform the following three variations:

Variation One: Perform a movement by tracing the outline of a curve, using your fingers or hand (one finger thin or two thicker, etc.) starting at some point in the space in front of your sternum and ending at some point in the space above and behind your head.

Variation Two: Then imagine doing this movement, the tracing of this curve in relation to your body. Then imagine the curve as a line that is left in space and can be picked up (in your mind's eye) and then place that curve action somewhere else.

Variation Three: Do the movement again slowly; this time paying attention to all the adjustments your body makes in order to perform the movement. There should be many things going on including a tightening of the muscles around this part of the body and a lifting of the sternum. Can you picture what is happening with your bones? What if you open up the space between your arm and your ear/ feel with your other hand what the shape is like?

The questions the performance of these variations gives rise to are: What is the relationship between your physical sensed actions and these written

descriptions? What definition of "thinking" would make it possible to accept these movements as a form of thought or as ideation? Another way of phrasing the question – where do the physical and the mental meet?

Let's continue this discussion with the following propositions:

Thinking Body

In the early 1900s, when she was studying voice in an American college, educationalist and movement researcher Mabel E. Todd came to the conclusion that problems with vocalization were due to bad posture which inspired her to study the mechanics of the skeletal structure. She came to the view that it should be possible to discover one's own internal, dynamic and balanced posture, as opposed to "imposing upon our bodies a fixed position of any part which we feel to be the 'right,' 'correct' or 'ideal' one." She believed that concentrating on an image in the mind would result in neuromuscular responses appropriate for carrying out specific movements with the least effort. She called this process psychophysical and applied her ideas to the teaching of both physical education and dance. In 1937, Todd published "The Thinking Body: A Study Of The Balancing Forces Of The Dynamic Man" (Dance Horizons, New York 1972). The book is a detailed exploration of the physiology of the body, including observations on mechanical forces and proprioception, and how it might be influenced by the mind.

In the early part of the 20th C, there was a confluence of new medical and scientific theories in the West, e. g. in the fields of anatomy, neurology, physiology and psychology that enabled such ideas linking thought and body mechanics and sensation to come forth. For example, British Physiologist and Nobel Prize recipient Charles Sherrington published "The Integrative Action Of The Nervous System" in 1906 (Yale University Press, New Haven, CT). Sherrington is credited with having discovered proprioception, and his work would have been a source of information for Todd. One could speculate on how this period marks a historical shift, in the West, in the →

→ development of concepts of mind and body integration one finds throughout contemporary dance training and choreographic practice. This historical/ cultural moment of openness to a reconfiguring of the relation between the physical and the mental could even be useful for distinguishing 20th century dancing bodies and ideas from previous periods. My proposal is that following the publication of "The Thinking Body," the concept of moving ideas takes on new significance.

Physical Descriptions

In the 1960s, the choreographer Trisha Brown took part in a composition workshop with the composer Robert Dunn in New York City. Dunn's workshop is well-known for having launched a period in contemporary dance history that led to the experimental work of the Judson Church; a period in which all existing rules governing choreographic forms were thoroughly challenged. From within this space of new thinking about what could constitute dance and choreography Brown evolved her working methods through a succession of stages. During one of these in particular she developed several choreographic systems she referred to as "dance making machines." Her interest at this time was less in the invention of movement *per se* but in the discovery of schemes and structures of its organization. One of her systems was created in 1975 and titled "Locus," a 27-point cube in which a different number was assigned to each point. The choreography involved generating a score by translating a written autobiographical statement into numbers, which were then transposed to points on the cube by the dancer who could "move through, touch, look at, jump over, or do something about each point in the series, either one point at a time or clustered."

Brown explored these ideas for organising movement during a period of several years culminating in the creation of her work "Set And Reset" in 1983. Still images from the two works show drastically different performing bodies; the dancers in the images from "Locus" are in relaxed and balanced states apparently moving between two different points in the system at the same time. The dancers in "Set And Reset," eight years later, still demonstrate the same state of relaxation and balance, but the number of points the body seems to be

moving between simultaneously has increased drastically. What one might be lead to contemplate is how a system such as "Locus" constitutes a representation of choreographic thinking and how this representation and the evolution of a distinctive way of moving / dancing are somehow co-dependent. Dance scholar Sally Banes has referred to Brown's dances as "physical descriptions of ideas," which gives us another relationship between movement and thought to ponder.

Acts Of Minds

In his book "Kinds Of Minds" (Dance Books, New York 1996), philosopher Daniel Dennett makes a proposal for what constitutes ideation or in his words "states and acts of mind." He points out two popular and rival answers: (1) that mental acts are composed in a sort of language; and (2) that our thoughts are like pictures. He argues that neither of these can account for mental activity because both get caught in the circular problem that they depend on an intrinsic understanding of what they are suppose to explain existing somewhere in the brain/ mind. Both need to define their own terms for describing themselves. The problem then is where in the mind do these terms come from? How do you know what the sentences in your language of thought mean? How do you know what your picture of something looks like?

Dennett then uses the production of written or sketched representations to suggest a way out of this problem. So, if I produce a shopping list the creation of the list possesses what he calls original intentionality, and the shopping list itself, the representation I create, has intentionality derived from this. If we accept that the brain or mind has no intrinsic understanding built into it based on the failure of the language/ picture explanation mentioned above; then, Dennett puts forward, we have to see the brain or mind itself is an artefact capable of producing other artefacts. It "gets whatever intentionality its parts have from their role in the ongoing economy of the larger system of which it is a part" which is, in his view, "mother nature" or the process of evolution by natural selection.

If we follow this line of thinking perhaps moving ideas are only possible through the production of these artefacts or representations; and the

co-dependency of subsequent movements upon them. So not just any movement could be referred to as a moving idea, but, for example, the variations you just performed are moving ideas because you have performed them in correspondence with these written instructions or descriptions. Looking again at the drawings produced by choreographers – as representations of their thinking – one can imagine that they possess intentionality derived from the choreographer who made them. If we follow Dennett's position, the representation itself does not exist anywhere in the mind. Therefore the drawing only has real value as part of a dynamic system within which it operates, and the recognition of this system makes it possible to link moving bodies and moving ideas.

In conceiving of her theory of mind/body integration, Todd did not have the access Dennett had to cognitive science and could not have formulated the view of mental states that he does. However, she and others set important precedents for a dynamic self-perception that influenced choreographers such as Trisha Brown to create situations and spaces that only thinking bodies could adapt to and perform in. It is difficult to foresee how our growing understanding of the brain and mind will stimulate and perhaps be stimulated by choreographic practice. In either case, we can continue to carry forward and contextualise questions about dancing and thinking alongside future developments.

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Choreografen machen choreografische Skizzen, wobei die gezeichneten Linien nicht unbedingt Richtungen meinen, sondern eine Idee von Bewegung verfolgen. Eine gedachte Linie, die Scott deLahunta uns aufträgt: dass wir mal mit der Hand vom Brustbein eine Bewegung über den eigenen Kopf ziehen sollen, eine Linie, die ohne Stift und ohne Spur bleibt, aber eine Idee davon gibt, dass diese Bewegung weniger ein Zeichen ist, durchaus aber eine Idee hinter der Bewegung zeigt. Schon Mabel E. Todd verwendete diese Linienführung, um herauszufinden, welche Körperhaltung «richtig», «korrekt» oder «ideal» wäre. In ihrem Buch «Der denkende Körper» sah sie, dass die Bewegung so selbst in der Lage ist zu skizzieren, um wie beim Schreiben oder Zeichnen richtige oder bessere Entscheidungen zu treffen. Charles Sherrington erkannte zur selben Zeit, dass das Nervensystem zu einer Art Rekonfiguration des Körpers und seiner Haltung fähig ist. In den 1960ern nahm Trisha Brown diese Idee auf, um choreografische Systeme zu erfinden, und der Philosoph Daniel Dennett entwickelte aus derselben scheinbar vorsprachlichen Tanz-Idee des Skizzierens die Frage, ob sich der Tanz wirklich «wie eine Sprache» verhalte, oder aber, ob im Tanz unsere Ideen sich «wie Bilder» gestalten? Abgesehen vom Problem, ob ein Betrachter Bilder oder Sprache nun auch wirklich entziffern kann, interessierte Dennett, wieso es beim Tanz überhaupt zu einer sprachlichen Erscheinung kommt. Ist es nicht so, fragt er, dass das Hirn beim Skizzieren von Bewegung sich eine Art Einkaufsliste schreibt, die es abarbeiten will, aber meist doch etwas anderes einkauft? Ist es nicht so, dass der Körper unbewusst immer eine Skizze anfertigt, nach der er sich bewegt? Und ist es nicht so, dass diese Skizze, wo sie auch keine Eins-zu-eins-Übersetzung von Tanz sein kann, etwas ist, dass aus dem Hirn geboren dem Körper neue Richtungen verleihen kann? Dieses choreografisch bewusste Skizzieren hat

tatsächlich die Potenz, mittels der hingeworfenen Idee unendlich viele choreografische Neuentwürfe zu produzieren. Der Stift also ist durchaus auch ein Medium des Tanzes.



'Willing conversations: the process of being between'

in Leonardo. 39:5. 2006, pp. 479-481.

A discussion about a special section in Leonardo featuring the pilot Arts Council England/ Arts and Humanities Research Board pilot 'Art and Science Research Fellowships' [see Critical Appraisal footnote 19] began in November 2004. In June 2005, Bronac Ferran, then director of the Collaborative Arts Unit, Arts Council England, who was coordinating the section, mailed to ask if I would contribute something about facilitating arts-science collaborations.¹

The special section also includes with an introduction from social anthropologist James Leach who had followed all sixteen pilot Fellowship projects including 'Choreography and Cognition' and our collaborator Alan Blackwell contributed another article on the specific outcomes of the 'Choreography and Cognition' project.

Leonardo, Journal of Arts, Science and Technology, was founded in 1968 in Paris by kinetic artist and astronautical pioneer Frank Malina. Malina saw the need for a journal that would serve as an international channel of communication between artists, with emphasis on the writings of artists who use science and developing technologies in their work. Today, Leonardo is the leading journal for readers interested in the application of contemporary science and technology to the arts. Source: <http://www.leonardo.info/leoinfo.html> (accessed 7 May 2010).

¹ Email to the author, 23 Jun 2005.

Willing Conversations: The Process of Being Between

Scott deLahunta

This short essay is a response to an invitation to write about working as a facilitator of interdisciplinary research for this special section of *Leonardo* featuring the Arts and Science Research Fellowships. My specific connection to the Fellowships was as research organizer and facilitator for Choreography and Cognition. The Artist-Fellow for the project was London-based choreographer Wayne McGregor, and the science host was Rosaleen McCarthy at the Department of Experimental Psychology, University of Cambridge. A description of this project is included in this issue under the title "Bodies Meet Minds: Choreography and Cognition" [1]. In the following essay, I explore the themes of willingness, inter-profession, conversations and wording, empathy, and collaborative writing. These relate to the conditions for and relationships within interdisciplinary collaboration.

WILLINGNESS

The Arts and Science Research Fellowships emerged from a socio-cultural context that has provided major support to collaborations between artists and scientists since at least 1996, when the Wellcome Trust launched their "sci-art" scheme. In 1998, the U.K. National Endowment for Science, Technology and the Arts was created, and in 1999 the sci-art Consortium was established, comprising no fewer than five major funding bodies coming together to support art and science projects. At the end of 2001, the Arts Council England and Arts and Humanities Research Board agreed to set up a new joint funding strand for interdisciplinary research fellows working across science, technology and art, and the call for proposals for the Research Fellowships came out in November 2002. This was the first art and science initiative in the U.K. to bring together cultural and education funding, and its emphasis on fostering mutual collaborative research between art and science practitioners differentiated it from other art and science programs.

This is the background of support against which I propose that a large number of people based in the U.K. with diverse professional practices think differently now about the relation between art and science. Growing interest stems from a curiosity about the intrinsic value of these exchanges, as more and more colleagues are seen to derive benefits from engagement across disciplines. Significant informal networks have resulted from the steady progression of productions, conferences, publications and other events and outcomes of collaborative projects. The evolution of support from sci-art to the Fellowships and toward more open-ended research has re-

sulted in unique conditions for productive creative exchange. There is, I believe, more willingness on the part of individuals operating from within diverse communities of professional practice to participate in interdisciplinary art-and-science collaboration.

INTER-PROFESSION

The Choreography and Cognition project was organized and facilitated with full acknowledgment that the participants were professional practitioners. This implies having specialized knowledge acquired through long and intensive preparation, engagement in a principal calling, vocation or employment, and being part of a larger body of persons engaged in the same calling. In this article I explore a few other terms such as "domain" and "communities of practice" as alternatives to "discipline," as I do not believe the term "interdisciplinary" fully captures the complexities and challenges facing these collaborations. In face-to-face meetings in the context of a project, it is professional borders that drift and open as collaborators search for the best means of relating to one another and stimulating creative and lateral thinking. However, these borders will constantly reassert themselves, for example, in the forms of obligation, responsibility and duty. Within the arts it is quite common for a practitioner to migrate or rove across disciplinary borders. Due to larger structures, including educational, subsidizing and institutional, it is difficult for an individual practitioner to move easily between professions as different as art and science (I recognize this foregrounds social and cultural formations over epistemological ones). Therefore, the organizing and facilitating of inter-profession projects should include an orientation to these formations, as in understanding the background and needs of the professional practitioner.

CONVERSATIONS AND WORDING

Choreography and Cognition grew out of conversations with Wayne McGregor in September 2001 about the field of artificial intelligence and how an investigation of this field might generate a better understanding of creative thinking and enhance his work with dancers and other artistic collaborators. These conversations led us a year later to contact practitioners working in the area of cognitive science and neuroscience and to organize conversations with them about brain-mind-

ABSTRACT

The author argues that the role of facilitation within art and science collaboration projects is perhaps best described not as a function or position, that of the facilitator, but as a framework for thinking about relations and how to encourage a certain quality of exchange. The article reflects on how the themes of willingness, inter-profession, conversations and wording, empathy, and collaborative writing relate to the conditions for interdisciplinary collaboration. This is based on the author's experience with collaborative projects, most recently as research organizer and facilitator for Choreography and Cognition, one of the first Arts and Science Research Fellowships jointly funded by the Arts Council England and Arts and Humanities Research Board (U.K.).

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creativity and movement. My role was to locate interested individuals and organize and facilitate these meetings. The background for support and networks I mention above in writing about "willingness" made this possible; it would be difficult to imagine the project without them.

The wording of the invitation that went out in September 2002 was more or less as follows:

Choreographer Wayne McGregor, director of Random Dance Company, and I are organizing a series of conversational meetings with researchers who are working in various ways on the study of the brain. Our aim is to stimulate an exchange of ideas between this field and the field of choreography—dance; and we seek psychologists, neurologists, philosophers and cognitive scientists who would find this interesting and would be willing to share their knowledge in an informal setting.

Through this networking and invitation process we eventually organized a series of nine meetings with interested scientists throughout the U.K. and one in Paris. The wording of the invitation with its emphasis on conversation established the informal tone of exchange for these meetings. However, even conversations require focus. In our case, Wayne began these meetings with the description of exercises he would give his dancers to create initial movement material for a choreography. This was enough to stimulate a long, informal but focused conversation about how mind, brain and body interact.

Conversations and wording overlap in the building of shared terms of reference from the careful composition of an invitation; to varying types of spoken exchange, moderated and un-moderated; to the drafting of applications for funds; to documentation and transcription of discussion; to exposure and explanations to a growing public and the writing of reports and other outcome-related publications, etc. Certain phrases or larger language constructions weave and morph their way throughout such a project, gathering relevance and changing emphasis within shifting contexts, coming over time to represent the process of negotiation, shared agreements and divergent imaginations. Facilitation supports these developments, reviewing and clarifying, adapting and editing, observing the evolution of what is written and spoken.

EMPATHY

These initial nine meetings eventually led to the Fellowship research period, in-

volving some but not all of the scientists originally contacted. Relationships with chosen collaborators grew as the first 3-hour conversations turned into long-term commitments and dialogue gave rise to agreement on concepts, sharing of aims and objectives and acceptance of different goals and needs. In my opinion, these mechanics should be underpinned by empathy, an understanding rooted in curiosity. The mechanics make a certain aspect of the professional relationship explicit; empathy helps guide social contact and nurtures forms of friendship. Inside this intersection between friendship and professional relation, the value of the interaction and exchange can be more appropriately assessed. The curiosity I refer to is expressed in the following: What constitutes the choice for a certain professional life, a life within which competence and expertise and their correspondence to value are essential? How is this choice the expression of someone's desire for a creative and challenging life path, where the hope is fulfilment beyond mere livelihood? Questions like these lie at the heart of this empathic approach.

How does one say something useful about empathy, which by definition is more intuitive or "felt" than systematic or logical? How does one translate the empathic approach into something concrete enough to be organized and facilitated? A way to start might be with someone's working environment; for example, these initial nine meetings all occurred in the scientists' workplaces. The firsthand ex-

perience of the instruments and spaces of laboratories, sizes and scales of office and seminar rooms, building facades, front doors and stairways brings the artist into a particular relation with the rhythms of the scientist. A year later, the scientists with whom we continued our relationship were invited to work where the dancers spend their days in the rehearsal studios, cafeteria, changing rooms and backstage of a major performing arts venue in London (Fig. 1). How someone thinks and sees is at least partly captured and expressed in his or her surroundings and environment, and when communities of practice and working cultures are so different, this location exchange can help build empathic relations.

COLLABORATIVE WRITING

As mentioned earlier, inter-professional research facilitation provides support for the evolution of shared and divergent language, sometimes guiding and ensuring clarity of communication and at other times just observing how others talk and write about the project. This can lead to the eventual production of a range of public texts from press releases to final project reports that take their place alongside other research outcomes such as new artworks and experimental data. Some public texts will be aimed at a general audience, explaining the project in accessible terms, while others may be written for a specialized arts or science readership. Both are acceptable markers

Fig. 1. First joint research session of Choreography and Cognition: scientists and dancers in the studio together, Sadlers Wells Theatre, London, November 2003. (Photo © James Leach)



of the project's success, but one may be deemed more significant than another depending on the domain within which the valuation takes place.

However, when it is the aim to foster mutually collaborative research (as was the case with these Fellowships) the production of texts should go beyond general description or purely specialized analysis. A third possibility exists in the form of collaborative writing or joint authorship involving at least one participant from each professional domain (art and science) working together on a single text to stand as an outcome of the research. Such a text should be intended for acceptance as an article, essay, or chapter within a specialist publication in either one or the other (or both) professional domains.

Collaborative authorship takes as its starting point the existence of these specialist publications, for example, peer-reviewed journals, whether in the field of art or science, that patrol and maintain the knowledge perimeters of a professional domain. What I imagine are inter-profession infiltrations that use writing to creatively contextualize outcomes and, through persistent production of these

texts (co-authored by at least one artist and one scientist), make it possible for knowledge from one domain to furtively seep into another. This would loosen the borders of professions without erasing them. The image here is of folding fresh thinking, derived from the collaboration between art and science, back inside of the specialist domain rather than necessarily disseminating the results of such collaborations to a wider public. In the context of the Choreography and Cognition project, the mutual interest sparked by our initial informal focused conversations has arrived at this point of *writing together*, and two such texts have been collaboratively produced [2].

To close, rather than a summary I offer this final reflection. The role of facilitation within art and science collaboration projects is perhaps best described not as a function or position—that of facilitator—but as a framework for thinking about relations and how to encourage a certain quality of exchange. If the collaborators themselves possess the willingness and empathy, and have an understanding of inter-profession issues, the implications of wording and how to focus conversation, for example, then it may

not be necessary to create an additional job within this framework. It may be a result of previous relations or even of chance that someone from within the collaboration appears to fill this role. A part-time position could be required as a practical matter to handle administrative aspects of facilitation the collaborators do not have time for. However, avoiding the promotion of a “necessary someone” to fill the facilitation position helps reduce the possibility that this way of thinking about relations becomes a mechanical part of the structure of inter-profession collaboration. This then frees up facilitation, in whatever form it takes, to remain as the process of being between.

References and Notes

1. See in this issue Rosaleen McCarthy et al., “Bodies Meet Minds: Choreography and Cognition,” *Locus* 39, No. 3, 173–177 (2006). Also, an extensive report can be downloaded from www.choreocog.net/.
2. Scott deLahunta and Philip Barnard, “What’s in a Phrase?,” in Johannes Bieinger and Josephine Fenger eds., *Im Kopf: Dance and Cognition. Jahrbuch der Gesellschaft für Tanzforschung* (Yearbook of the German Dance Research Society) 15 (Münster, Germany: LIT Verlag, 2005) pp. 253–266; Scott deLahunta et al., “Densities of Agreement,” *Dance Theatre Journal* 21, No. 3, 17–23 (Autumn 2003).

'Sharing Questions of Movement'

in *De theatermaker als onderzoeker: Theater Topics II*. eds. M. Bleeker, L.

Heeteren, C. Kattenbelt & K. Vuyk. Amsterdam University Press. 2006, pp. 182-186.

In November 2005, Henk Borgdorff and Marijke Hoogenboom, my research directors at the Amsterdam School of the Arts, passed on a call for articles for the upcoming *Theater Topics* publication under the theme "Theater maker as a researcher".¹ It was a good opportunity to write to publish some reflection on the research work with Amsterdam-based dance company Emio Greco|PC.² At this time, I was just beginning to develop a mutually supportive research relationship with them, similar to the one with choreographer Wayne McGregor in London. This publication provided a good platform for writing about some of this work for the first time in a comparative context.

¹ Email to the author, 6 Nov 2005.

² Company website: <http://www.ickamsterdam.nl/> (accessed 7 May 2010).

Sharing Questions of Movement

Scott deLahunta

Several years ago, I began to research digital tools to support the creative process of making dances. This enquiry has broadened and now includes software development, research into new forms of documentation and dissemination of performance, and connections between choreography and other practices or disciplines.¹ In 2006, with the support of the Art Practice and Development Research Group (Amsterdam School for the Arts), I will continue this research.

This essay takes as its main focus the possibility for shared approaches to movement research. Many disciplines are concerned with recording, analysing, archiving, modelling, documenting, simulating and notating human movement. These include choreography and dance, architecture, cognitive and computer science, film animation, visual anthropology, biomechanics, engineering and technology research.

Science and technology have already established common ground partly on the basis of sharing computer-related movement research across various fields (e.g. ergonomics, biomechanics, computer animation and robotics). Choreographers and dancers have had some involvement with computers since the 1960s, but a clear line of collaborative projects underpinned by shared movement research issues has emerged in the last ten years.² Developments in the future will take advantage of a general increase in support for interdisciplinary research, and more effective shared methodologies based on a better understanding of differences in work and research cultures.³ The challenge for choreography and dance will be to retain its unique artistic and creative relationship to movement questions and to contribute to the growth of standards and procedures from this critical perspective. One important basis for this can be traced to the following meeting in 1994 between digital artist Paul Kaiser and choreographer William Forsythe.

William Forsythe tried to convey to me how he derived unexpected kinds of movement from the vocabulary of the classic ballet. As he described his methods, he began drawing imaginary shapes in the air, using all parts of his body – not only his feet and hands, elbows and knees, but also his skull, shoulders, butt, and even his ears and chin. He talked and moved rapidly, building up a complicated and invisible geometry of dance that I had no ability to visualise or follow. (Kaiser in: Sommer, 2003, p. 10.)

Soon after this demonstration, Kaiser suggested that animated computer graphics could make the ideas behind Forsythe's movement creation more accessible to a non-dancer. A team of multimedia researchers at the Centre for Art and Media Technology in Karlsruhe (ZKM) picked up this proposal; eventually producing a prototype that included video illustrated by the addition of graphic lines tracing the movements as

Forsythe demonstrates them. The prototype's success inspired the team to create a self-tuition education tool to assist new dancers entering the company in understanding Forsythe's choreographic thinking.⁴ This resulted in a version with over one hundred short lecture-demonstrations for use by the company, and public interest in the project led to the eventual publication and distribution of the interactive multimedia CD-ROM *Improvisation Technologies: a tool for the analytical dance eye* (1999). This CD-ROM is itself the product of a process of motion analysis and representation; as a tool for the analytical eye the dynamic visualisations are presented in the context of a systematic organization of sophisticated choreographic/moving ideas. These lie somewhere between a notation system and the choreographer's sketchbook; presenting, in Forsythe's own words, 'just some of the ways of thinking about analysing motion'. (Forsythe in: Haffner, 2003, p. 20.) The innovative visualisations and organisation of the materials on the CD-ROM make it possible for movement researchers in other fields to apply this thinking to their own areas.⁵

In early 2000, a group of artists and researchers from dance, film animation, artificial intelligence, computer science and engineering came together at Arizona State University to initiate the *motion-e* project. The aim of the project was to 'revolutionize computer-assisted documentation, analysis, teaching and creation of modern dance' and to create art works, science and art publications, new technology tools and methodologies. One of the art works was choreographed by Trisha Brown and titled *How long does the subject linger on the edge of the volume...* (a comment she overheard from one of the computer operators).⁶ The piece uses a 3-D motion capture system to record movement information or motion data from the dancers in real-time meaning while they are performing. This data interacts with a cluster of intelligent agents created by software artist and computer scientist Marc Downie and produces moving animations, which are projected onto a large scrim at the front of the stage. Downie and his collaborators have written a statement describing their approach:

The essential characteristic of our imagery is this: It thinks by picturing things. It sketches the relationships it perceives as soon as it starts making them out. This keeps its frames in constant flux, for it continually readjusts itself as it tentatively advances its ideas. (...) What is the imagery trying so hard to grasp? The same thing we are: the intricacy of Trisha Brown's choreography as it unfolds.⁷

Before the shared procedures mentioned at the start of this essay can be achieved, there is the need to produce descriptions and representations of movement research that are meaningful and valuable to the various disciplines involved. These co-descriptions, mutually understood, help to bridge differences in work and research cultures and help shared procedures evolve. Co-description is one of the themes of a new network drawing links between research groups in Genoa, Paris, Bonn, Amsterdam and Birmingham.⁸ At the core of this network are two important movement research projects: the

ongoing development of the EyesWeb software in Genoa and the work of the Gesture Analysis group at IRCAM (Institute for music/acoustic research and coordination) in Paris. The strongest evidence in support of the speculation of this essay can be found in recent projects at IRCAM (some use the EyesWeb software) in which the aims of the creative and research process were similar to those of the *motion-e* project: to develop interaction between choreography and computation based on a shared understanding of movement.⁹

For one of these recent projects, the choreography titled *This is My House*, collaborators technology researcher Rémy Muller and choreographer Myriam Gourfink developed a system 'using computer vision and machine-learning techniques to delegate to the computer the task of doing human motion following'. (Muller, 2004, p. 2.) This following technique, in the words of Gourfink, made possible 'the processes of modification of the choreographic score' during the performance itself.¹⁰ Without going into the elaborate details underpinning these statements, the relevant observation for this essay is that this collaboration developed a shared approach to movement research, created mutually understood descriptions and produced meaningful results in the context of both dance and science/technology research.

In Amsterdam, the dance company Emio Greco|PC (Emio Greco and Pieter C. Scholten) is exploring innovative ways of documenting, analysing and representing their work.¹¹ This is taking the form of a long-term interdisciplinary research project, guided by dance researcher and former company member Bertha Bermudez Pascual. The aim is to create a dynamic source of information about their past, present and future work; a 'living archive' based on principles of movement and choreography that are constantly evolving. This gives rise to many questions such as what notation system can capture inner intention as well as the outer shape of gestures and phrases, how to analyze and represent open processes in relation to art works, how to document and enhance Greco and Scholten's critical/reflective approach to choreography.¹²

This interdisciplinary research has taken shape and evolved along several lines including: in September 2004, the company's *Salon #5* was dedicated to the implications of 'repertoire' and archiving for contemporary dance and provided an early platform for a discussion of Pascual's research into notation; in 2005 the company was in residence at the Amsterdam School for the Arts where they explored themes related to reproduction and authenticity, new systems of notation and dance idioms; in 2005 and 2006 a documentary film was made based on key principles of the *Double Skin/Double Mind* workshop in Vienna (August 2005); research is underway with trained specialists in the Laban and Benesh notation systems (Pascual has received funding to study the Benesh system); and computer-based techniques of gesture analysis and simulation will be explored with the previously mentioned research group at IRCAM in Paris. There is a new initiative to prototype interactive graphic visualisation tools that will support both the documentation and creation, and an exploration of what the emerging field of cognitive linguistics might bring to bear on the project is planned. In addi-

tion, there is ongoing exchange with similar projects involving dance artists based in Europe and the United Kingdom.

From this background of research, during the next six to eight months support will be sought to consolidate and focus the inquiry and to engage on a more consistent basis with an interdisciplinary team of specialists from the various fields already mentioned. Here is where the shared approach to movement research as surveyed briefly in this essay comes into view: different disciplines from arts, technology and sciences working together to further our understanding of human movement in all its complexity. A variety of outcomes are anticipated, including the integration of fresh insights from science and technology into the already physically and philosophically charged creative foundations of the company's work.

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NOTES

- 1 See: Software for Dancers: www.sdela.dds.nl/sfd; RotoSketch: thesystemis.com/rotoSketch; Liquid Reader: www.liquidpress.net; Choreography and Cognition: www.choreocog.net.
- 2 For some historical background prior to and including the 1990s see: deLahunta, S., 'Periodic Convergences: Dance and Computers', in: S. Dinkla and M. Leeker (eds.) *Tanz und Neue Medien* (book and CD-ROM/DVD), p. 66-84, Berlin, 2002.
- 3 Clear evidence for this growth can be found in the cultural and education funding programmes of several countries, in particular United Kingdom, Canada and Australia; with recent initiatives structurally joining together arts and education funding.
- 4 The concepts of 'choreographic thinking' or 'moving ideas' can be confusing to other disciplines outside of the contemporary dance field. There are some approaches to these published in a recent short essay: deLahunta, S., 'Moving Ideas: questions for the dancing mind', In: *ballettanz*, 10, p. 20-23, October 2005.
- 5 It is the interest shown from these other specialist disciplines that has compelled Forsythe to establish a foundation that sponsors 'interdisciplinary research to understand better the embodied knowledge articulated by the dancing body'. Recently, interactive design researchers from the Advanced Computing Center for Art and Design at Ohio State University have started to work on a multimedia education tool

based on Forsythe's choreography *One Flat Thing, Reproduced*; and they have developed an innovative research methodology to engage with other disciplines at the University (architecture, music, cognitive psychology, engineering and comparative studies) in the design research phase of the project.

- 6 From Trisha Brown's statement on the *motion-e* documentation site: ame.asu.edu/motione/research7_brown.html.
- 7 This statement and the relevant chapter from Marc Downie's extensive PhD thesis is available from: www.openendedgroup.com/artworks/howlong/howlong.htm (additionally there is an interesting interview with Downie here: www.artificial.dk/articles/downie.htm).
- 8 This emerging network comprises at present the following organisations: Eyesweb (Genoa) www.eyesweb.org; IRCAM (Paris) www.ircam.fr; Animax Multimedia Theater (Bonn) www.animax.de; SYMON, University of Birmingham www.symon.bham.ac.uk.
- 9 See the Real Time Applications research group: www.ircam.fr/atr.html.
- 10 Myriam Groufink website (the reference can be found in the description of *This is My House*): www.myriam-groufink.com.
- 11 The project has received initial support by the Art Practice and Development Lectorate, Amsterdam School for the Arts in the frame of a residency for the company in 2005 and ongoing support for the development of the notation and archival research; including support in 2006 for my work on the project. See the company website for more information: www.emiogrecopc.nl.
- 12 For more information about 'Choreography as a Critical Practice' see Pirkko Husemann's essay in *Stationen 1*. Berlin, 2003, p. 10-16; Additionally please refer to Greco and Scholten's manifesto in 'The Wake-Up Calls of Emio Greco and Pieter Scholten' by Gabriel Smeets, 2004 (downloadable at www.emiogrecopc.nl).

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'Sharing Descriptions of Movement'

Co-author Frédéric Bevilacqua. in International Journal of Performance and Digital Media. 3:1. 2007, pp. 3-16.

In December 2005, I proposed a contribution to International Journal of Performance Arts and Digital Media editor David Collins in the form of a report based on an international workshop I was co-organising with Frédéric Bevilacqua in June 06 in Paris in the context of NIME 06 (New Interfaces for Musical Expression) conference at IRCAM (Institute for Research and Coordination Acoustic/Music).¹

The International Journal of Performance Arts and Digital Media is a forum to energise, innovative and inspire creative thinking and practice surrounding the combination of digital technologies with the performance arts (theatre, dance, music, live art).

Disciplines may be domain-specific or in convergence. Source:

<http://www.intellectbooks.co.uk/journals/> (accessed 7 May 2010).

¹ NIME 06 publicity site: <http://recherche.ircam.fr/equipements/temps-reel/nime06/> (accessed 7 May 2010).

Sharing descriptions of movement

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Abstract

In this essay the authors report on the findings of the one-day workshop called Choreographic Computations: Motion Capture and Analysis for Dance held at IRCAM (Institute for music/acoustic research and coordination) in Paris in June 2006. The focus of the workshop was on new innovations combining motion capture and computer-based techniques with choreography and performance. An international group of artist programmers and dance makers who are bringing complex algorithmic procedures into alignment with choreographic creation were invited to give presentations and discuss, with each other and the invited audience, the shared understanding of movement and gesture they are developing.

Keywords

choreographic
computation
gesture follower
dance
EyesWeb
Isadora
artificial intelligence

Background

On 4 June 2006, we organised a one-day workshop called *Choreographic Computations: Motion capture and analysis for dance* at the Institute for music/acoustic research and coordination (IRCAM) in Paris in the context of the annual New Interface for Music Expression (NIME) conference.¹ Established in the 1970s, IRCAM has remained singularly dedicated to the connection between research and creation with a focus on music.² Today there exist several departments working together under three headings: research, creation and transmission. Under research there are several groups, including the Real-Time Musical Interactions Team investigating 'real-time computer technology for digital signal processing and machine learning for music, sound and gesture'.³ Bevilacqua has been directing the gesture analysis research of this team since the end of 2003.

Our motivation to organise the workshop arose from an overlap of different events. In December 2004, we participated in a workshop at the Monaco Dance Forum and discovered a similar approach to cross-disciplinary research involving movement, dance and science. In September 2005, we took part in a small group meeting organised by Antonio Camurri (InfoMus Lab, Genoa) on the topic of Motion Analysis Research and Dance. This gathering marked the start of efforts to establish a network of research institutes working on the theme of movement analysis within interdisciplinary arts and science research.⁴ One of the commitments made by the group was to continue meeting in the context of other events, such as the EyesWeb Week organised by Camurri and his team in February 2006 and our workshop organised at the start of NIME 2006.⁵

- 1 NIME06 workshops:
<http://www.nime.org/2006/workshops.htm>
- 2 IRCAM:
<http://www.ircam.fr/>
- 3 Real-Time Musical Interactions:
<http://www.ircam.fr/imtr.html?&L=1>
- 4 The emerging network comprised at the time: Eyesweb (Genoa); IRCAM (Paris); Animax Multimedia Theater (Bonn); SYMON, University of Birmingham (UK); Monaco Dance Forum (Monaco). See: Scott deLahunta, 'Sharing Questions of Movement', in: Maaïke Bleeker, Lucia van Heeteren, Chiel Kattenbelt and Kees Vuyk (eds.), *De theatermaker als onderzoeker: Theater Topics II*, Amsterdam: Amsterdam University Press, 2006, pp. 182–186.

- 5 EyesWeb Week:
<http://www.infomus.org/EYWweek2006/Index.html>
- 6 See brief biographies.
- 7 Audio documentation of the presentations available here without the visuals:
<http://www.du.ahk.nl/nimeworkshop/>
- 8 Le Vasseur, P, 'Computer Dance: The Role of the Computer', *Impulse: The Annual of Contemporary Dance*, San Francisco, 1965, pp. 25–27; Beaman, Jeanne, 'Computer Dance: Implications of the Dance', *Impulse: The Annual of Contemporary Dance*, San Francisco, 1965, pp. 27–28.

Focus and objective

The focus of *Choreographic Computations* was on new innovations combining motion capture and computer-based techniques with choreography and performance, an area in which we felt there were a group of artists breaking new ground. The unique dimension we wished to emphasise in their work was the bringing of complex algorithmic procedures into alignment with choreographic creation and the development of a *shared* understanding of movement and gesture. This was referred to in the announcement as 'carving out fresh territory for correspondences between choreography and computation'. The organisation of the workshop was intended, at least in part, to test how far we were correct in our assumptions⁵ and to help establish what a shared understanding of movement and gesture might comprise. The event was also meant as an opportunity for the artists themselves to meet and perhaps gain stimulation from each other's work. Since it was our observation that they had similar goals, but were using different approaches, we hoped there would be cross-fertilisation of methods.

The artists and researchers we invited to present their work were Antonio Camurri, Mark Coniglio, Marc Downie, Myriam Gourfink, Rémy Muller and Dawn Stoppiello.⁶ Each presentation lasted from 30 to 45 minutes with time reserved after for discussion. The audience for the workshop comprised approximately forty individuals from a wide range of backgrounds, artists and scientists united through their interest in movement research and gesture analysis. The atmosphere in the single room was intimate and informal; the presentations were made from one side of the room without a stage, and the audience engaged in discussion at the end of each. However, in the following brief report, we reserve our reflections primarily to the comments and statements made by the presenting artists. All comments in quotes without a reference are taken from the transcripts.⁷

Introductory presentation

The aim of the introductory presentation by deLahunta was to give some context for why these artists were working in new and unique ways. We were specifically interested in how their projects brought the computer and programming into play as a creative partner in connection to making dances. And we were looking at the possibility of the development of a shared understanding of movement and gesture, shared by both the choreographer/dancer and the computer specialist (software artist, engineer or programmer). However, there is earlier creative work that could be argued to have already explored these topics, provisionally weakening our distinction proposal:

- 1964 at the University of Pittsburgh, choreographer Jeanne Beaman and computer scientist Paul Le Vasseur made computer generated choreography using an IBM 7070 computer to randomly choose a sequence of events from a list of movements: rotate shoulders, hop, jump, fall, gallop, flex knee, rotate leg, walk with legs bent, move left arm, rise etc.⁸

- Another early pioneer of the convergence between choreography and computers was John Lansdown, an architect by training from London. He was particularly interested in the possibilities of 'artificial creativity' to use the computer as an autonomous composer, rather than support or augment the existing creative process.⁹
- There is Merce Cunningham's well-known connection to the development of and his subsequent creative use, still today, of the 3-D human figure animation software LifeForms. This is the support approach Lansdown was less interested in, but still shows a close link between choreography and computer at the level of the creative process.¹⁰
- Additionally, although there were no computers directly involved, many 20th century artists including choreographers worked at some point with rule-based or algorithmic systems; in dance we have the example of Trisha Brown and William Forsythe.¹¹

While we accept that these approaches and projects made use of the computer (or computation) as part of the creative process and may have encouraged a shared understanding of movement and gesture, the artists and researchers we invited have been building and working with systems to analyse, recognise, learn, perceive, model and/or follow movement (or gesture) with the computer. Analysing and modelling movement has been a research trajectory in computer science since at least the late 1970s; hence most of the algorithms are already in existence.¹² But recent technological innovation, such as increases in memory capacity and processing power, has helped to put these approaches as instruments into the hands of artists. This we felt to be a clear departure from these earlier examples.

Now these systems, as evidenced by the work of the presenting artists/researchers, are being built in correspondence to a choreographic creative process, sharing an understanding of movement and gesture with dancers. This sharing occurs, at least in part, through the production of descriptions of movement in its own terms (as in physical) and in the symbolic abstractions that are necessary in order to use these computation techniques of gesture modelling, learning, following etc. We have coined the term 'co-description' to help frame this notion. However, as we have expressed already, the workshop was intended to test our ideas, and, in the following, we discuss some specific examples and in the conclusion will return to some of these issues.

Gesture follower research

Following the introduction, Bevilacqua described some of the gesture analysis research he has been directing with the Real-Time Musical Interactions Team. The main aim has been to establish methods for computing high-level parameters of movements similar to the ones used by choreographers in creation and performance (e.g. notions of movement quality, expressiveness and meaning). The background assumption was that a focus on high-level parameters could better facilitate the design and use of systems meant to interact with gesture. Another hypothesis of the research was that

9 John Lansdown, 'The Computer in Choreography', *Computer: IEEE Computer Society Journal* 1978, 11:8, pp. 19–30. And 'Computer-Generated Choreography Revisited'; John Lansdown, "Artificial Creativity": an Algorithmic Approach to Art'. A version of this paper was given at the Digital Creativity Conference, Brighton, April 1995. <http://www.pixelpoint.org/2001/article-00.html>

10 Merce Cunningham Website: http://www.merce.org/about_danceforms.html

11 Sources for Trisha Brown's dance making algorithms: Anne Livet (ed.), *Contemporary Dance: An Anthology*, New York: Abbeville Press, Inc., 1978; *The Postmodern Dance Issue: The Drama Review*, 19: 1, March 1975; For William Forsythe discussing algorithms see: Paul Kaiser, 'Dance Geometry: William Forsythe in dialogue with Paul Kaiser', *On Line, Performance Research*, 4: 2, Summer 1999, pp. 66–69. A version can be found on-line: <http://www.openendedgroup.com/ideas/conversations.htm>

12 For example see: Norman Badler's work on Human Modeling and Simulation; <http://www.cis.upenn.edu/~badler/>

13. See on-line introductory notes at <http://www.cs.cmu.edu/~tom/mlbook.html> to Tom Mitchell's *Machine Learning*, McGraw Hill, 1997.
14. See: http://en.wikipedia.org/wiki/Hidden_Markov_Models
15. <http://shf.ircam.fr/523.html> for a general description of the score follower; Example paper: D. Schwarz, A. Cont, N. Orio, 'Score Following at Ircam', 7th International Conference on Music Information Retrieval (ISMIR), Victoria, 2006.
16. F. Bevilacqua, R. Muller, 'Gesture follower for performing arts', Proceeding of the Gesture Workshop 2005, Ile de Berder, France.

the use of interactive systems in the context of performing arts is usually more limited by poor real-time motion analysis techniques than by the motion capture hardware specifications.

One aspect of the gesture analysis research explored various mathematical techniques such as Machine Learning, the study of 'computer algorithms that improve automatically through experience'.¹³ After some tests with techniques used to automatically extract features of motion capture data (for example Principal Component Analysis), the main research focus was directed towards methods to recognise and follow phrases using Hidden Markov Models (HMM), a statistical approach that models what we observe as the output of hidden states.¹⁴ This approach relies on the idea of a 'learning' phase, when movement phrases are recorded and then processed by the computer using the HMM. This reveals parameters that are re-introduced into the system as a recognition schema, which is then applied in real-time to the movement phrase as it is performed again. The recognition schema is able to evaluate and report on the similarities between this live performance and the previously recorded and 'learned' examples. This works on the principle of probability theory by attributing a 'likelihood' rating that is continuously updated from the beginning of the performance. The likelihood is the results of the comparison between two examples, a high value reporting that the two phrases are performed almost identically and a low value indicating that the phrase are very different; this is one way we could say the phrases are 'recognized' by the computer.

An important point in this approach was to consider a gesture as a time-based process, instead of trying to recognise postures. This approach was developed not only with the recognition scheme in mind, but also aiming at the idea of performing gesture following, i.e. precisely indicating, 'where we are inside the phrase'. Such a capability is analogous to *score following techniques* developed for over 20 years in the computer music field including extensive development by researchers at IRCAM. Also using HMM, *score following* aligns the audio signal produced by a musician with the score he or she is playing and uses this information to connect to the electronic dimension of the music, putting the performer more in control of the 'possibilities of expressive performance'.¹⁵

Score following is intended to connect the computer system more closely with the high-level parameters of human performance and perception. However, it is automated on the basis of an existing musical score. The critical development of the *gesture follower* is that it does not work with a predefined score, but, interestingly, using the gesture follower induces the possibility of creating a score, which can be annotated.¹⁶ This can be done manually by adding markers to highlight particular sections or transitions, in a timeline representation of the phrase. These annotation elements can then be used as an output of the gesture follower during the performance. For example, the markers can be used to segment in real-time the performed piece automatically.

Generally this particular proposed scheme of recognition/following enables the information to be extracted from the motion-capture data in

direct correlation to examples given by the performer. The results of the gesture analysis are thus dependent on the information contained in the examples chosen in the learning phase. In this sense, this approach can be seen as an attempt to propose a 'context-dependent analysis'. One could speculate how such a system contributes to a decrease in the gap between the choreographer's understanding and the programmer's understanding of the process by gradually introducing observations of the dancer as information at key points directly into the digital tracking/analysis loop.

Multimodal versatility

Against the backdrop of the IRCAM research approaches, Antonio Camurri presented recent developments in scientific and technical research his team in Genoa has been conducting, for many years. They are the developers of the software EyesWeb for the real-time analysis of expressive gesture using state of the art computer vision and other techniques. This approach is significantly different to the ones based on 3D optical motion capture systems that use reflective markers and multiple cameras. EyesWeb operates typically without markers using one or two video cameras and integrating multimodal inputs (video, sounds, sensors etc).¹⁷ Camurri gave an example of a recently developed approach that can transform any object (e.g. a table) into a tangible interface, where the location and the type of the touch is sensed using a set of microphones/accelerometers directly attached to its surface.¹⁸ This processing is achieved with EyesWeb and can be complemented by an additional video input, allowing for the multimodal measurement of different ways of touching and interacting with the object.

Notably, in parallel with development of Eyesweb, a consistent framework has also been developed considering separate levels of gesture analysis from low to high-level parameters.¹⁹ Typically, various analysis modules allow for the determination of large set of parameters related to the silhouette, point trajectories, spatial and temporal statistics (such as average spatial occupancy) to parameters related to movement qualities (for example rigid vs. light gestures).

However, the team's research goes beyond the development of software and is more generally dedicated to the study of non-verbal communication for which dance is considered to provide essential case studies. Particularly, research topics reside in the question of how expressive cues between dancers, or between dancers and audience can be measured. An important effort is made by the group to validate the relevance of the proposed analysis with experiments in various music and dance contexts. Additionally, collaborations with psychologists are being pursued, and studies include the correlation of parameters with basic emotion or more recently the study of empathy between musicians performing together.²⁰

Several examples were demonstrated during the talk, in particular, where parameters have been inspired by the theory of effort developed by movement analyst Rudolf Laban in the early 20th century.²¹ An important part of their development work tends to answer principally to the question of 'how is the gesture performed' instead of 'what is performed', and

17 EyesWeb site: <http://www.eyesweb.org/>

18 IST Project TAI-CHI (Tangible Acoustic Interfaces for Computer-Human Interaction), January 2004–December 2006, <http://www.taichi.cf.ac.uk/>

19 A. Camurri, B. Mazzarino, G. Volpe, 'Analysis of Expressive Gesture: The EyesWeb Expressive Gesture Processing Library', in A. Camurri and G. Volpe (eds.), *Gesture-Based Communication in Human-Computer Interaction*, LNAI 2915, Springer Verlag, 2004. For those interested to understand more about low and high parameters, they are described in relation to Digital Signal Processing here: <http://www.create.ucsb.edu/~xavier/Thesis/html/node161.html>

20 EyesWeb website/publications list for references to this work. <http://www.eyesweb.org>

21 For more information about see: Vera Maletic, *Body-Space-Expression: The Development of Rudolf Laban's Concepts*, Berlin/New York: Mouton de Gruyter, 1987.

- 22 For a list of analysis modules see: <http://www.infomus.dist.unige.it/EyesWeb/EywMotionAnalysis.html>. Upcoming version: EyesWeb XMI with extended multimodal interaction is now under testing.
- 23 For an extensive discussion of his agents, see Marc Downie's Doctoral Thesis, 'Choreographing the Extended Agent', MIT Media Lab, September 2005. Available on-line at: <http://www.openendedgroup.com/ideas/ideas.htm>.
- 24 See the 'Artistic Statement' here: <http://www.openendedgroup.com/artworks/howlong/howlong.htm>
- 25 For previous work of these artists, see the website for the Open Ended Group here: <http://www.openendedgroup.com/>
- 26 In the performance of the motion-capture version of *Loops*, the pre-recorded material is cast into a 'colony' of artificial intelligence agents whose computational responses are visualised in a moving graphic score that never repeats. For more details and also references for these quotes see the reference materials here: <http://www.openendedgroup.com/artworks/loops/loops.htm>
- 27 This project was organised and produced under the title of the 'motion-e project' by the Arts, Media and Engineering program

Laban's effort theory provides useful descriptions for them to use in this task. The EyesWeb software is used by artists and researchers worldwide, including artists presenting here today. It is freely distributed via the InfoMUS lab's website, and Camurri and his team are in constant development, frequently releasing new versions with recently developed modules for analysis.²³ If, as we are suggesting, choreographers are poised to collaborate with computer specialists (artists or scientists) in a shared field of movement/gesture analysis, Camurri's group in Genoa is producing an invaluable resource.

FLUID thinking images

Marc Downie is an artist and artificial intelligence (AI) researcher and programmer, whose work is inspired by natural systems and a critique of prevalent digital tools and techniques. His artworks comprise interactive installations, compositions and projections. Downie began his presentation by describing his interest in a 'new kind of picture' created by 'autonomous agents with their own bodies, their own perception systems and own ways of choosing what to do'. These software agents are programmed as separate systems capable of analysing and interacting with data coming from different sources, such as motion-capture.²³ Inspired by their capacity to understand and respond to their surrounding data environment, Downie and his collaborators have called the new kinds of pictures the agents make 'thinking images'.²⁴

In 2001, Downie joined digital artists Paul Kaiser and Shelley Eshkar to create *Loops*, in collaboration with choreographer Merce Cunningham. Kaiser and Eshkar had previously collaborated with Cunningham on projects using 3-D motion-capture animation.²⁵ *Loops* used motion-capture to record the movement of Cunningham's 1971 solo dance for his hands, and Downie applied his knowledge of agent-based AI and real-time graphics to create a 'colony' of 'autonomous digital creatures' that would interact with this data.²⁶ This project encouraged the artists to accept a commission to collaborate with choreographer Trisha Brown on a new creation, which would use a motion-capture system during the performance.²⁷ Not only would Downie have the opportunity to press his agents into a relationship with real-time motion-capture data (*Loops* had been pre-recorded), but also to program his new agent colony at the same time as the dance was being choreographed.

A major challenge was realised when he could not write code fast enough in the rehearsal studio to respond spontaneously to what the dancers were doing. Finding himself taking 'fewer and fewer risks', he wrote a tool called FLUID to interact with his own code. FLUID was designed to move easily between debugging and writing code and was able to remember everything that happened during a working session. This memory ability made it possible for Downie to name unexpected occurrences that might happen during a rehearsal so that he could call upon them later. He said, 'Trisha can, with a single instruction transform a segment of choreography because she delegates the problem solving to her dancers (. . .). I needed



Figure 1: Triangle – captures and recaptures movement from the stage; extending, distorting and moving its body from stage right to stage left (Images courtesy Marc Downie).

that ability to do that in my own practice'. FLUID was his solution to this need. With FLUID and his agent-based approach to making interactive art, Downie challenges the dominant paradigm embodied in the term 'mapping' and its related aesthetics.²⁸

The collaborative dance work came to be titled 'How long does the subject linger at the edge of the volume . . .', a comment Trisha overheard someone on the motion-capture team make. Premiering in April 2005, the piece was 3 years in the making. When asked to identify a few specific points when Trisha and he connected during the creation process, Downie remarked that it was in the 'naming of things' that this was perhaps most explicit. This naming process was part of developing a common enthusiasm and language for what they were doing. Other cooperative decisions were made in silence, e.g. he showed her the Triangle image and the next day she came with a solo inspired by it.

In fact, the Triangle image opens the piece (see Figure 1). When the dancers first step out and start across the stage from stage right to left the Triangle appears and starts 'hitching a ride on the dancers (. . .) sending out lines and retracting them leaves traces on its own body'. It does this by searching for motion-capture markers on the dancers. The goal of the Triangle is to get from stage right to left following the dance, always making it across because it has 'learned a rough set of heuristics about where and when it should connect and let go of the dancers'. The Triangle agent has 'seen the dance before', but it still has to make new decisions of every performance about when and how to connect to it. The audience watches this 'thinking image' projected on a large scrim hung in front of the dancers; the stage behind is well lit so that one can easily see both the projection and the dancers.

With self-directed agents like the Triangle and Weaving (another agent that is part of the dance), Downie makes a strong proposal for a new way of thinking about the aesthetics of interactive art making. He doesn't consider his agents as mapping input to output. Rather they display 'a set of expectations that are intentions about how the world works and how they will act in the world'. Downie's methods are computationally complex, but his terms and descriptions evoke strong connections with choreographic body-based movement practices. The creation of his new tool, FLUID, shows his commitment to engaging with the dance making process. This combination: a rich new repertoire of descriptions to stimulate and be stimulated by choreographic practice in combination with a cooperative

at Arizona State University. Choreographer Bill T. Jones was also involved. Extensive documentation is available here: <http://ame.asu.edu/motione/>

²⁸ Example reference for 'mapping' see: Marcelo M. Wanderley (guest editor), 'Mapping Strategies in Real-time Computer Music', *Organised Sound*, 7: 2, 2002. While referencing the increase in 'smarter mapping', e.g. using advanced computation such as machine learning previously mentioned by Bevilacqua, as a good trend, he still questions the use of the term mapping at all' and offers the concept of agent-based aesthetics as an alternative. See his Doctoral Thesis page 39.

- 29 Performing Arts Research Team: <http://www.ircam.fr/301.html?L=1>
- 30 Muller's Blog on the theme of 'This is my House' under 'artistic collaborations': <http://recherche.ircam.fr/equipes/temps-reel/movement/muller/>

understanding of creation processes is why this collaboration stands out as a strong indication of where computation and choreography might go together in the future.

Following and resonance

Paris-based choreographer Myriam Gourfink has developed a unique body of works. She is known for her approach to movement material in which she explores an expanded world of time with extremely slow and often small movements. She was invited by IRCAM to work on a project using the gesture tracking and analysis systems, the Performing Arts Research Team and the Real-Time Musical Interactions Team were developing.²⁹ After a preliminary phase of research, Rémy Muller was the member of the IRCAM team selected to work closely with Gourfink on her dance piece titled 'This is My House', which premiered in 2005 at Quimper, France.³⁰

'This is My House' is a performance in which the movement of five dancers is recorded using a variety of sensing devices and then analysed in the computer. The result of the analysis is used to trigger a change in a written score displayed on video screens, which the dancers are able to see while they are performing (see Figure 2). The scenography has been uniquely constructed to make this reading while performing possible by positioning twelve screens on the grid directly above the dancers. The movement is slow (which helps make the recording, analysis and triggering possible) and often performed on the floor, and so it is relatively easy for the dancers to see the changes on the screen. The written score uses symbol notation developed by Gourfink inspired by Labanotation (see Figure 3).

This is a collaborative work that illustrates the shared understanding of movement and gesture mentioned previously, and we can use it to elaborate on various aspects of co-creation in this context. Because Bevilacqua's team had developed some of the concepts for analysis prior to inviting Gourfink to work with them, an initial fit with her unique choreographic



Figure 2: 'This is My House'. The screens are visible above the dancers (Photo: Rémy Muller).

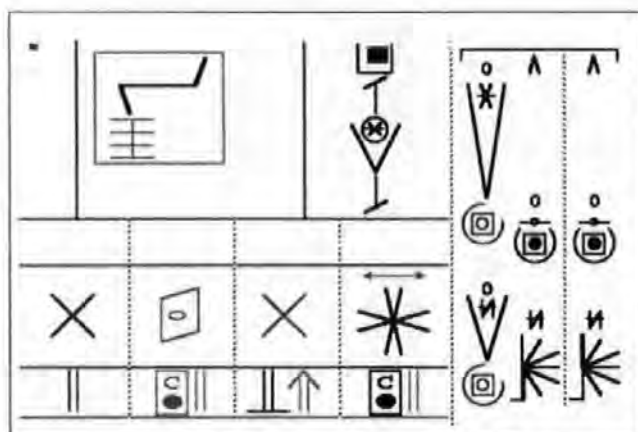


Figure 3: Sample screen from the written score for 'This is My House' (Courtesy: Myriam Gourfink).

approach had to be found. After a series of experiments, Gourfink and Muller eventually saw the possibility of using the gesture recognition and following system to allow the performer to modify the 'pre-written' dance. However, the co-creation had still to be realised/implemented in the computer, and it is in this process that the concept of shared understanding can be explored.

Muller commented that Myriam wrote the scenario and he 'just made the implementation', through the development of the appropriate software elements. However, in his description of the fine-tuning of the system he set up, there is an indication of a deeper process. Resonance or synchronicity between dancers was one of the properties of the dancers' movement the analysis system was built to recognise. Muller said, 'I spent some time to find the range it made sense to talk about "resonance" between dancers. (...) The system doesn't give an answer that isn't really close to what we see on stage'. Tuning the system to the appropriate threshold for the recognition of resonance within the context of the live performance required Muller to identify with what was working, artistically, on the stage. Gourfink and the dancers are the main arbiters of the space of the stage, but Muller's intuitive grasp of what works and what doesn't informed his adjustment of the system.

The outcome of the collaboration between Gourfink and Muller is a dance that is dependent on the computational input for its performance. The network of relations between movement sensing, the four types of analysis being performed and the triggered notation score on the screens, subsequently modifying the movements, is such that this is a work that is the same but new each time it is performed. This makes it arguably an 'open work' that is co-conducted by different agents, not the types of agents that have their own 'thinking' like Marc Downie's, but agents that depend on the analysis of the performance in relation to a set of written rules.³¹ In the creation of 'This is My House', choreographic and computational thinking have

31 The discussion of the meaning of 'agents' is as open-ended as the debate about interactivity; it relies very much on the specific context of its use.

- 32 Scott deLahunta, 'Isadora: An interview with artist/programmer Mark Coniglio', *International Journal of Performance and Digital Media*, 1: 1, pp. 31–46. An earlier on-line version is here: <http://www.sdela.dds.nl/sfd/isadora.html>
- 33 Find quote on the website for the Digital Fellows Program 2003: http://www.dtw.org/dig_fellows03.cfm
- 34 For Coniglio's explanation see: <http://www.troikaranch.org/16revs/technology.html>

settled into a particular correspondence, one we feel deserves closer study. It sets important precedents through retaining and magnifying to some degree the rigorous aesthetics of Gourfink and simultaneously demonstrating the value of the gesture analysis systems the IRCAM team has created.

Gestures and lines

Mark Coniglio and Dawn Stoppiello are the co-founders and directors of Troika Ranch, a performance group that has integrated dance, theatre and interactive digital media in their work since the early 1990s, longer than any of the other collaborations presented today. Coniglio is notably the creator of Isadora, a real-time video processing software used as a creative and performance instrument by artists worldwide.³² Troika Ranch worked for several years with the 'MidiDancer', a wearable device Coniglio first built in 1989 that measures the angular change at several joints on the dancer's body. This information was sent over a wireless link to a computer where the data was used to control a variety of media events, e.g. sonic, video, lighting and/or robotic.

In 2003, Coniglio began to investigate a new system for measuring and identifying the quality of dancers' movement. In his words 'striving to match the complexity embodied by the live dancer using the quality of movement as a source of media control'.³³ After a period of research, Coniglio settled on using EyesWeb, the software mentioned earlier, that can use a single camera to track the silhouette of the dancer. It superimposes a 12-point skeleton onto this silhouette (head, shoulders, elbows, wrists, top of pelvis, knees and ankles)³⁴ (see Figure 4). EyesWeb then sends information about the pathway of each of these points to Isadora where the information is analysed and 'mapped' to dynamic graphic effects (and other forms of media). The system does not have the accuracy that an industry



Figure 4: Screenshot of the EyesWeb 12-pt skeleton (Courtesy: Marc Coniglio).

standard 3-D motion-capture system does, but it gives the same result every time. This makes the software suitable for Coniglio's research into sensing qualities of movement, and the overall setup something they could easily tour on the road.

Now that Coniglio could get the point pathways into Isadora, he started to visualise them as simple lines being drawn in space and projected on the screen. These dynamic lines, drawn (as on-screen projections) while the dancer was moving, served as the next step in Coniglio's movement analysis research. He started to break the lines up into smaller parts in real-time, segmenting them as a way to analyse them for simple properties such as degree of curvature, velocity and complexity.³⁵ A change in movement or gesture was automatically recognised by the computer as a change in the properties of the line and vice versa, and notably this was taking place in real-time. Coniglio began to explore what he could do with the information derived from this analysis of the line/gesture. Through the segmentation process, certain properties of the gesture were initially isolated, and these could be recombined in a variety of ways, which Coniglio felt avoided some of the problems of one-to-one direct mapping Downie had discussed critically. The output and effects (in image and sound) derived from the gesture analysis component of the work was, in Coniglio's opinion, approaching the quality of the actual gesture to which the analysis was being applied (see Figure 5).

The line has always been a provocative and effective tool for the artistic imagination in visual arts, as from its simplicity profound qualities emanate. But the combination of analysis and understanding its expressivity may have been best accomplished by visual artist Paul Klee in 1925, who, in his *Pedagogical Sketchbook*, defined and analysed the primary visual elements (including lines) and ways in which this analysis could be applied.³⁶ One

35 Segmentation is widely used in the fields of movement research; breaking a dance phrase or gesture into smaller parts in order to learn something about the whole is often the first step in analysis. Scott deLahunta and Phil Barnard, 'What's in a Phrase?', in Johannes Birringer and Josephine Fenger (eds.), *Tanz im Kopf/Dance and Cognition, Jahrbuch der Gesellschaft für Tanzforschung* 15, Münster: LIT Verlag, 2005, pp. 253–266.

36 Klee, Paul, *Pedagogical Sketchbook*, England: Faber and Faber Limited, 1953.



Figure 5: Lucia Tong in Troika Ranch's 16 [R]evolutions (Photo: Richard Termine).

37 The final performance may have taken place in the context of the Monaco Dance Forum, 13 December 2006. <http://www.monacodanceforum.com/>

38 For a discussion of tuning interactive systems see references to the work of composers and instrument builders Dan Trueman and Curtis Bahn, in S. deLahunta, 'Permuting Connections: Software for Dancers', in Paul D. Miller (ed.), *Sound Unbound: An Anthology of Writings on Sound Art and Multi-Media*, Cambridge: MIT Press (upcoming 2007).

39 Quote from Artist's Discussion, Monaco Dance Forum, 14 December 2006.

might consider Coniglio's approach as bringing an important level of embodiment to Klee's thinking, engaging computation in the process of understanding the line and through this the comprehension of what a gesture is. The question is: does this take us a step closer to the idea of a shared understanding of movement?

Summary and conclusion

As mentioned earlier, the workshop was intended in part to test our assumptions about this new approach to the connection between computation and choreography. The diversity of the presentations, in terms of aesthetics, modes of working and production conditions, makes it difficult to return to some of our generalisations. For example: the access Marc Downie and Trisha Brown had to high resolution 3-D motion-capture strongly contrasts the approach of Troika Ranch who build systems they can take on the road and set up quickly in different spaces. There is a good chance that the full version of 'How long does the subject . . .' with agents and dancers, both performing in real-time, may never be seen again due to the expenses and other complications associated with its production.³⁷ However, the creation of this work gave Downie the opportunity to advance his thinking on mapping alternatives and agent-based aesthetics, which includes a vocabulary rich in psychophysical metaphor. This we see as making an important contribution to the field alongside Troika Ranch's dedication and resourcefulness.

Both Rémy Muller and Marc Downie described finding ways to grasp and engage with the dance creation process, and both were working with tools they could adjust and tune in ways that did not restrict this.³⁸ Conditions that allow for 'shared enthusiasm' (Downie) frame the engaged state of mind that makes working together possible. A shared enthusiasm has immediate affect, implies excitement and curiosity, and when it includes 'naming' things together, the overall notion of a shared understanding comes into view. However, it is important to note that sometimes understanding takes place in silence; no verbal descriptions were necessary when Trisha Brown could simply watch the Triangle in action. Crucially however, having enough time and space is a primary ingredient for choreographic computation projects to take advantage of 'shared enthusiasms'. Despite having generous support for their project, Brown has remarked that she felt that they were 'just scratching the surface'.³⁹

It seems that a good aesthetic fit between systems and individuals is also important. The artistic approaches of choreographers Gourfink and Brown resonated with the systems they worked with, and Stoppiello has spent nearly her entire performing career working with the technology Coniglio develops. It is important that the work of the EyesWeb and IRCAM gesture analysis teams maintain strong links to science, so that we can draw on descriptions of movement and gesture from other fields such as psychology and neuroscience, and explore how and where these approaches might influence and interact with artistic work. But for the art, the concept of a clear aesthetic vision that fits whatever knowledge of gesture is manifest in the system(s) being used is critical.

In final summary, it seems not the time to make more observations induced from these specific examples. We hope the meeting and this report will serve to inform the field of a subset of rigorous related practices being undertaken by a relatively small number of individuals. At this stage, it is premature to say that this is a 'fresh territory', but we think there is something in this work of great substance that should be further explored and linked to new directions of thinking in science, philosophy and art.⁴⁰ But, this will require more support for interdisciplinary research that emphasises choreographic creation and works together to ensure that the capacity of dance remains undiminished.

References

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<http://www.ircam.fr/atr.html?L=1>

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Mark Coniglio and Dawn Stoppiello (New York) are media artist and choreographer and co-directors of Troika Ranch – a dance theatre company that integrates dance, theatre and interactive digital media in their live performance works. Coniglio has focused his career as an artist and computer programmer towards a singular goal: to find ways for the movements and vocalisations of performers to interactively manipulate digital media in a meaningful way.
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Marc Downie (New York) is an artist and artificial intelligence researcher. He holds degrees in Natural Science and Physics from Cambridge and Media Arts from MIT, and a PhD from MIT's Media Lab. His interactive installations, compositions and projections have presented advances in the fields of interactive music, machine learning and computer graphics. <http://www.openendedgroup.com/>

Myriam Gourfink (Paris) is a choreographer, whose unique work introduces yoga techniques and computer-choreography to contemporary dance, exploring micro-movements and challenging conventional notions of dance. The performance she creates requires extreme physical control resulting in a strange but boundless beauty. <http://www.myriam-gourfink.com>

Rémy Muller (Paris) is a signal and image processing engineer, with a specialisation in computer music as well as video processing (Images and Systems Master, Lyon). At Ircam, he is an engineer/developer with the Performing Arts Research Team. He performs research on motion following/recognition and develops tools for Max/MSP and EyesWeb.
<http://recherche.ircam.fr/equipes/temps-reel/movement/muller/>

⁴⁰ Erin Manning, 'Prosthetics Making Sense: Dancing the Technogenetic Body', *Fibreculture: The Journal Of Internet Theory and Criticism and Research*, Issue 9 (general issue), 2006 <http://journal.fibreculture.org/issue9/index.html>

Suggested citation

deLahunta, S., & Bevilacqua, F. (2007), 'Sharing descriptions of movement', *International Journal of Performance Arts and digital Media* 3: 1, pp. 3–16, doi: 10.1386/padm.3.1.3/1

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'Dance (in the presence and absence of) Technology'

This is the pre-translation version. The published version appeared as:

'Danza y Tecnología' in En moviment. Barcelona: Theatre Institute Mercat de les Flors. October 2006, pp. 16-17. (See Appendix pp. 427-428)

In August 2006, I received an invitation from Barbara Raubert, dance critic for the newspaper *Avui* in Barcelona, who was preparing a publication for the Mercat de les Flors, the institutional theatre in Barcelona. She asked me for a short paper "talking about the role of new technologies in dance, which they are and why. Also, we would like to know when is the mixture of dance and technologies considered dance and when is it considered cinema; when is it creation and when is it technology."¹ The deadline was very tight, only a few weeks. My response was that I was in a new phase of thinking and was not sure I was prepared to write on this particular topic and offered an older paper. Her response was that "maybe it would be easier to take an old text", but "all these thoughts about what is new or can be, etc that may be even more interesting, and hopefully this can help you clarify something."² I accepted her proposal and wrote this as a new text.

¹ Email to the author, 18 Aug 2006.

² Email to the author, 23 Aug 2006.

Dance (in the presence and absence of) Technology

(This is the pre-translation English version as submitted for publication in September 2006.)

By the time I moved to Amsterdam in September 1994 to teach at the School for New Dance Development, Netherlands was already an important environment for the growth of new media culture. This probably was one of the reasons that Technology/ Media became the main theme of a symposium on choreography we organised in June 1996. Re-titled *Connecting Bodies*, "an international symposium on the connections between the discourses and practices of dance and technology focussing specifically on the impact of new media technologies on dance making/ choreography", the symposium was the first of its kind in the Netherlands.¹

An impressive gathering of presenters included artist and computer scientist Thecla Schiphorst showing LifeForms, the 3-D human figure animation software she had been developing with Merce Cunningham as a tool for choreographic creation; Heidi Gilpin, dance dramaturge with William Forsythe demonstrated early versions of what would be published in 1998 as the *Improvisation Technologies* CD-ROM; and Oslo based Amanda Steggell (choreographer) and Per Platou (musician) showed documentation and discussed their performance work *M@ggie*s Love Bytes*, one of the first to use the Internet for connecting remote spaces as a part of the performance. There was a project shown by Peter Mulder from the NOB (Dutch Broadcasting Company) connecting a performer in a complex 3-D motion capture system to graphic imagery during a live orchestral concert. There was also a short "interactive" dance performance made especially for the symposium that used Big Eye, a motion tracking software being developed at the Studio for Electro-Instrumental Music (STEIM) in Amsterdam.

The breadth of work shown at the symposium covered the basic "catalogue" of technologies often connected with choreography and dance, from digital creative tools to real-time interactive performance instruments. But the symposium was not simply a pedestal for technology. Every presenter was in the process of thinking hard about the impact of technologies on dance and vice versa. The collective discussion was rich and incisive, and our chairperson, Diana Theodore, summarized the two days with an "inventory of issues" and questions that remain relevant today such as: does technology produce a different idea of the body and could this be liberating; can dance provide a resistance to the notion of technological disembodiment; what makes a good "technographic" (dance and technology) performance; and can we maintain a culture of movement memory via technology?²

Inspired by this wide range of new artists, materials and ideas, I embedded myself further into this community of practice called "dance and technology" as a writer, researcher, advocate, speaker and organiser.³ Mark Coniglio, co-director of Troika Ranch, and I worked together to revive discussions on an email list which had been launched earlier under the title "dance-tech", and we launched the resource website *Dance and Technology Zone* in early 1997.⁴ This ushered in a period when the growth of information becoming available to me on a daily basis seemed to mirror an actual increase in artistic activity. The feeling at the time was not only of growth, but of a kind of rapid expansion and maturation. Two years later, in February 1999, the organisers of the *International Dance and Technology Conference* (IDAT) at Arizona State University confirmed this feeling by writing: "We can now begin looking historically and critically at how the convergence between these fields has developed, how this effects us, and how dance and technology can continue to give breadth to one another in the coming century."⁵

However, the artwork that was being made had its critics. Outside of the dance and technology community of practice, the general perception was often a variation on

"too much technology too little dance". I felt different perspectives were necessary and sought to open up thinking about the range of relationships inherent in this type of work; particularly in its making. For example, one of the intrinsic strengths of the dance and technology community could be seen in the conjunction of two creative domains or disciplines working with radically different materials. Convinced that the production of strong artworks could, in part, be achieved by making the conditions for interdisciplinary creation much better, I became involved with others in the organisation of a number of "research labs".⁶ Short and intensive, these projects brought together new collaborative teams and supported existing ones; maximized access to a range of technologies; were process- orientated and emphasised constructive peer-to-peer feedback. There was always an effort to make documentation of the research outcome available, sometimes not as successfully as we wished.⁷

At the same time, we pursued another line of enquiry titled *Software for Dancers*, which set out to "to develop concepts for a software rehearsal tool for choreographers and those practitioners for whom the body in motion is a primary material".⁸ This research has evolved along different lines including *Choreography and Cognition* in which we shared an intensive research process with psychologists and neuroscientists.⁹ This project shifted the focus of the research to the mind of the choreographer/ dancer. In doing so we made the empirical discovery that building tools to support creative process and studying various aspects of brain functioning are closely linked; nothing new in the history of cognitive science, but the *Choreography and Cognition* project showed it was possible to integrate the two fields of knowledge. The idea of the brain as an information-processing environment may not be the most appropriate conception in all circumstances; but it makes it possible to conceive of the relation between dance and technology differently.

Critical to the interdisciplinary research labs and the *Software for Dancers/*

Choreography and Cognition project is the assumption of a culturally stable concept of choreography and dance. This concept has a shared history, belief that the basic material exists in the moving body of the dancer and the primary locus of choreographic activity is the rehearsal studio and stage. These stable entities are important and useful, especially when trying to organise productive exchanges between art and science. But another way of thinking is to blur the boundaries between disciplines and practices by separating some of these concepts, and, for example, applying the concept of choreography to artistic work that uses new technologies to elicit movement from the artwork's intended audience.¹⁰ As our social landscape is pervaded by mobile and locative technologies, this type of artwork, no longer possible to contain on any single stage (unless the idea of stage is expanded to include an entire city), might be perceived as the vanguard of dance and technology practice.¹¹ However, with no moving body of the dancer and no stage there is a decided absence of dance. How can this be reconciled?

A recent project has suggested a way. By their own definition, the previously mentioned projects are all bound to the idea of specialist knowledge. In a recent workshop, organised at Tanzquartier Wien and titled *Absent Interfaces* "researching new approaches to performance and media", we determined to continue exploring the same relationship the *Connecting Bodies* symposium did in 1996. But now we assumed nothing to be necessary; e.g. no certain specialist knowledge, no specific technological instruments, and to question the classic dance and technology arrangement: the relation between body as input, computer as processor and audio/video media as output.¹²

The full results of *Absent Interfaces* are still forthcoming, but they seem to contain a hint of at least three critical questions. If one response of the dance and technology community in the last decade was to take advantage of increased processing speeds, lowering costs and new software development, what response might there

be now? Are we at the threshold of certain technologies acquiring the depth and breadth of cultural meaning making it possible for dance artists to use them metaphorically and self-referentially? And if some of the newest technologies are biological, as seems clearly to be the case, what will be the artistic reaction to this? One possible response to this last question is the 2001 performance piece of Swiss choreographer Yann Marussich, *Bleu Provisoire*, in which biochemical reactions make up the performance.¹³ How might works of this type that hack the body's internal machinery change our thinking about relations between "dance and technology"?

After ten years of engagement, the observation I would make now is that "dance and technology" will not converge as implied by the previously mentioned comment of the 1999 IDAT conference organisers. Rather its development has been and will continue to be periodic, fragmented and often subsumed into other genres or types of work.¹⁴ While continuing the *Software for Dancers* research along its different strands, I have revised my original idea of the interdisciplinary research labs to reflect a different attitude to separate disciplines. I think it is less important today to emphasize distinctions between practices and more appropriate to relax the idea of specialist knowledge, to blur the boundaries between disciplines and highlight the freedom for artists to use whatever means necessary to make and disseminate their work.

At the same time, there are recent developments that do follow the convergence trend of "dance and technology" in which machine-based gesture tracking and movement analysis are being combined with choreography and performance in new ways; for example in the recent work of Trisha Brown made in collaboration with software artist Marc Downie entitled *How long does the subject linger at the edge of the volume...* in which Artificial Intelligence Agents generated their own graphical responses to the choreography in real-time.¹⁵ We have explored these

developments in a recent symposium titled *Choreographic Computations: Motion Capture and Analysis for Dance* organised at IRCAM, Paris in June 2006.¹⁶

The questions posed by Diana Theodore in June 1996 about "dance and technology" can be traced throughout these many projects over the last decade: from *Connecting Bodies* to *Absent Interfaces*; from *LifeForms* to *Software for Dancers*; from early Internet performances to computer-based choreographic agents; from mind-hacking (cognitive science) to bio technology art; and the emergence of the non-specialised (and uncategorized) artist. What is clear is that each specific manifestation of practice, in its specificity and contextual relations, provides answers to these questions. Artists, curators, audiences and critics today who generalise with the view that "dance and technology" means "too much technology and too little dance" are missing this wider range of possible relationships where neither may be deemed essential and yet, in either their absence or presence, continue to give rise to new creation in thinking and artwork.

Scott deLahunta

2006

Endnotes (all URLs checked on 12 September 2006)

¹ The original symposium website: <http://www.sdela.dds.nl/boi/sympos.htm>

² Symposium summary by Diana Theodore: <http://www.art.net/~dtz/diana.html>

³ Origin of the term is probably most easily attributed to the *Dance and Technology Conferences I-III* hosted by the University of Wisconsin (Madison, 1992), Simon Fraser University (British Columbia 1993) and York University (Toronto, Ontario 1995). Proceedings from I and III are available here: <http://www.surrey.ac.uk/NRCD/pConferences.htm>.

⁴ Websites for Troika Ranch: <http://www.troikaranch.org/>; and the Dance and Technology Zone: <http://art.net/~dtz/>.

⁵ IDAT 99 Archives: <http://www.ephemeral-efforts.com/IDAT99.html>

⁶ Digital Dancing Documentation: <http://www.braunarts.com/digidancing/>.

⁷ 7. Some sample research lab websites: <http://dance.asu.edu/cellbytes2000/scott/index.html>; <http://www.sdela.dds.nl/transdance/report/index.html>; <http://www.sdela.dds.nl/mcrl/index.html>.

⁸ 'Software for Dancers' Sanjoy Roy article (original project) <http://www.sdela.dds.nl/sfd/sanjoy.html>.

⁹ 9. Choreography and Cognition documentation website: <http://www.choreocog.net>.

¹⁰ In some ways this would not be new thinking, as the audience becoming the performer is associated with the genre of "interactive art" dating back to the Happenings of 1950. For more background and references refer to *The New Media Reader*, eds. Noah Wardrip-Fruin and Nick Montfort. Cambridge, MA: MIT Press, 2003.

¹¹ A quintessential work of this kind has been created by the UK based performance group Blast Theory in their locative performance/ media project "Can You See Me Now?" <http://www.blasttheory.co.uk/>. Additionally, an essay on the same theme titled 'Blurring Boundaries: a theory of the artwork' is available in the First Edition of the On Line Journal COMPAS: <http://www.compasbcn.com/>.

¹² Absent Interfaces was conceived and facilitated by Daniel Aschwanden (AT) and Scott deLahunta with supervision and organisation support from Martina Hochmuth from TQW; as a one-week workshop from 28 November through 3 December 2005 with invited artists Heine Avdal (NO/ BE), Myriam Gourfink (FR), Anne Juren (AT), Ralo Mayer/ Philipp Haupt (AT), and Veronika Zott and Tomate (AT).

¹³ Bio-Art is an artistic response to biotechnology, which, in the example of Marussich, extends the developments of Performance, Installation and Body Art (more information on Yann Marussich can be found here: <http://www.perceuseprod.ch/>). There are many sources of information on Bio-Art available on-line including conferences and exhibitions, for example: <http://www.a-r-c.org.uk/db/about.html>.

¹⁴ For some earlier thoughts on this I have published a chapter titled: 'Periodic Convergences: Dance and Computers'. in *Tanz und Neue Medien* (book and cd-rom/dvd). eds. Dr. Söke Dinkla and Dr. Martina Leeker. Berlin: Alexander Verlag. 2002,

pp. 66-84. A report on IDAT 99 by Dragan Klaic provides another perspective:

<http://cf.hum.uva.nl/%7Etheawet/technology/articles/idad99.html>.

¹⁵ . For more information on the Trisha Brown/ Marc Downie collaboration see:

<http://www.openendedgroup.com/artworks/howlong/howlong.htm>.

¹⁶ Choreographic Computations: Motion Capture and Analysis for Dance:

<http://recherche.ircam.fr/equipes/temps-reel/nime/workshops.htm>. A report will be published in a

forthcoming issue of the International Journal of Performance Arts and Digital Media

(<http://www.intellectbooks.co.uk/journals.php>).

'Constructing Memory: creation of the choreographic resource'

Co-author Norah Zuniga Shaw. in Digital Resources: Performance Research.
11:4. 2007, pp. 53-62.

In Autumn 2006, I was co-editing this issue on Digital Resources for Performance Research and submitted this article which was originally developed for the 'Digital Resources for Humanities and Arts' conference at Dartington College of Art in September 2006. Norah Zuniga Shaw contributed the section on the project of William Forsythe which she was working on.

Performance Research is a specialist journal published by Routledge that promotes a dynamic interchange between scholarship and practice in an expanding field of performance. Interdisciplinary in vision and international in scope, its emphasis is on research in contemporary performance arts within changing cultures. Source: <http://www.tandf.co.uk/journals/titles/13528165.asp> (accessed 7 May 2010).

Constructing Memories

Creation of the choreographic resource

SCOTT DELAHUNTA AND NORAH ZUNIGA SHAW

INTRODUCTION

There is an inherent and well-debated tension existing between the live dance performance and its documentation or recording. This has to do with the unmediated relation between performer and audience and how this combined presence is entangled with the requirement that the dance should be continually disappearing. If a work of choreography leaves anything more than traces or fragments behind in memory, then it is not danced choreography. The materiality of dance is inextricably bound up with its own immaterial dimension.

These are the normative features of this tension between dance and its documentation in which the dancer's presence and vitality becomes almost a cliché, i.e. the videotape of a performance can never be 'the real thing', any recording, whether computer based motion capture or hand written notation, can never achieve the status of the 'live' work. However, it does not take long before this gap between presence and absence is converted into something else meaningful. Performance and other scholars and writers, intrigued by dance's vanishing, enter into philosophical debates about writing, bodies, stillness, texts, thought and gesture. Anthropologists, ethnographers, preservationists and librarians of culture all consider the dance's recording or document, as flawed as it may be, as the vehicle for furthering aims and goals of the institutional domain whether they are research in higher education,

public understanding or promotion of heritage. Conventional dance reconstruction has a long history of creative interacting, even if problematically, with prior productions. And to some contemporary dance artists, the ephemerality of dance is self-evident to the extent that they make work reflexive of this condition.¹

However, there is a shift to this story marked by two poles. One pole is a change in the notion of what constitutes a valuable resource for a researcher seeking insights in the interstices between knowledge disciplines. And it is here that artistic creativity is attracting attention from other fields and subsequently gaining value. The emphasis of this attention in some circumstances has moved subtly away from the art object or performance itself towards its creation. The second pole is the artists themselves opening up and sharing their creative process, perhaps sensing and looking to interact with this increasing external interest or seeking to understand themselves better, a self-demystification of one's own practice in order to sustain continuous innovation. In either case, an overall result of this shift is that artists and others are increasingly producing and consuming research resources that emerge out of the making part of the choreographic practice. Even if this means applying a particular way of looking at what gets made, as with the Forsythe project described further in this essay.

Given this situation, one could argue that while the dance may disappear, a valuable

(All URLs available 23 November 2006.)

NOTES

¹ On dance's disappearance see the writings of André Lepecki, Jacques Derrida, Mark Franko, Peggy Phelan, Alain Badiou; for dance's preservation see Johnson, Catherine, J. and Allegra Fuller Synder. *Securing Our Dance Heritage: Issues in the Documentation and Preservation of Dance*. Council on Library and Information Resources, July 1999; for reflection on dance reconstruction see Thomas, Helen. *Reconstruction and Dance as Embodied Textual Practice* in Carter, Alexandra (ed.), *Rethinking Dance History: A reader*. London and New York: Routledge, 2004, pp. 32–45; for contemporary artists making work about dance's disappearance see on the work of Vincent Dunoyer: Laermans, Rudi, Hugo Haegheens, Gerald Siegmund. *Mediale Bemiddelingen. Over Vincent Dunoyer en anderen*. Cultureel Centrum Maasmechelen, 2003.

² This can be found in the concept of Creative Industries, which focuses on exploiting the intellectual property found in products of cultural creation.

³ Susan Melrose and Paul Carter are writers who take a critical position relative to university based practice-based research. Both emphasise the need to address creative practice in its own terms and from the perspective of the artist as different from the professional spectator or academic. Related materials can be found on Melrose's website: <http://www.sfmelrose.u-net.com/> and in: Carter, P., *Material Thinking: Collaborative Realisation and the Art of Self-Becoming*, Melbourne, 2004.

⁴ Many thanks to Franz Anton Cramer for thoughts written here stemming from a recent discussion.

⁵ Siobhan Davies Dance <http://www.siobhandavies.com/>

⁶ The NRC has created similar resources for other UK choreographers, e.g. Lloyd Newson and Shobana Jeyasingh (<http://www.surrey.ac.uk/NRCD/>). To read about the digital archive initiative: <http://www.ahrc.ac.uk/awards/casestudies/siobhandaviesdance.asp>.

⁷ The concept of a simple digital video annotation tool dates back to Autumn 2001, when Davies herself was a participant in an intensive meeting in London called Software for Dancers: <http://www.sdela.dds.nl/sfd/>. The idea became reality when a small amount of funding was obtained in 2004 to develop RotoSketch: <http://thesystemis.com/rotosketch/>.

⁸ Sarah Warsop personal email communication 10 November 2006.

⁹ Emilio Greco/PC <http://www.emiogreco.com/>

creative resource remains. More than a mere 'trace' this resource is useable and generative in a variety of ways. It can be transmitted and disseminated; it is transferable and renewable; and it can carry compressed information that can feed back into the choreographic process. There are complex issues here. Creativity is far from neutral in particular as manifest in the current goal-directed (teleological) desire to make it useful in some non-art sectors.² And furthering the understanding of creativity is no less charged with ethical issues than the study of the brain and consciousness. However, it is not the aim here to critique institutional policy or embedded beliefs. Rather we wish to ground the remainder of this essay in the creation of choreographic resources from the perspective of the artist, addressing these issues from within the creative practice itself.³

THE CHOREOGRAPHIC RESOURCE

Siobhan Davies, Emilio Greco, Wayne McGregor and William Forsythe are four of the most prolific and successful choreographers practicing today. Their invention of significant contemporary dance works has produced a rich body of unique materials related to choreographic creation and production. These materials are evolving as the artists continually seek new methods of making, with the aim not to repeat and to avoid fixed procedures and forms. These materials and the artists responsible for them have achieved the status of 'resource' for researchers not only from the performing arts, but also from other disciplines including architecture, music, philosophy and the cognitive sciences. As an aspect of this achievement as well as the desire to 'step back' from the body of materials they have created, these artists and the organisations that have been built up around them have begun to think or rethink in some cases how to create, manage and disseminate their choreographic resources.⁴ The focus of this rethinking tends to oscillate between the establishment of an archive and how to fold resources back into

their own artistic work. Their approaches can be described as 'necessarily unique' since the focus is on individual artists actively engaged in making original works. At the same time, some of the methods used could be described as shareable even if they comprise newly invented approaches.

DYNAMIC DRAWINGS (SCOTT DELAHUNTA)

Artist Siobhan Davies

Organisation Siobhan Davies Dance⁵

The choreographic work of London-based choreographer Siobhan Davies has been available as 'resource packs' from the UK's National Resource Centre for Dance for several years. And recently arts and humanities research funds have been provided to put 'the collected works of Siobhan Davies Dance ... into an online fully searchable digital archive'.⁶ The resource creation team for the digital archive project is currently being assembled. They will face a range of technological, methodological, educational and artistic challenges. It will be interesting to see what connections are made with the following initiative in rethinking the teaching of repertoire, the transmission of creative process and the development of a digital tool to augment dance making.

Under the heading of the Bank Project, the Siobhan Davies Dance organisation annually brings together company dancers and a small number of experienced professional dancers to research making processes. Each year, the Bank Project takes a dance from the existing repertoire for the dancers to work with. However, rather than learning the finished performance as one might expect with repertoire, the Project takes as a starting point the original ideas, images, questions and tasks that informed the work's creation. This gives the dancers who are not in the company the chance to experience 'the creative working methods of the company' through generating their own materials; and gives the company dancers a

chance to revisit and reconsider making methods.

The Bank Project 2006 was used as a context for a weeklong development session of RotoSketch; a software tool designed to augment the choreographic process.⁷ The aim of the software tool is to make it possible for a choreographer to annotate video playing in real-time. The prototype has a small set of features that make it possible to record a phrase of movement material and then play it back on a portable tablet computer while drawing directly on the moving image. The choreographer/dancer can then use the features to explore different relationships between the action and time of the drawing and the trace it leaves in relationship to the movement. For the Bank Project the sketchbook was introduced into the studio at the point when sketchbooks and writing tools were already in use [see right]. One of the company dancers, Sarah Warsop, had these remarks about using the sketching tool:

Transferring the information into a different medium allows you to see or 'resee' what you've done. To be able to stand outside the movement and look at rhythm, structure, and shape (shape as a moveable thing, and a static thing), could allow you to go back into the movement with new information. [...] The act of sketching although still physical lets the mind make different links and associations and therefore the choices made might be unusual and unexpected.⁸

Warsop's comments indicate that using the sketching software helps to simultaneously capture and extend the trace of the gesture physically through the drawing action and expand the space for imagined, creative gestures. At the same time, the drawn images are themselves immediately digitized and as such constitute an unusual document of live performance; one that contains a range of information not only about the mark itself, e.g. thickness and length, but also its creation, e.g. speed and acceleration. This raises intriguing possibilities about the nature of this material in the creation of choreographic

resources and in relation to the searchable digital archive initiative mentioned above.

GIVING NAMES (SCOTT DELAHUNTA)

Artist Emio Greco and Pieter C. Scholten
Organisation Emio Greco|PC⁹

In Amsterdam, the dance company Emio Greco|PC is researching ways to create an information resource derived from their creative work from which they, their performers, other artists and designers, researchers and thinkers might draw. The impulse for this comes from their need to 'meet new developments in movement' with adequate descriptions, notation, documentation and analysis. The



• Figure 1. Joanne Fong and Matthias Sperling using RotoSketch. Siobhan Davies Studios, London, June 2006.

seeds of this research could be traced to the start of the Salons in 2003 when EG|PC began a series of informal discussions with the aim to contribute to the development of a new discourse on dance grounded in 'the experience and expertise of the dance maker and in close connection to the practice of dance making'.¹⁰ From within and in parallel to this initiative several themes related to the idea of information resource emerged such as repertoire and archive, transfer, authenticity, reconstruction and renewal. From these further questions were derived, for example: how to create a 'living archive' based on principles of movement and choreography that are constantly evolving; what notation system can capture inner intention as well as the outer shape of

¹⁰ Bleeker, Maaiké. 'Questions of Movement and Meaning': Emio Greco/PC's Salon Dance & Discourse at The Anatomical Theatre Revisited. Salon Introduction (unpublished). April 2006.

¹¹ 'Dance and new media: new ways of creating and documenting dance; new ways of creating and documenting dance'. EG|PC Notation/Archive Interdisciplinary Research Project. Cinedans. De Balie, Amsterdam. 2-3 July 2006. Invitees: Marion Bastien (FR), Bertha Bermudez (NL), Maite Bermudez (ES), Frédéric

Bevilaqua (FR), Scott deLahunta (NL), Bianca van Dillen (NL), Carolien Hermans (NL), Corinne Iola (UK), Eliane Mirzabekiantz (FR), Chris Ziegler (DE).

¹² Fabius, Jeroen (2007) Looking Back, Transfer, and Collectivity in *Company in the School: between experiment and heritage*. EG|PC and ARK, Amsterdam: 20.

¹³ *Double Skin/Double Mind*. Documentary Film. Director: Maite Bermudez. Premiered at the July 2006 Cinedans Festival.

¹⁴ IRCAM Gesture Analysis/Real Time Applications; Frederic Bevilacqua, Nicolas Leroy.

¹⁵ Random Dance, <http://www.randomdance.org/>

¹⁶ Badiou, Alan. *Handbook of Inaesthetics*, Stanford, 2005: 66.

¹⁷ Choreography and Cognition <http://www.choreocog.net>. See extensive documentation on line. Full articles: Scott deLahunta and Philip Barnard, 'What's in a Phrase?', in *Tanz im Kopf/ Dance and Cognition*, ed., Johannes Birringer & Josephine Fenger, Jahrbuch der Gesellschaft für Tanzforschung 15, Münster: LIT Verlag, 2005, pp. 253-66; Scott deLahunta and Phil Barnard, 'Densities of Agreement' (co-authored with Phil Barnard, Ian Nimmo-Smith, Jennifer Potts and Cristina Ramponi). To be published in *Dance Theatre Journal* 21(3) (Autumn 2005).

¹⁸ See Interview with Wayne McGregor in 'Augmenting Choreography: using insights from Cognitive Science', co-authors: Phil Barnard, Wayne McGregor. In Jo Butterworth and Liesbeth Wildschut (eds.), *Choreography in Contexts: Critical Perspectives on Choreographic Practice*, Andover, New Jersey: J. Michael Ryan (upcoming 2007), pp. [pages?].

¹⁹ Forsythe Company <http://www.frankfurt-ballett.de/>

²⁰ See the Foundation Mission Statement for quotes. Additionally the Foundation is setting up the William Forsythe Archive: current projects

gestures and phrases; how to analyze and represent open processes in relation to artworks.

Over the last two years, these questions have become more focused and transformed into a series of practical interdisciplinary investigations being conducted within the frame of an extended research project. Generally referred to as 'notation research' and with the coordination of company member Bertha Bermudez, the project now organises direct encounters with specialists from various fields of knowledge interested in movement and its analysis. The aim is to bring specific perspectives from different disciplines to bear on various properties of dance and movement in relation to the 'notation research' project; and to do this as collaborative research. This encounter period was launched at a two day meeting in early July 2006 in Amsterdam to which a group of individuals were invited to present their research into dance notation systems, cinematography and film making, computer based motion tracking and gesture analysis, interactive design to enhance understanding of dance and the scientific study of the brain's perception of movement.¹¹

In order to better understand how these different approaches come together, it is useful to return to the practice from which these questions derive. Greco as the performer and Scholten as the dramaturg have a unique choreographic collaboration stemming back to their first work together, a 1996 solo for Greco titled *Bianco*. Having performed in most of the works until now, Greco is 'gradually stepping back'.¹² This is not unusual for contemporary choreographers, who often start making work to be performed by them either in solo or with a small ensemble. Gradually invitations to dancers to join this process evolve into a selection procedure guided by a feeling for the type of performer the choreographer likes to work with. Eventually some kind of training or indoctrination for new dancers into the

approach of the choreographer (in the case of EG|PC two individuals) may be organised.

Therefore, alongside the Salons, the need to develop a more explicit information resource to help transfer or transmit movement knowledge to new performers also provided a research starting point. One result is an extensive glossary of terms relevant to their creative working process. Divided into 'inside' and 'outside', the glossary explores the range of possible meanings of a movement concept, such as *speed*, mingling those most relevant to Greco and Scholten with its other connotations. This exercise in giving names also evolved in the context of the movement workshops Greco and Scholten have offered under the title *Double Skin/Double Mind* since 1996. Working closely with Bermudez, Greco and Scholten have recently made a selection of seven principles that underlie the work and are always part of the preparation for creating and performing. Assigned names such as Breathing, Jumping, Expanding, and Reducing, these principles have been collected and exposed through the making of a documentary film based on the workshop/ that took the name of the workshop.¹³

Within the overall project this documentary film and its making represent one approach and some possible solutions to the questions of the 'notation research' project. It also exposed some of the inherent weaknesses of naming and categorisation, which are under consideration. The most recent encounter was October 2006 with the Gesture Analysis group at IRCAM in Paris where two of these principles of movement, Breathing and Jumping, were recorded using a system of sensors which measure various changes over time such as velocity, spatial orientations and displacement.¹⁴ The data from these sensors was analysed in the computer to produce a learned representation of the movement. This model can be further analysed in direct comparison with the dancer's movements to look for patterns that cannot be seen by the human eye [see Figure 2]. This research will continue along several lines of

²¹ William Forsythe, transcript from New York City meeting September 2006.

²² From 'I can dance again', Sylvia Staude interviews Frankfurt-based choreographer William Forsythe, 21 April 2005. For SignandSight.com: <http://www.signandsight.com/features/119.html>

²³ William Forsythe, transcript from New York City meeting September 2006.

'kinaesthetic intelligence'. In the experience of making and doing dance, there is no inherent contradiction in claiming that the body knows and that thought or ideation manifests through movement. There is generally no need to explain this shared terminology to other dance practitioners, but to non-dance and non-arts disciplines, it can provoke confusion. It is at this meeting point with another discipline where the concept of 'physical thinking', explored for its contradictions and asymmetries, can bring important questions and approaches to bear on the creation of the choreographic resource.

In *Choreography and Cognition*, a project initiated by London-based choreographer Wayne McGregor, the overlapping of descriptions of intelligences and thinking processes was critical. This project involved intensive collaborative research between McGregor, his dancers and a number of cognitive scientists who were invited to create experiments related to the choreographic creation process.¹⁷ Alan Wing and Kristen Hollands used motion capture technologies to record and visualise data to explore their question: 'what frames of reference are dance movements controlled in,

what are the crucial sensory systems for describing these frames of reference and how might selected disruptions or perturbations help to test this'. Alan Blackwell studies the cognitive dimensions of design and notation systems using analytic methods from a range of fields including experimental psychology and design research. His project involved collecting notebooks and scores from McGregor and four of the dancers, and using some of these analytic methods to discover where McGregor might experience the limitations of his design tools [see Figure 3]. And Tony Marcel used an interrogative approach in the studio that was more dramaturgical than scientific; blurring the boundaries between methodologies and distinct (discipline bound) ways of seeing and thinking. Reluctant to refer to himself as a scientist in these circumstances, he referred to Wayne's rehearsal process as another way of 'doing psychology'.

Notwithstanding Marcel's rich provocations, the collaboration triggered a lot of questions and McGregor was often asked to explain how he, as an artist, benefited from working with the scientists. His responses fell into two

• Figure 3. Alan Blackwell's analysis of notebooks from Wayne McGregor and Laila Diallo.

Wayne (page WN17)



Laila (page LN20)



Wayne: Description: Represents An operation, physical; Basic objects Words, numbers in circles, graphic sketches; Metric space transformation, mapping across the body; Object relations Divided by dancers in groups; Attribute relations Bent and straight lines; Correspondence: object= xxxxx, attribute= xxxxx, structure= xxxxx.

Laila: Description A progression; Represents Floor pattern; Basic objects More and less symbols, labels of people; Metric space; Object relations Names of people are near corresponding sections; Attribute relations xxxxx; Correspondence: object= xxxxx, attribute= xxxxx, structure= xxxxx.

Wayne: Description Phrase marks with instructions, operations; Represents Operations open to interpretation, maybe a duet, Basic objects Phrase marks, arrows, words, symbols; Metric space Linear left to right, then down; Object relations Symbols are placed freely, indicate interventions in a phrase. Words have choreographic meanings from a rule base; Attribute relations Symbols are functions of moving, what, where, when, how; Correspondence: object= metaphoric: multiply and divide gestures, attribute= metaphoric: vertical words may show intersection, structure= xxxxx.

Laila: Description Like one of Wayne's; Represents Phrasing, words for the values given to symbols; Basic objects Operations; Metric space Time within phrases; Object relations An extra layer; Attribute relations Orientation of words doesn't matter; Correspondence: object= xxxxx, attribute= xxxxx, structure= xxxxx.

categories. Firstly, making use of ideas taken directly into the studio to generate new material. This occurred when the science experiments provided a 'practical puzzle for the body and the brain to solve. The *process* of solving the puzzles, the time it took to see the body and brain attempt to come to terms with the difficulty and the ensuing solutions provided the most useful information to capitalize on in the studio'. Secondly, McGregor speaks of a less direct application of the insights gained during the collaboration in what he refers to as the 'conceptual frameworks, discussions, debate, explanation and dialogue that surround the practical events themselves. This transfer of knowledge(s) permeates the process in many fundamental ways'.¹⁸ In either case, the philosophy of disappearance was noticeably missing in this bringing together of cognitive science and dance-based understandings of movement and thought.

The Choreography and Cognition project generated a very large pool of insights and a wide range of fresh descriptions related to dance analysis and creation. Additionally essential tools for interdisciplinary art and science collaboration were collected. The next phase of McGregor's research into the choreographic process and the many 'intelligences' involved in dance making will take place during a research residency at the University of San Diego that will bring him into close contact with researchers in the fields of psychology, cognition and computer science. The aim is to start to generate and schematize a more detailed description of his creative thinking process. Additionally, the research will engage with specific questions about documenting (and archiving) creation processes in relation to the design of experimental protocol including control conditions and data collection.

The ultimate aspiration of McGregor and his collaborators is to build an artificially intelligent and autonomous choreographic agent (ENTITY). Artificial Intelligence and Artificial Life research has revolved around the

notion of building something as a way of understanding it. Building ENTITY is envisioned as a means to extend and broaden understanding of the unique blend of physical and mental processes that constitute dance and dance making. This ostensibly impossible project will require not only further exploration of the multiple descriptions of choreographic thinking and productive cooperation with related scientific perspectives; but engagement with other understandings of what it is to think, to move and to create.

BALLET AS INFORMATION AESTHETICS (NORAH ZUNIGA SHAW)

Artist: William Forsythe

Organisation: The Forsythe Company and the Forsythe Foundation¹⁹

The video playing on the wall shows an empty stage. Three architects, a designer, an engineer, a philosopher, and a cognitive psychologist sit waiting and watching as suddenly the video image is filled by a rush of dancers dragging twenty heavy steel edged tables. The dancers then efficiently and calmly arrange the tables in a grid and depart. Two men begin curving their bodies in and around the hard surfaces, reading each other, moving with liquid control and slicing through the space in abrupt waves of activity. Two more enter and then another and another until 17 dancers are flying, sliding, reaching, and twisting their bodies within, above, and under the grid. Complexity builds and chaos seems ever present but a system is evident in the dancers' attention, in moments of alignment, and in patterns of activity. What the viewer can't know but can sense is that the dance is controlled by a complex array of cues and movement structures that challenge and stimulate visual perception. It is a set piece of choreography but is always changing particularly in relation to time, but also in the addition or subtraction of dancers and insertion of new material. The piece is William Forsythe's *One Flat Thing, Reproduced*, and the scholars

• Figure 4 (opposite):
overhead shot of *One Flat Thing, Reproduced*.
Bockenheimer Depot,
Frankfurt, April 2006.
Photo: Thierry de Mey.

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watching it are part of the interdisciplinary working group creating a new interactive animated score for it.

William Forsythe has been engaged in creating links between dance and other intellectual traditions throughout his career. Building on this, he has recently established The Forsythe Foundation with the aim of 'advancing the art of dance by promoting critical thinking in dance education and practice'. Forsythe is already known for having made the CD-ROM *Improvisation Technologies: A Tool for the Analytical Eye*, which forged new ground through its use of effective graphic visualisation and its reception in fields outside of dance, for example architecture. This inspired the Foundation to focus on interdisciplinary research to 'develop more precise and accessible methodologies for communicating choreographic ideas'. The aim is to create multiple approaches to documenting dance that acknowledge the complexity of choreographic thinking, while increasing its cross-disciplinary intelligibility, and defining new territory for dance studies.²⁰

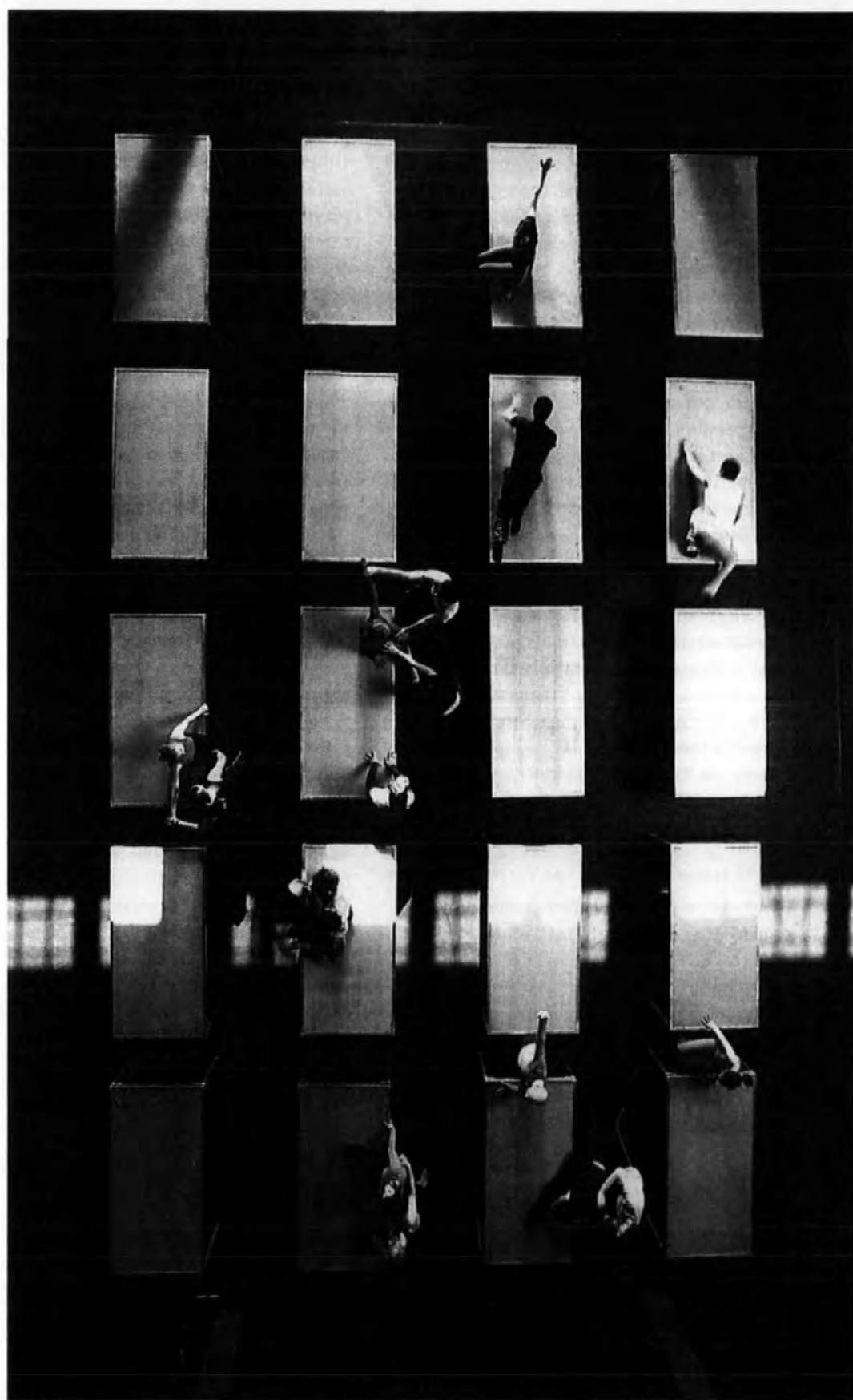
In May 2005 somewhere in the transnational spaces between Ohio, Frankfurt, Paris, Amsterdam, and New York, connections were forged between the Forsythe Foundation, the Ohio State University Dance Department and Advanced Computing Center for the Arts and Design to establish an interactive media project focusing on *One Flat Thing, Reproduced (OFTR)*. Forsythe's vision was explicit: 'I'm trying to develop a dance notation on DVD with the table piece 'One Flat Thing' to show how a piece develops from the inside, how it functions, how it's put together. To demystify the process and elucidate the principles of choreography'.²¹ It was also clear what it was NOT. This would not be an effort to create a score from which the piece could be reconstructed (as is the priority of traditional dance documentation). Again, Forsythe was clear, 'we are not trying to recreate the experience of the piece, or the genesis of the piece, it's not etymological, it's not archaeological, it's not historical, it's not any of that. It's

simply about saying, watch space become occupied with complexity'²² [see Figure 4].

So if it is about scoring but not about reconstructing then what is the central purpose of this effort? In part, the project seeks to illustrate what those of us in dance already know but struggle to articulate, that moving is a thinking process and that choreography is a form of knowledge. It is also about constructing new ways for dancers to leave behind, big, meaningful, engaging traces that relate to their dances performed in the ever-vanishing moment, but also have their own aesthetic integrity. The project seeks not only to capture the vitality of the piece but also to construct a new way of looking at dance, one that considers both discipline-specific and cross-disciplinary ways of seeing and ways of thinking.

To do so, the first step was to delve into the piece and its component parts. The team approached this from within dance and without. As mentioned earlier, scholars from multiple disciplines, the interdisciplinary working group, were invited to view the piece and respond to it from their areas of expertise. At the same time the dancers and designers worked with the Forsythe Company to systematically analyze the material and systems of exchange that make up the meat for the choreography. Nothing was off limits as Forsythe was open to radical reductions as well as elaborate visual embellishment. Starting in 2005, a year was spent, viewing and dissecting the complex intertwining pieces of the dance, learning its history and origins, learning with the interdisciplinary working group what it revealed about human perception in complex environments and considering its relationship to complexity science, information aesthetics, and current issues of surface and event in architecture.

All of the background work has now come together to allow for initial exploration of data visualizations and interactive modules that elucidate the patterns and principles in action in OFTR. The iterative design process continues, as does the pursuit of deeper and more complete



Johnson, Catherine, J. and Allegra Fuller Synder (1999) *Securing Our Dance Heritage: Issues in the Documentation and Preservation of Dance*. Council on Library and Information Resources, July.

Laermans, Rudi, Hugo Haeghens, and Gerald Siegmund (2003) *Mediale Bemiddelingen. Over Vincent Dunoyer en anderen*. Cultureel Centrum Maasmechelen.

Thomas, Helen (2004) 'Reconstruction and Dance as Embodied Textual Practice', in Alexandra Carter (ed.), *Rethinking Dance History: A reader*, London and New York: Routledge.

data as the team works to construct visualizations of the dance that stand apart from the dancers. What if everything was reduced to sound and we just listened to the patterns in the dance take place? What if all the interlocking movement themes in this polythematic piece were assigned a shape or color, and then they were placed in space according to their duration and repetition, and finally the cues for each moment were indicated with a burst of light? What animated cloud of shapes and color would emerge? What would this reveal about the complex system of relationships in the piece? How does this relate to the data visualization strategies in neuroscience, statistics and bio-informatics? What if we traced each of the dancers' pathways, varying the qualities of the lines according to when they are under, over, or between the tables and then removed the dancers from the picture and let the pathways play out their own? What would we see then? How can we allow the eventual users of this score to change the principles and characteristics of the animations to create their own aesthetic universes from the richly specific data housed in the piece? And what kinds of objects or traces will this leave behind? These are the questions that are central to the project at present.

SHORT SUMMARY: CONSTRUCTING MEMORY

The theory of constructed memory says that memory isn't necessarily fixed at the time of an experience. It is a creative and dynamic process in which the recollection of past events is a condition of present circumstances; where you are and what you are doing when you remember. It is the generation of a new memory each time something is recalled. This active and recursive process fits nicely to the concept of choreographic resources discussed here. For there is a loose co-dependency built into the resource creation being undertaken in these four projects. As these artists step back to reflect on their body of work and how to make dance more intelligible, they remain highly attuned to the

needs of their own creative practice. The choreographic resources get absorbed back into the practice; making it possible for the artist to either 'move on' categorizing and setting aside certain approaches or 'go deeper' taking on fresh perspectives on existing ideas. It may be the research encounters and exchanges around the creation of resources that leaves marks on their next choreographic work. These are all active meaning constructing processes closely related to making new dances.

Whether using technology to transfer the dynamic action of drawing into pliable data; inventing impermanent names for individual capacities and unique movements; generating creative agents informed by the thinking in movement; or asking experts from different fields to describe the information contained in choreographic work, the projects outlined here emphasize dance as a particular form of knowledge. Not as an unknowable ephemera, but a complex and meaningful resource for understanding human perception, complex systems of interaction, and moving ideas. But these artists are not concerned that unlocking some of the mysteries of their practice will diminish the experience for the viewer. Quite the contrary, they seek no less than to challenge themselves and their audiences to take dance making to new places and to reveal 'the next level of imaginary trace'.²³

All of these projects make use of various forms of documentation to produce something meaningful. But their research is not taking place in the gap between dancing and its documentation, nor does it draw attention to dance's disappearance. As such, it is a form of scholarship balanced precariously at the edge of the creative practice itself. More a part of than about it...

'Day of the Figurines with Blast Theory'

in Digital Resources: Performance Research. 11:4. 2007, pp. 148-151.

In Autumn 2006, I was co-editing this issue on 'Digital Resources' for Performance Research. I had seen 'Day of the Figurines' in Berlin early that year, thought it was fitting the theme of the issue and was also looking for an opportunity to reconnect with Blast Theory who had been important to my research at an earlier stage. Therefore, I proposed to include this short dialogue with Matt Adams.

Performance Research is a specialist journal published by Routledge that promotes a dynamic interchange between scholarship and practice in an expanding field of performance. Interdisciplinary in vision and international in scope, its emphasis is on research in contemporary performance arts within changing cultures. Source: <http://www.tandf.co.uk/journals/titles/13528165.asp> (accessed 7 May 2010).

Day of the Figurines

BLAST THEORY (MATT ADAMS) AND
SCOTT DELAHUNTA

Day Of The Figurines (DOTF) is set in a fictional town that is littered, dark and underpinned with steady decay. The game unfolds over twenty four days, each day representing an hour in the life of the town that shifts from the mundane to the cataclysmic: the local vicar opens a summer fete, Scandinavian metallists play a gig at the Locarno that goes horribly wrong while an occupying army appears on the High Street.

How players respond to these events and to each other creates and sustains a community during the course of a single day. From the gasometer to Product Barn, the canal to the Rat Research Institute, up to a thousand players roam the streets, defining themselves through their interactions.

The centrepiece of the game is a vast model town installed as a game board in a public space - created using silhouettes of buildings, cut and folded from the metal tabletop. Each of the thousand players is represented by a small plastic figurine, which is moved by hand every hour for the duration of the game. To begin the game, players are invited to select their own figurine and create a **biography** for it including answering questions about its past and future and how it is represented to other players. They then see their figurine placed in the model town. Thereafter game participation is via mobile phone, with players receiving a minimum of one text (SMS) a day updating them on the progress of their figurine and inviting them to make increasingly challenging decisions regarding the fate of themselves and other players. The

goal of the game is 'to help others' and texting messages to other players may provide opportunities to do this.

DOTF continues Blast Theory's enquiry into the nature of public participation within artworks and within electronic spaces.¹ Using emergent behaviour and social dynamics as a means of structuring a live event, Blast Theory's work invites participants to establish their own codes of behaviour and morality within a parallel world. One of the unique aspects of DOTF, compared to earlier works such as 'Can You See Me Now?' (2001) or 'Uncle Roy All Around You' (2003), is that it deliberately targets low-end phones. The game is playable on any phone that is able to receive SMS, which embeds the game much more deeply in the players' daily lives. With up to a thousand players, managing the interactions is accomplished using sophisticated **orchestration** tools developed especially for DOTF.²

PLAYER BIOGRAPHY

The player biography is an important piece of information in the overall game framework. Can you say something about how you decided what information to collect?

The player biography is critical and we spent many months revising the five questions that are asked. All five questions are entered into the game database and are then available for use as part of messages generated for the player. The advantage of a twenty-four day game is that the

¹ Blast Theory: <http://www.blasttheory.co.uk/> accessed 14 May 2007.

² For more information on the research and development of DOTF see: The Presence Project <http://presence.stanford.edu/3455/Collaboratory/> 627 accessed 14 May 2007.

long time period that may elapse between a player providing us with this information and the game using it back to them adds to the sense that the game is personalised for that player. When registering for the game, each player sits at a web terminal next to the board with their chosen figurine mounted on a metal plate next to them and writes their answers into the appropriate fields. We finally settled on this technique having used written cards and face-to-face interviews in previous iterations because it gives the player the most time to arrive at answers that are right for them.

I'd like to explain each of the questions:

Q1 Describe a special place from their childhood?

This provides the figurine with a history; it locates them in time and space. It is also filled with an emotional resonance and is open for the player to interpret very widely.

Q2 How would they like to be remembered?

This projects forwards in time and suggests even at the outset that the figurine may die. It invokes feelings of mortality and legacy.

Q3 Name someone they feel safe with?

This establishes the figurine as part of a social world in which relationships matter. By

referring to safety it suggests that risk and danger may be ahead. And, as with their own figurine, the choice of a name provides a huge opportunity for subtle expression with only a single word.

Q4 What's their distinctive feature?

Some players refer directly to their plastic figurine as a way of choosing this answer and thus link their fictional representation in the previous answers with their physical representation on the board.

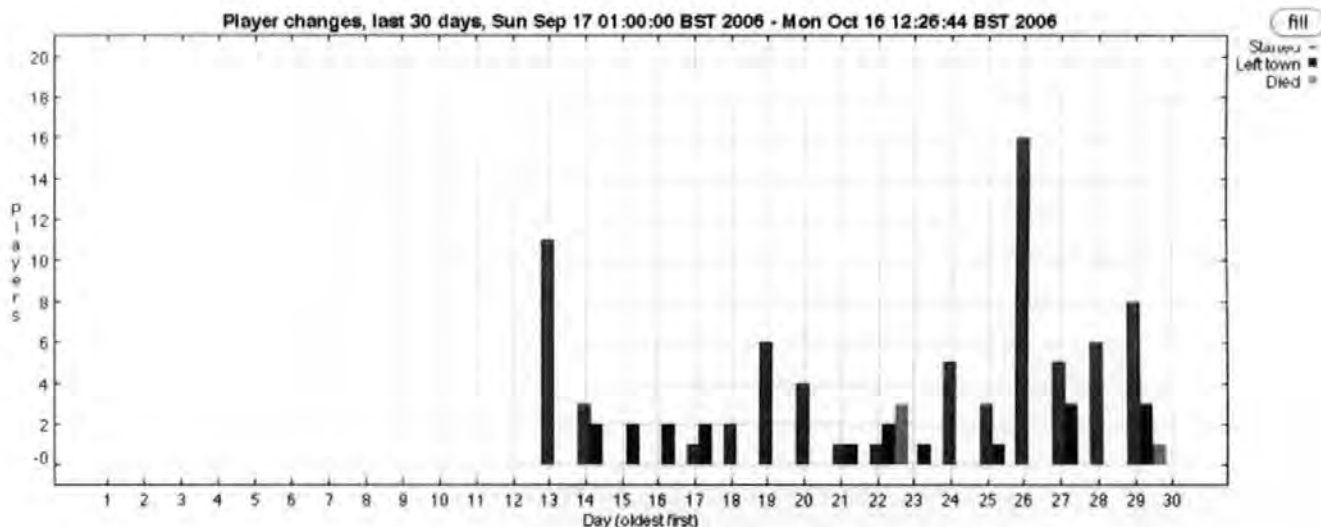
Q5 What kind of shoes are they wearing?

A throw-away finish to undercut some of the previous answers. Shoes are distinctive and expressive and are used easily within the game to describe players.

THE GAME BOARD

To participate in the game, an individual has to come to a particular location, fill in a biography and select a figurine to be placed on a physical game board, which represents the fictional town. Why the elaborate creation of physical materials?

The board provides a significant threshold for entry into the game: players must make a



journey to the board and choose a figurine before they can join the game. And the board then establishes the mood for the piece. Because the game is usually played through the narrow channel of SMS in which we cannot even author the font in which the text is displayed we felt that the board can provide a rich and stimulating aesthetic experience at the outset to imprint the geography of the town into the minds of players. It also retains a performative aspect: players see each other joining, they witness the moving of the figurines.

The board almost acts as an inversion of location-based games such as in some of our earlier work (e.g. 'Can You See Me Now?'). The figurines appear to be bound by Cartesian space as they are moved around the board while the players roam free sending and receiving SMS wherever they are. It is essentially a display for a digital world.

The game as a whole is sited within a gallery or museum, is created by artists and sits within a body of game related work by those artists. As a result it is our intention to lure players into observations, reflections and experiences that they would not usually get in a game and the board is a critical part of that process.

Steve Benford, our long-time collaborator and director of the Mixed Reality Lab at Nottingham University, commented on this: 'The augmented game board in *Day Of The Figurines* has been explicitly designed to be a spectator interface, intended to attract new players, to reveal aspects of the game that would normally be hidden, and to frame the introduction to the game'.

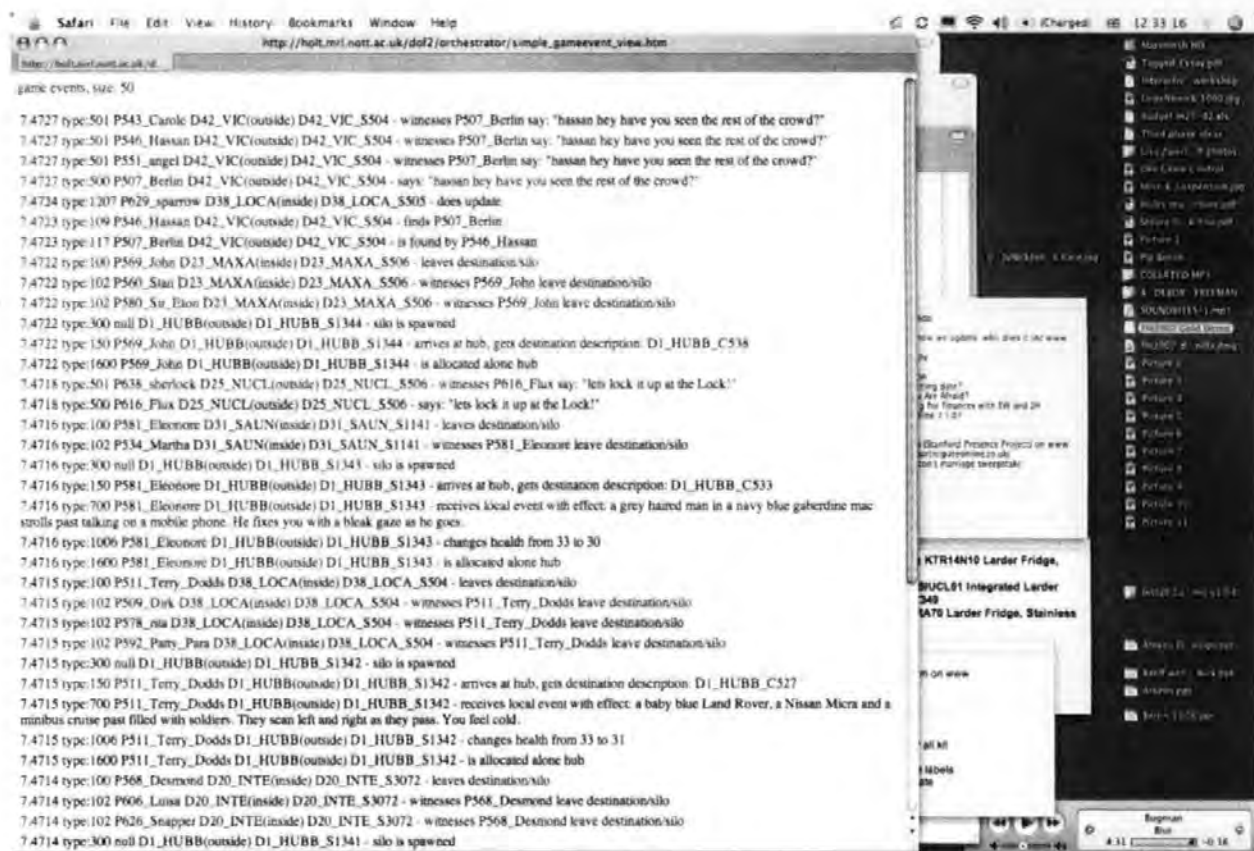
ORCHESTRATION TOOLS

Can you briefly describe what 'orchestration' is and how it relates to the idea of 'scaling up' gameplay? And how does your work as artists collide and/or blend with the objectives of a more commercially orientated project?

Orchestration refers to the tools and techniques employed during the course of a game to manage player's experience. This might be as simple as providing help to a player who is stuck or might be as complex as creating a fictitious player who interacts with a player to give them a particular game experience. We have used orchestration techniques in all of our games. For example in 'Can You See Me Now?' we can move players in the queue when they are waiting to play, we can throw them out of the game and we can alter the distance needed for a runner to catch a player.

However because DOTF runs over twenty four days, uses very short discrete game events (sending SMS) and moves slowly it provides a very rich opportunity for orchestration. And because it is designed for up to a thousand players we have needed tools to give us a picture of what is happening in the game. So we have graphs that show how many messages have been sent in the last ten minutes, in the last twenty four hours and in the last twenty four days. This gives a crude indication of activity in the game but can be surprisingly useful.

Our wish to scale up comes less from an interest in commercialising our work and more from a wish to reach a larger audience on their own terms. How might we create artworks in which large groups of people interact with one



another in a rich and nuanced way? That this piece runs on players' own mobile phones is a big achievement for us because mobile phones are extremely hostile spaces for game innovation, as we learnt when making 'I Like

Frank' (2004) for 3G phones. Trust, community and democracy are frequently bandied about in discussions of new media and communication technology. We seek to explore the limits of these ideals in *Day Of The Figurines*.

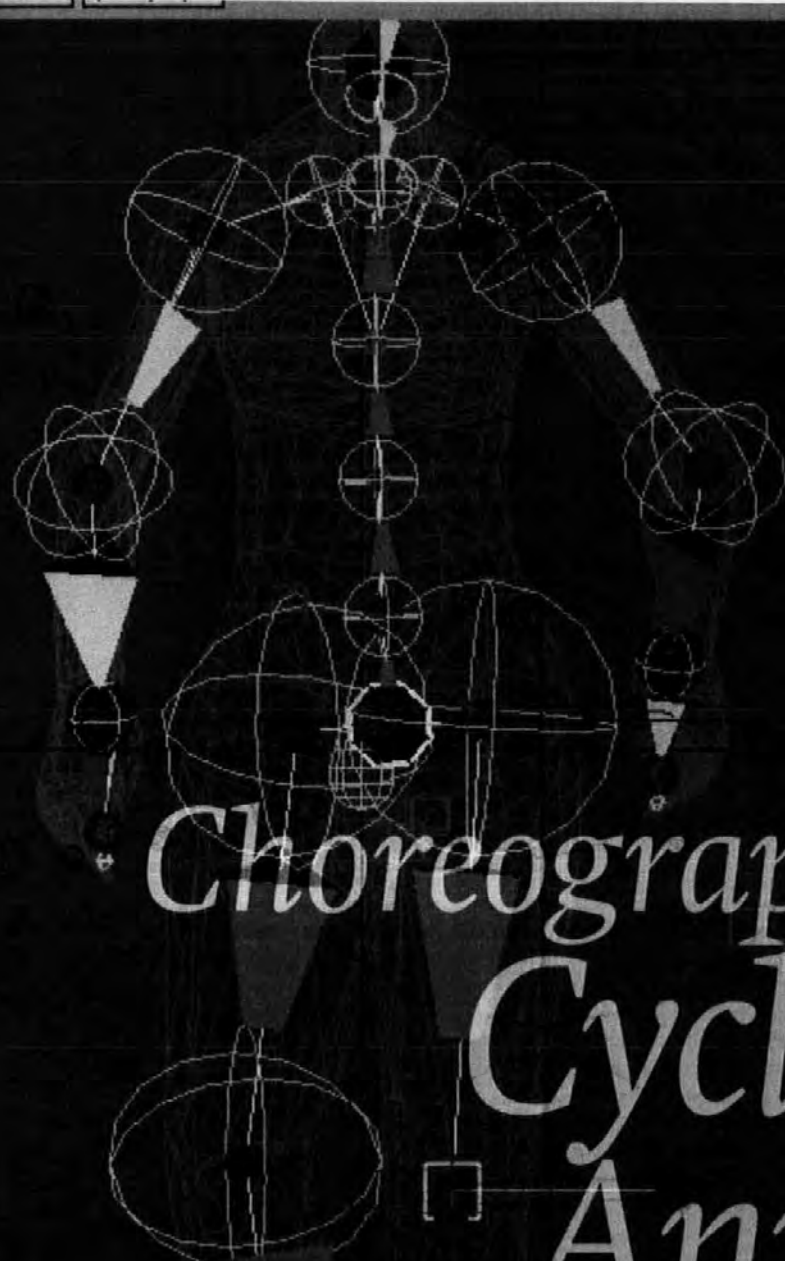
'Choreographing Cycling Anims'

in *SwanQuake. The User Manual*, ed. S. deLahunta. Plymouth: Liquid Press/i-DAT. 2008, pp. 17-26.

SwanQuake began with discussions with the artists (with whom I had worked on several other projects) in January 2004 about creating a game engine modification for an art work involving motion capture and choreography/ dance. I was invited to participate as writer on the project and a year later proposed the idea for the book which I edited. The essay included in this collection uses primary material from three key interviews with the artists John McCormick and Ruth Gibson in June 2005 and January and May 2007.

The User Manual opens the SwanQuake project up to discursive reflection and expansion through its selection of articles and essays. In the first section, the User Manual takes you through some of the processes of making SwanQuake including sound composition, choreography and computer animation work. Also in section one is a modicum of do-it-yourself instructions and two views on igloo's work in relation to the wider field of digital arts practice and culture. Source:

<http://www.swanquake.com/intro.htm> (accessed 7 May 2010).



Choreographing Cycling Anims

Scott deLahunta

Producer Right (X-Ray)

Ready

Transport Controls - Keying Group: TR

Story Action ▼ Ruth Jump 01 tk1 ▼

4 96

S: 0 0



Hi John, I got a nice pipeline going on for matching the start/end poses on the Ruth NPC anims and I'm exporting them slowly to Unreal. But what is correct position for the hips? I am making them 0,0,0 but should I be making them so that the feet are on the floor?? - All the other stuff to do with exporting and getting into unreal is fine - not having any stretch problems and I've coded up a pawn and that's working, but it's 'bumping' up and down a bit. I've been playing with the numbers but can't figure it... It probably would be a whole heap easier if I could see the PC collision hull ... Bruno

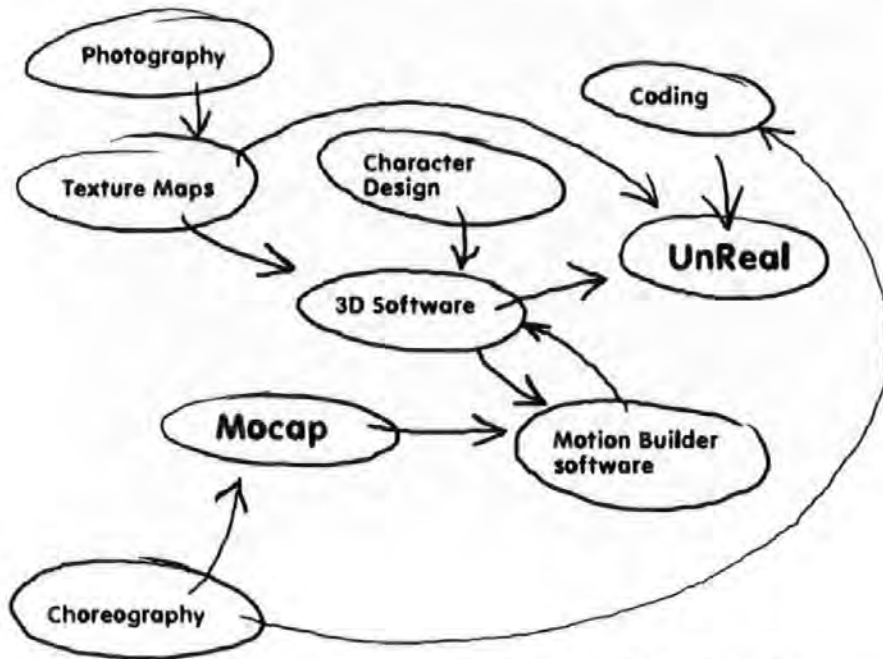
(email from Bruno Martelli to John McCormick 02.02.07)



When one thinks of choreography the first image that comes to mind is a dancer moving across the stage with sharp and rhythmic gestures sometimes expressed by the whole body sometimes by the isolation of parts. Movements and gestures can originate from anywhere: the fingertip, the spine, top of the head, the foot or from a more interior impulse of an organ or the fluid systems of the body. The dancer may be and is often trained in the sense of having practiced a set of movements or gestures following some system of 'dance technique'; e.g. Classical Ballet, Cunningham, Bharatanatyam, Contact Improvisation. Dance techniques also express an aesthetic ideology or belief. A technique is in some way an idea about what dancing is; an idea made manifest through physicality. (Foster, 1992: 480-95) Dance technique provides a formative aesthetic background for dance making. The dancer embodies this aesthetic background, which the choreographer (who may also be the dancer) somehow uses, manipulates, reframes and/or subverts. But trained or not the body on stage has cultural significance; and its very placement on a spot in that space, moving or not ('idling' in animation parlance), reflects a choreographic decision. (Lepecki, 2005)

While its most common usage may be in the context of the last paragraph, the term choreography may be found referring to the orchestration of other kinds of movement; from organised political demonstrations to synchronized swimming and message flow around the Internet.¹ In the process of creating *SwanQuake*, the choreography finds its genesis in the dancer's movements then runs iteratively through MoCap (short for 'motion capture'), character design, texture maps, photography and coding eventually arriving at its destination as scripts and objects in the database structures of the *Unreal* game engine. *Fig.1* The audience member who visits this computation space finds it modified for the purpose of the art of movement algorithmically 'rendered as image-movement', to poach a phrase from **Johannes Birringer's** summary elsewhere in this book.²

This essay will trace the choreographic story inside the *SwanQuake* project: from the preparation of the motion capture sessions to exploiting the core functionality of the game engine.³ It will explore the possibilities for dance making when the 'virtual' or calculated properties of matter are available for choreographic decisions; what happens when these decisions are made along with new discoveries (and desires to return to an earlier stage in the process) in the face of a constantly evolving palette and proliferation of possibilities. The creation of *SwanQuake* has no parallel this author is aware of. In commercial animation the mandates of the market make it impossible to engage in such a long process; and compared to the few artistic works where motion capture, game engines and choreography have come together *SwanQuake* stands out, not least because the complicated technical learning required is almost entirely taken up by the core artists themselves. The result is a closer relationship with the materials that they seek to understand, control, manipulate and release. This has led to the choreography in *SwanQuake* undergoing an unusual



Splash image Motion capture software

Fig. 1 SwanQuake production pipeline

Fig. 2 (below) key frames from Daylight Robbery

transformation; something this essay seeks to explore through reflecting on the ongoing dialogue the author has had with the project's main choreographers, Ruth Gibson and John McCormick.⁴

Artists' Background

Gibson began dancing at three years old and exploring her choreographic side when she was only eight. Over the next twenty years her passion didn't diminish as she participated in an eclectic range of dance activities including studying at the **School for New Dance Development** in Amsterdam in the late 1980s, an education programme renown for nurturing the most experimental of new dance in Europe at that time. Founding **igloo** with graphic and visual artist **Bruno Martelli** in 1995 was the start of a new period of creative work for Gibson, marked notably by igloo's use of 3-D motion capture technologies. As noted elsewhere in this book, that year they made their first joint work *Daylight Robbery*, using digital motion capture techniques at the time 'virtually unknown and untried by most dance artists'.⁵ Fig. 2 Since then, Gibson and Martelli, often in collaboration with John McCormick, have developed an impressive and unique collection of art works that have made use of motion capture systems.⁶

3-D motion capture is a complicated technology combining hardware and software that is difficult to use without extensive learning. These are the same systems we read about being used in the making of film animation (such as *Lord of the Rings*) and scientific research into enhancing athletic performance. In the last ten years many contemporary choreographers have begun to explore



the artistic potential of motion capture. Gibson's considerable experience as a Motion Capture model and supervisor working with high-end companies including **Vicon UK** (Oxford), **BBC** (London), **Televirtual** (Norwich) and **Motek** (Amsterdam) gives her a unique understanding of what the systems are and are not capable of. With a background that includes dance studies at **Victoria College**, John McCormick has been integrating technology and dance as co-director of the Melbourne based **Company-in-Space** since 1992. From 1999, he has been working with full-body motion capture systems; accumulating experience that has few parallels today in the field of contemporary performance.⁷ In early 2004, they began to work together on *SwanQuake*.

Motion Capture to Moving Characters

The main body of movement data came from three motion capture sessions each preceded by two weeks of rehearsal.⁸ The two main capture sessions, April 2004 and 2005, used the indoor optical motion capture system of Motek in Amsterdam. Some decisions about the movement and gestures that would be captured were based on the types of characters, sounds, terrains and environments that were being created for the different levels. For example, for the character known as the 'insect', the plan was to capture movement of the dancer on stilts so that the leg lengths would fit to the modelled skeleton. *Fig. 3* The capture sessions were designed to optimize the palette of possible movement material to be used in the project. Improvisations were combined with learned phrases; and stock movements such as walking, crouching and running were recorded. In order to give the dancers a feeling for where their captured movements might end up, some of the graphic environments were projected and composer **Adam Nash's** *SwanQuake* soundscapes were played during capture sessions.⁹

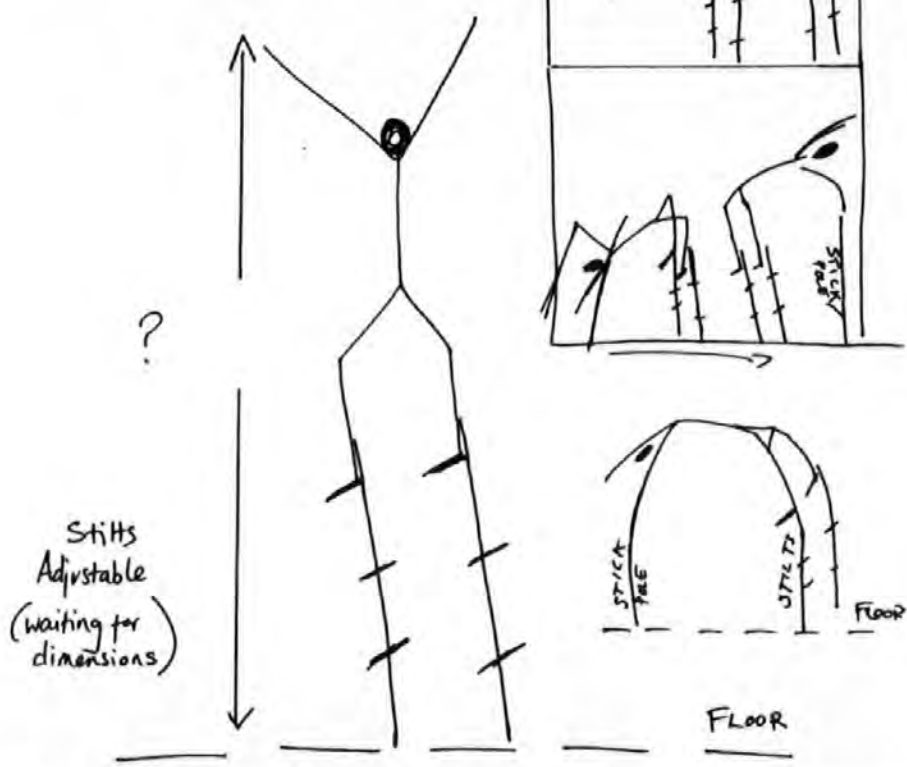
The first Motek session was generally more experimental resulting in material that was, according to Gibson, 'creative but unusable'. (RG, 24.01.07) For the second they rehearsed more rigorously in order to obtain better data for their purpose. For example: ensuring the performers were starting and stopping in key positions and facings so that the phrases could be seamlessly joined together later in the animation process.¹⁰ Spacing the capture sessions a year apart was 'a deliberate choice, so that there has been enough time to improve on the last, select and add more dancers and within reason try and anticipate/forecast/predict future developments of the work'. (RG, 20.05.07) In August 2005, after the second Motek session with the optical system, Martelli and Gibson had the opportunity to try a relatively new motion capture device called the Gypsy Gyro that uses rotation sensors on a wearable suit and has an extensive wireless range.¹¹ They used the Gypsy Gyro for capture sessions outside for another artwork entitled *Summerbranch* written about elsewhere in this book.¹² These outside captures were not intended initially for *SwanQuake*, but this changed over time for reasons that will be addressed later in this essay.

After the two first capture sessions, Gibson and McCormick were faced with the task of organising the motion capture data: naming and categorizing the hundreds of recorded motion fragments (lasting from twenty seconds to one minute) 'according to the different characters ... and style of movement for the different scenes'. The result is a library of movement and gesture data recorded in two spreadsheets. Each record includes a file name (e.g. D1_S3_TONI), the specific take (e.g. Toni birdman tk1.c3d), the anticipated character (e.g. birdman) and the environment (e.g. piranesi level). This initial assignment of a character and environment corresponded to the planning they had done prior to the capture sessions in Amsterdam. Both Gibson and McCormick stated that how the movement had been imagined 'as fitting into different characters,

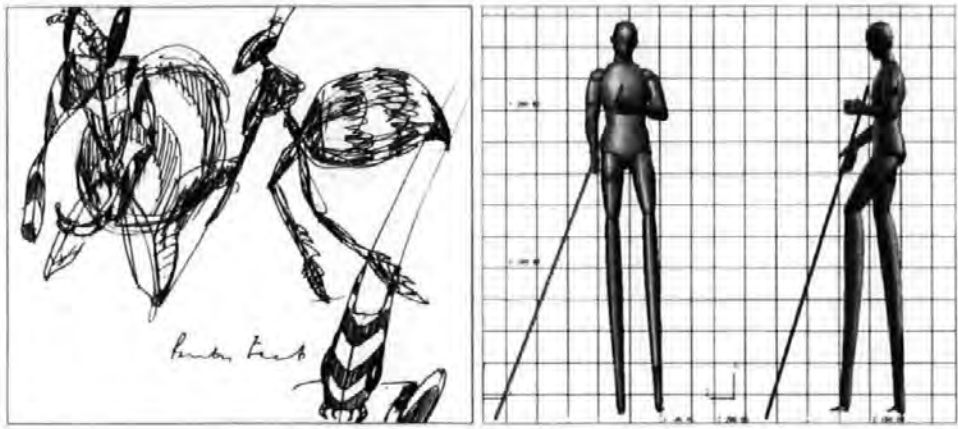
1.1 Choreographing Cycling Anims Scott deLahunta

STILTS IF POSSIBLE WE COULD PUT MARKERS ON STILTS AND POLE OR NOT
KIRSTY

sketches and models for capturing on stilts



Choreographing Cycling Anims



might change' once they had a chance to see how the matches appeared. Already a degree of trial and error and serendipity was anticipated in what Gibson referred to as 'trying to get the cast... '.

Team members **Alex Jevremovic** and **Marshall White** were responsible for creating and building the characters in close collaboration with Bruno Martelli who was developing the various environments. Several characters have been made including **Elk Man**, **Mole Man**, **Space Man**, **Fox**, **Rabbit**, **Shadow** and **Insect Man**. Fig. 4 Some of the characters have extensions such as antlers and antennae that accentuate the movement. As mentioned earlier, Insect Man has long legs for which motion capturing on stilts was attempted. The design of the characters themselves is a difficult and time-consuming process involving building a skeleton and geometry (the basic overall shape of the character) both of which need to be integrated with the motion that has been captured. The 'polygon' is the main, usually triangular, building block for the overall shape and form of an animated character. Counted as individual pieces, there can be thousands of polygons used in any individual 3-D object each joined at a 'seam' along their edges and referred to as the 'polygon mesh'.¹³



FIG. 4 Rabbit character model

At this point in their choreographic process (approximately June 2005), Gibson and McCormick were thinking in terms of being able to 'push any motion at the character at any time'. At the same time, the character designers were looking for the 'synergy between the motion and the geometry' and how these combined elements would work in the context of a specific environment.¹⁴ This meant trying the motion capture material in different characters, and for this

the team used a 'TESTBOX ... basically a cube to try stuff out in'. (RG, 21.04.07) Here they could get an idea of how the movement would look against different backgrounds, with different colours, texture maps and lighting.

One of the challenges for Jevremovic and White was creating characters that would not break the polygon mesh apart when performing particularly challenging movement material. To test the 'cohesion' of the characters, they sometimes used one of the motion-capture data files affectionately referred to as 'Julia's arse breaking motion'. Here the performer **Julia Griffin** was motion captured doing an extreme movement phrase involving a twisting arabesque that spirals to the floor. If this phrase broke up the character, the animator could increase the number of polygons or change the 'weighting' in particular polygons in the rupturing area to ensure that the character would work with all possible movements. However, this would add additional time-consuming work with no guarantee at this stage that the movement would end up as part of the choreography in the final work.

With so many variables in play at any one time, the team was constantly balancing the desire for choreographic experimentation (trial and error) against practical constraints. Creating the fully animated characters for *SwanQuake* or finding the 'cast', as Gibson referred to it, was a difficult back and forth process. The 'pipeline' is a commercial animation industry term for the entire motion-capture process from planning, recording, data processing and finally mapping and binding the motion to characters. In a commercial context, the

pipeline is designed so that the overall process is as efficient and cost-effective as possible. Figure one is an illustration of something akin to this concept of the 'pipeline' for the *SwanQuake* project; but that's where *SwanQuake*'s resemblance to a commercial project ends. When asked about the process of creating the choreography for *SwanQuake*, John McCormick responds, '... with normal game creation they absolutely wouldn't do it this way. They would have everything set at the very beginning and they would have to stick to it, just because of time and money'.

For the *SwanQuake* project time was relatively flexible and the date for the conclusion of the project open-ended. This meant that other projects began to inform *SwanQuake* developments. For example, *Summerbranch*, mentioned earlier, was finished and began touring successfully.¹⁵ Some of the motion captured outside in August 2005 for *Summerbranch* started to look useable for the characters in *SwanQuake*. There were longer travelling sequences that worked better than joining together a number of shorter ones in the animation phase. Gibson also refers to an 'authenticity' that was the anticipated result of being captured on uneven terrain. (RG, 20.05.07) This was a unique quality not perceivable in the studio-based motion capture, and they recognised it could be used in *SwanQuake*.

Enter the Player/ Viewer

In a 3D computer game Player and Non-Player Characters (PC and NPC) co-exist in the game world together. The player or viewer controls the movement of the PC using standard game controllers, the mouse, keyboard and/ or joystick, and the actions of the NPC are often triggered by movements of the PC. For the *SwanQuake* project, this meant that after movement was selected for a character in its environment, the choreographic process would involve a set of decisions about these controls. As John McCormick explained in June 2005, 'when the player gets close to a character, the character starts performing those actions which can be a long sequence from all the combination of shorter sequences'. The trigger for these actions to start is programmed into the game engine. So which movements would happen in what order? Would it be possible to apply compositional ideas from the real to the virtual 3-D space? Could principles such as repetition, cannon, theme and variation, accumulation and counterpoint work in this context?

Remembering that hundreds of recorded movement fragments were stored in the motion capture database, with names like Courtly Dance, Shuffle Feet, Waltz, Arms into Whirls, Skull and Tail, Greek Bow and Insect Jump1, it would seem that an endless number of possible combinations could be strung together choreographically. Perhaps a random sequence generator could be programmed like an improvisation system devised by choreographers such as **Trisha Brown** and/ or **William Forsythe**. The viewer controlling the player character might approach the dancer or non-player characters from any direction, making the experience more like a site-specific work than something taking place in the proscenium theatre, like moving around a 'sculpture with moving parts'. (ibid)

But here connections between actual choreography and 'virtual' choreography start to break down. Much of the motion for the project was originally captured with the idea of choreographing or scripting action sequences that placed an emphasis on the qualities of gesture and shape of the movement itself. While this remained of critical importance, as evidenced by the use of the material captured out of doors, the choreographic focus shifted over time as Gibson and McCormick began to explore the interaction the PC (the player/ viewer) would

have with the NPC (e.g. Elkman, Moleman, Spaceman, etc.). They began to place more emphasis on the experience of the player/ viewer and on 'relationships and encounters' in the space and less on specific movements. They simplified the movement repertoire focusing on 'simple task stuff' such as moving chairs and furniture in the House level with the idea that the relationship between the animated characters and their environment might then appear to be more 'real'.

D
 Their concept for the choreography changed along with a shift in possible 'movement' repertoire. For example, using animation techniques such as fade away meant that the slow disappearance of the non-player character could constitute a choreographic decision. The simple common looping player animations that transport the player character around became important movement material. The title of this essay refers to some of these 'cycling anims' with prosaic names such as CrouchB, FlyF, JumpTakeoff, RunF, WalkB and Swim Idle. They also started to look closely for the best moments of captured stillness in the motion files to use as 'idles'; for those moments when a character is still. As Gibson wrote, stillness isn't 'really still' and the player or viewer should be able to perceive the idling character breathing. (ibid) New ideas for motion, animation and interaction were also emerging through the learning involved in creating, touring and adapting *Summerbranch*. (RG, 24.01.07) The player/ viewer in the 3-D space might still trigger pre-scripted action sequences, but John and Ruth would base their choice of motion data from their motion capture libraries more on the 'quality of performance in the environments, player interaction and presentation' than on something resembling conventional choreographic principles.¹⁶

Scripting Behaviour

Moving into the final stages of building the first full environment of *SwanQuake* (the House environment), McCormick and Gibson are planning to use only a fraction of the original motion capture data. Instead they will bring into play the relational and 'behavioural aspects' of both player and non-player characters, seeking to create an uncanny experience for the player/ viewer through structuring simple encounters that accumulate meaning over time. (Table 1) Some of the original material created for the motion capture sessions seems to have had this in mind already; one dancer improvising by simply orbiting the other, advancing and retreating, with a high degree of awareness of each other. Gibson is also working with the materials provided by the project composers, **Luke Pither** and Adam Nash, to harness the sonic signatures of the different environments to accentuate and augment these encounters.¹⁷

Table 1: SwanQuake / Choreographic Possibilities
 (from Ruth Gibson notes 20.05.07)

- NPC characters **ambling** around (simple tasking) in their environment. When approached by the PC they might: a) run away; b) disappear c) act out a lyrical dance; d) group with others; e) advance; f) fade
- NPC's **lyrically dancing** around in their environment when approached by the PC they might: a) start to simple task; b) keep repeating one cycle c) fade to stillness
- NPC's **roaming** in their own environment might they: a) group b) escape the level; c) leak to another level; d) dance in unison

Summary

As mentioned earlier, the technologies of game engines and motion capture are difficult to force into unconventional processes, but the *SwanQuake*/ igloo team have worked hard for four years to surmount these challenges while maintaining an open-ended creation process. Theirs has been a unique journey of emergent choices and aesthetic discoveries.

If it were an ideal world I would go back to the motion capture studio and work out a few new phrases and movement vocabulary for the characters. ... However having said that, working within the limitations of a set library has given John and I some surprising choices at times'. (RG, 20.05.07)

But how have dance and choreography been transformed throughout this long process?

In the introduction to this essay it is proposed that '... a (dance) technique is in some way an idea about what dancing is'. With this in mind, read the start of this email exchange in early 2007 between Martelli and McCormick:

'Hi John, I got a nice pipeline going on for matching the start/ end poses on the Ruth NPC anims and I'm exporting them slowly to UnReal. But what is the correct position for the hips?'

What sort of idea about dancing is contained here? Perhaps it is an indication of a technique for composing the digital bits of dancing. But is it still choreography when collision hulls replace bodies and numbers direct motion?

During the first interviews for this essay, the discussion focused on the choreography of movement sequences for motion capture, followed by the mapping of these recorded movements to digital characters with the aim to eventually trigger them as action sequences. At this earlier stage, even though real movements and gestures had been translated into digital formats, the choreographic approach followed a line of thinking somewhat analogous to the process of making a dance for the actual stage. But this changed over time. Despite the title, *SwanQuake* was never intended to be experienced as a game, and the move away from the conventions of computer video gaming has only increased during the creation process. The choreographic approach has also steadily left behind concepts or principles derived from a live physical setting. Emerging from the overall design collaboration is something more akin to an orchestration of image, sound, immersion and experience folded together, aimed to elicit a mixture of feelings, curiosity and wonder. For the part that choreography now plays in this orchestration process, Gibson and McCormick have focused their attention on the generation of atmosphere, empathy and affect through odd encounters with sensible creatures; and for this they have created a pool of potential interactive relations between the player and the non-player characters. If the choreographic design in *SwanQuake* can be traced to the underlying codes of multiple possible digital renderings, its artful essence lies partly in the experience of unpredictability and 'not quite knowing where the control lies' in these uncanny interactions. (RG, 24.01.07)

We have post post post production going on here and John and I kind of toy with ideas and mull them over and leave them for a while to settle which I guess may seem casual from the outside but when we hit on something then we really know it's right as it's obvious to us. It's a bit like that with Bruno and I as well, a similar relationship, it's the same we don't necessarily have to talk to each other but we do take ages. When I'm working on a live piece I work at lightening speed, make quick decisions and chuck out the irrelevant. (Note from Gibson 16 May 2007)

Notes

1. 'Choreography, in a Web services context, refers to specifications for how messages should flow among diverse, interconnected components and applications to ensure optimum interoperability.' 📄
2. See in this book Johannes Birringer, 'Data Art & Interactive Landscapes'
3. 'A game engine is the core software component of a computer or video game or other interactive application with real-time graphics. It provides the underlying technologies, simplifies development, and often enables the game to run on multiple platforms such as game consoles and desktop operating systems' (Wikipedia/ Game Engine). For more on the evolution of the game engine in connection to artists see in this book Shiralee Saul and Helen Stuckey. 'Art is DOOMed: The Spawning of GameArt' 📄
4. All quotes attributed to John McCormick and Ruth Gibson, unless otherwise noted, are drawn from three main interviews: June 2005, January and May 2007.
5. See in this book Johannes Birringer, 'Data Art & Interactive Landscapes'.
6. For description of motion capture systems see igloo's website 📄
7. For description of some of this work see Company-in-Space website 📄
8. First session at Motek April 2004 with 8 cameras Vicon Optical. Performers: Julia Griffin and Kirsty Little. Second session at Motek April 2005 with 12 cameras Vicon Optical. Performers: Antonia Grove and Julia Griffin. Third session outside Gypsy Gyro, August 2005. Performer: Joanne Fong 📄
9. See in this book Adam Nash, 'Real Time Art Engines 2: Sound in Games'.
10. Motion Blending is the term in 3-D human figure animation that refers to the seamless clipping together of sequences automatically; however the requirements of SwanQuake dictated that the team had to prepare this for manual production.
11. see Gypsy Gyro / Animazoo website 📄
12. From igloo's website: 'Summerbranch explores movement and stillness in nature. Using camouflage and other disguises, a person or a computer character can blend into a 'natural' environment captured and treated through the moving image. This installation uses the tools of the military-entertainment complex, computer gaming, motion capture, 3D environments and special effects to question what is truth and what is artifice in our attempts to reproduce nature.' Also see in this book essays by Johannes Birringer, 'Data Art & Interactive Landscapes'; and Helen Sloan 'Cultural Resonance: Participation, audiences and interface'.
13. Because of the computing power needed to redraw these, if the object is also moving it means that an animated character in a real-time game has what is referred to as a 'polygon budget'. SwanQuake at the time of this essay had a polygon budget of approximately five to six thousand polygons per character.
14. Quote from conversation with Alex Jevremovic. See in this book: 'Pushing Polygons: interview Bruno Martelli and Alex Jevremovic'.
15. Most recently Summerbranch was featured in the New Forest Pavilion, 52nd International Art Exhibition, La Biennale de Venezia (June/ July 2007).
16. This had in part to do with the fact that igloo had simultaneously been developing Summerbranch and had learned from the experience. (RG, 24.01.07)
17. 'My concerns are with the imperfections and the spaces between things, tonal & atonal, discordant & harmonic, sound organised in different relations to pitch, vibration and resonance.' (RG, 20.08.07)

References

- Foster, Susan (1992) / 'Dancing Bodies' in *Incorporations* / Jonathan Crary & Sanford Kwinter eds / New York: Zone Books.
- Lepecki, André (2005) / *Exhausting Dance: performance and the politics of movement* / London: Routledge
- RG (2007-8) / Email communications between Ruth Gibson and Scott deLahunta / January, May 2007; August 2008

🌐 All links: www.swanquake.com/usermanual/ScottdeLahunta

Biography

Scott deLahunta works from his base in Amsterdam as a researcher, writer, consultant and organiser on a wide range of international projects bringing performing arts into conjunction with other disciplines and practices. He is an Associate Research Fellow at Dartington College of Arts and Research Fellow with the Art Theory and Research and Art Practice and Development Research Group, Amsterdam School for the Arts. He lectures on the Amsterdam Master of Choreography and serves on the editorial boards of *Performance Research*, *Dance Theatre Journal* and the *International Journal of Performance and Digital Media*.

'Introduction: The Body has to be Clear and the Words have to be Right'

in *Capturing Intention: documentation, analysis and notation research based on the work of Emio Greco | PC*. ed. S. deLahunta. Amsterdam: Emio Greco | PC and Amsterdam School of the Arts. October 2007. pp. 4-9.

The *Capturing Intention* book I edited and wrote this 'Introduction' for was planned in early 2006 as an outcome of the second phase of the 'Notation Research Project' with Amsterdam-based dance company Emio Greco | PC.¹ The second phase of research was based on the 'Double Skin/Double Mind' workshop and along with the book, the outcomes included an Interactive Installation, film documentary and interactive dvd-rom. That research is still ongoing in the context of 'Inside Movement Knowledge' a two-year (2008-2010) collaborative, interdisciplinary research project into new methods for the documentation, transmission and preservation of contemporary choreographic and dance knowledge.² This project is also one of the four compared in the publication on Choreographic Resources No. 27.

¹ Company website: <http://www.ickamsterdam.nl/> (accessed 7 May 2010).

² Documentation site: <http://insidemovementknowledge.net/> (accessed 7 May 2010).

Bodies

Traces

Sources

Theory

Scott deLahunta works from his base in Amsterdam as a researcher, writer, consultant and organiser on a wide range of international projects bringing performing arts into conjunction with other disciplines and practices. He is an Associate Research Fellow at Darlington College of Arts and Research Fellow with the Art Theory and Research and Art Practice and Development Research Groups, Amsterdam School of the Arts. He lectures on the Master in Choreography/New Media at the Amsterdam School of the Arts and serves on the editorial boards of *Performance Research*, *Dance Theatre Journal* and the *International Journal of Performance and Digital Media*.

Introduction

The body has to be clear and the words have to be right

From the moment they locked themselves away in a studio for two months in 1995 with 'the ambition to come out of that space with a proposal', the entanglement of body and words has been a constant thread running through the artistic collaboration of Emilio Greco and Pieter C. Scholten. The proposal they came out with was named the "language of the flesh", and it gave rise to a basic structure that consisted of seven directions they later linked with the *Seven Necessities*, the manifesto in which they described the "credo about their artistic choices".¹ Language, structures, flesh and the dialectics inherent in their own unique collaboration quickly gave rise to another body.² A growing body of work, a collection of choreographies, materialized: first a trilogy *Fra Cervello e Movimento* (1996-1999) then the still ongoing *Double Points* series (1998-). In the middle of this: an invitation to conduct a coaching project for the Internationale Tanzwochen Wien for which they created *Double Skin/Double Mind* (DS/DM). Avoiding the ideas of technique and training per se, Greco and Scholten used this as an opportunity to analyze and explore their creation process, as is described in 'The moment to question... Double Skin/Double Mind'.

And if the entanglement of body and words is one constant thread, the other must be that, for Greco and Scholten, the dual paths of creation and research are continuously feeding each other in an unusually tight recursive process. And impressively, whether by necessity or design, they have refused to allow this creation/research process to remain theirs alone. For while they continued taking on new creative challenges, they and their organization, Emilio Greco I PC (EG I PC), expanded their research initiatives beyond the simultaneously evolving and constant DS/DM workshop, to include the *Dance & Discourse* Salons, inaugurated in January 2003, and the *Notation Research Project* – as first announced by Bertha Bermúdez in the context of the Salon held on 5 Octo-

ber 2004, a meeting dedicated to the discussion of *repertoire and archive*.

This book, entitled *Capturing Intention*, is one of the latest outcomes to emerge from the *Notation Research Project*. The title explicitly points toward the basic question that is driving the research: what notation system can capture inner intention as well as the outer shape of gestures and phrases? The content of this book contains the traces of a number of encounters and working processes, all circling around this basic question (if not circling then running in parallel with overlaps), that began in preparatory stages in 2004. This was followed by a *first phase* in 2005 that included a DS/DM documentary film project (see

accompanying DVD-ROM) and a period as *artists-in-residence* exploring the concept of *transfer* within the educational context of the Theatre School, Amsterdam continuing through to 2006.³ The core material of this book and the other DVD-ROM is a result of the *second phase* of research that began in April 2006 under the heading: *Dance and Media: A Multi-disciplinary Research Project on New Ways of Dance Notation/ Documentation and Re-creation*.⁴

It is the *multi-disciplinary research* approach that defines this second phase of the research project: its energies and directions (sometimes convergent and sometimes not); its multiple foci and points of departure; its overlapping but separate fields of terminologies and expertise. For the aim of this second phase was to bring specific perspectives from different disciplines to bear on various properties of dance and movement in relation to the *Notation Research Project*. And to do this as collaborative research *vis-à-vis* a series of events and meetings leading to the development of prototype tools and approaches (See Time Line).

As Marijke Hoogenboom describes in her essay at the close of the book: "the interdisciplinary project team, which has been constituted for the purpose of taking up this second phase of research, takes as its departure point the assumption that the complex nature of dance cannot be adequately represented with a single technology".⁵ In other words (and there are many instances throughout this book of the same ideas being described in different terms), we, the research team, decided that the basic question, "what notation system can capture inner intention as well as the outer shape of gestures and phrases?", could be best answered through organised encounters between different specialist perspectives.

In this book, you are invited to enter into these encounters with individuals who are specialists in dance notation systems (Marion Bastien, Eliane Mirzabekiantz and Bertha Bermúdez via her recent studies), cinematography and film making (Maite Bermúdez), computer based motion tracking and gesture analysis (Frédéric Bevilacqua), interactive design to enhance understanding of dance (Chris Ziegler) and the scientific study of the brain's perception of movement (Corinne Jola). Additionally, we have included the perspective of other individuals working in the more academic areas of culture studies and

philosophy (Maaike Bleeker, Susan Melrose, Franz Anton Cramer) that were not directly involved in the second phase encounters. However, we do intend to involve these areas more in the *third phase* of this research and their contributions here help to broaden the space for thinking about the implications of the *Notation Research Project*.

Notation Research-in-Progress

On 5 April 2005, Bertha Bermúdez and I met in De Baile café in Amsterdam for her to describe the *Notation Research Project* to me. My short summation of our talk included the following item in a longer list of seven points:

"Point #5 Normally passing these dances onto others is done through instruction with the body and words. To do this *the body has to be clear and the words have to be right*."

Bertha Bermúdez, at that time starting her study of existing notation systems, was about to meet with Benesh specialist Eliane Mirzabekiantz in Paris and was also planning to introduce the idea of making a documentary of the *DS/DM* workshop to the filmmaker Maite Bermúdez. Further elaboration on these encounters can be found in the essays of Eliane Mirzabekiantz and Maite Bermúdez.

The planning and making of the *DS/DM* documentary provided a major impetus to the *Notation Research Project*. Here was a core set of material where this entanglement of language, structures and flesh might be analyzed to a useful purpose not only for Greco and Scholten, who at the time felt the need to "understand the logic of the workshop and its structure better", but also to give the second phase of the project a concrete 'boundary object' to work with by providing a set of nameable components and describable elements.⁶ For the interdisciplinary team this material was to prove invaluable, and you will find components and elements such as *Breathing*, *Jumping*, *Expanding* and *Reducing* appearing throughout this book and accompanying DVD-ROMs. It is essential to understand that these principle components (there are a total of seven) are always part of the preparation for creating and performing. Through doing *DS/DM*, the intention behind/inside of each movement is brought to a high degree of concentration and the conditions for the appearance of new making ideas are established. It is to the exploring and exploiting of *DS/DM*,

with the aim to 'capture' this concentrated intention, that the rest of the second phase of research has been devoted.

The encounters for the second phase began officially in Amsterdam with a Salon held in April 2006 in the context of the *Anatomical Theatre Revisited* symposium organized by Maaike Bleeker.⁷ Following this, all members of the interdisciplinary team met for the first time at a two-day symposium in early July 2006 during Cinedans in Amsterdam; here they were invited to present their current research and to start to exchange approaches. The working meetings and events that took place after this symposium can be traced along the Time Line. As mentioned earlier you are invited, here in this publication, to enter into these through reading the individual essays and through viewing the accompanying DVD-ROMs.

However, we also leave things open-ended as a manifestation of the in-progress nature of the current research. For the basic question about notating intention that we started from has been our catalyst, our ingredient stimulating a wealth of ideas, rich insights and new representations as you see contained in this publication. We have not thus far discovered the system, method of documentation, analysis or notation that gives any one answer to our question, but one might reflect that arguably this was not the point to begin with. In Scholten's words, "It is in the attempt to do this process and to speak about it... it is not to capture intention, but to try". At the same time, a discovery in its purest form is not known before it appears; and we may yet come across something of singular importance. We can only establish the best conditions for this to happen. And perhaps to try harder following Greco's proposal: "I think the responsibility is more with us, not so much the various systems being used. (...) And we have to be clearer, how can they capture something if we don't really describe that moment".

The Wider Context

By attempting to discover adequate notations and descriptions for new movement expression, in addition to the context of the creation/research work of EG I PC, the notation project enters into two other contexts, historical and contemporary. The aspiration to notate movement seems a basic human and cultural urge as evidenced by constant endeavor through several centuries. This continuous invention is revealed in part by a list of approximately eighty

documented dance and movement notation systems, in which movement analysis is at least implicit, that dates back to the mid-1600s and includes the Laban and Benesh systems invented in the early half of the 20th century.⁸ Sciences and technologies emerging in the 1800s brought new instruments and methods of analysis to bear on the topic of movement research and in the 1900s the anthropological study of movement, and systems invented to further that study, sought to understand human gesture within its social and cultural context.⁹ The science of computer graphics picked up and contributed to these threads of movement research through the development of digital technology not only for furthering scientific study (e.g. in the field of biomechanics), but also for the creation of animated characters to populate new media spaces from the cinema to 3D virtual environments.¹⁰

This extreme *précis* of the past few hundred years lends support to an initiative like the *Notation Research Project* that aims to bring different disciplines from arts, technology and sciences together not only to pursue the specific research goals of the project, but to further understanding of human movement in all its creative complexity. But this understanding should not come at a cost to the arts – the main research agenda here is an artistic one and it should remain so. But for this it's important to seek a clarification of the relation of dance to other 'knowledge domains'.¹¹ Dance is obviously a site of knowledge based on the existence of a community that has agreed to learn and advance this largely through the production of art-making processes and performances.¹² But dance's status as a 'domain' is largely evaluated on the strength of its contribution as 'art' to the public sphere. This evaluation is not always useful for understanding the full nature of what dancing and dance making contains, and here is where exchanges with other non-art disciplines and practices can be productive. There are two essays in this book that explore this idea: one is the essay by Corinne Jola. From her perspective as a cognitive neuroscientist, Jola offers a valuable condensed glance at a very different set of descriptions of movement intention grounded in the culture of science with an aim to bring these into a generative relationship to the driving artistic aims of the project. The other is a re-published essay titled 'Sharing Questions of Movement' in which I sketch out some possible territory of productive cross-domain research involving dance and choreography.

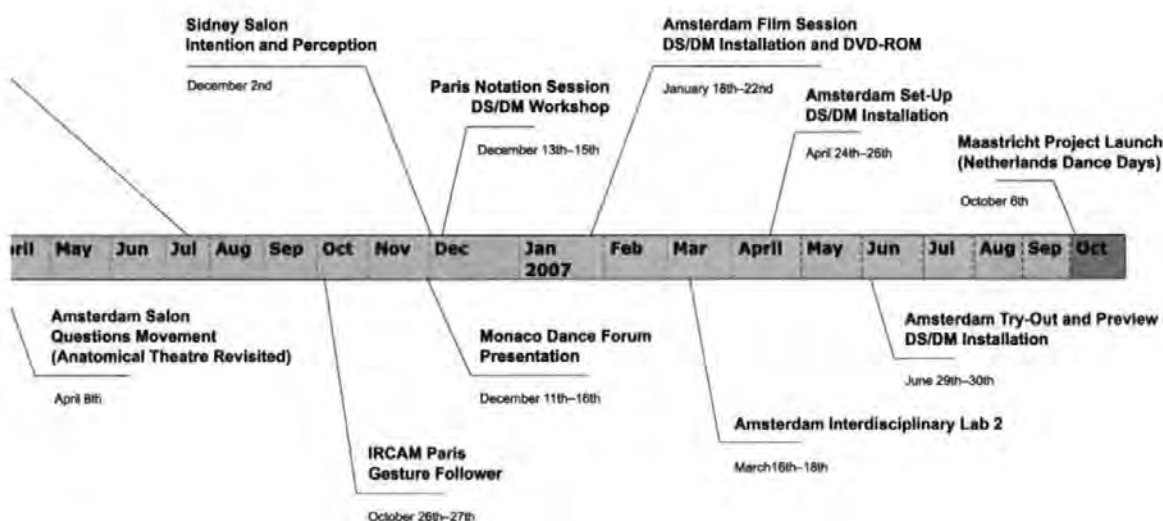
Notation Research Project Time Line



There are a handful of other contemporary choreographers also actively engaged in these issues related to knowledge production and the implications for arts creation/research, among them Wayne McGregor, Siobhan Davies and William Forsythe.¹³ As with EG I PC, they do this not only through making dances for an audience, events conforming to the conventions of the field, but through innovating new and 'unconventional' types of traces and artefacts of the dance creation process. Through exploring fresh approaches to documenting, analyzing and an/otating their creative work, they deepen their own understanding while simultaneously stimulating the attention of others who may utilize these traces as resources in their own research. All are working with interdisciplinary teams from both art and non-art disciplines to investigate these possibilities.

The future: archive and re-creation

The *Notation Research Project* has had the benefit of support from some key organisations and the concerted and concentrated efforts of all involved. And the aim is to continue with the next phase developed in part from the second phase results and to include *archival* and *re-creation* work. The plan is to do this together with building a new consortium of institutional partners and individual researchers based in the Netherlands. In the meantime, for EG I PC the *Dance & Discourse Salons* have now been integrated into a new creative and education unit inside the organization, the *Accademia Mobile*, which is now in operation. Additionally, there are ambitions to establish a major international choreographic research centre in Amsterdam where a wide range of different disciplines can continue to interact.



- 1 Quotes from email communication with Pieter C. Scholten 14.07.07.
- 2 See: 'The wake-up calls of Emilio Greco and Pieter C. Scholten'. Interview by Gabriel Smeets on the making of the trilogy *Fra Cervello e Movimento – Bianco, Rosso and Extra Dry* (Amsterdam 2004). Available www.emiogreco.nl (accessed 16.07.07)
- 3 The Theatre School residency spawned two additional publications: *Company in the School*. Eds. Jeroen Fabius and Ingrid van Schijndel. Research group Art Practice and Development & Emilio Greco I PC. 2007; *Transfer*. Eds. Marijke Hoogenboom, Pol Eggermont and Nienke Rooijakkers. Amsterdam School of the Arts. 2007
- 4 The term 'media' as the plural of medium is used here to refer broadly to a variety of methods and technologies for recording, storing, representing and transmitting; in this way it makes reference to both digital and analog formats, old and new technologies.

- 5 See in this book: Marijke Hoogenboom. 'Conditions for Research'. p. 80.
- 6 The notion of the 'boundary object' can be found in anthropological and other areas understood as something that can foster cooperation and communication among the diverse members of heterogeneous working groups.
- 7 See in this book: Maaïke Bleeker. 'Questions of Movement and Meaning' (framing statement for symposium). p. 16.
- 8 See: Anne Hutchinson Guest. *Choreographics: A Comparison of Dance Notation Systems from the Fifteenth Century to the Present*. Gordon and Breach Science Publishers S. A., 1989.
- 9 For a look at early development in movement sciences see: Scott deLahunta. 'The Human Walking Apparatus: a technological episteme', in: *Interagir: avec les technologies numériques: Nouvelles de Danse*. No. 52. 2004. pp. 36-49.
- 10 For a similar thesis see page 9 of Laurence Louppe's 'Imperfections in Paper'. in Louppe, ed. *Traces of Dance: Draw-*

- ings and Notations of Choreographers*. Paris: Editions Dis Voir, 1994. pp. 11-33.
- 11 The concept of 'knowledge domain' is not commonly used in reference to the arts; its use here points towards future discussions.
- 12 There is a useful concept in the social sciences referred to as 'communities of practice' in which the concept of knowledge is disassembled into its function in the creation and sustaining of the practice-based relations of a particular community or field. One of the foremost theorists of this concept is Etienne Wenger www.ewenger.com (accessed 16.07.07).
- 13 For some description of these other projects and the concept of the choreographic resource see: Scott deLahunta and Norah Zuniga Shaw. 'Constructing Memory: Creation of the Choreographic Resource'. in: *Digital Resources: Performance Research*. Eds. Ric Allsopp and Scott deLahunta. Vol 11, No 4. pp. 53-62.

Appendix

Non - English Publications

virtualna efemernost umetnost digitalnega plesa

792.8"199":007.5

scott deLahunta

Ozadje

Kot na vseh področjih sodobne umetnosti se tudi v plesu stekajo različne zgodovinske trajektorije. Ena od njih je tradicija koreografije, plesnega treninga in izvajanja, na katero sta vplivala predvsem Merce Cunningham (v sodelovanju z Johnom Cageom) in kasneje Robert Dunn, čigar predavanja iz kompozicije v zgodnjih 60-tih v NYC (nanja je vplival Cage) so položila temelje za delo eksperimentatorjev skupine Judson Church, v kateri so sodelovali Trisha Brown, Steve Paxton, Simone Forti, Yvonne Rainer, Douglas Dunn, David Gordon in drugi.

Spisek imen skupine Judson Church so kanonizirali pisci in poznavalci, kot na primer Sally Banes, ki je leta 1980 o njih napisala knjigo *Terpsichore in Sneakers: Post-modern Dance*.¹ Dogajanje v Judson Church je mogoče razumeti kot način manifestacije revolucij šestdesetih let, saj so eksperimentatorji skupine v prakso oblikovanja plesa vnesli geslo »vse gre in se s tem jasno izrekli za enega od poudarkov desetletja. Tega ni mogoče razumeti le kot upor proti omejevanju, ampak kot nadaljevanje tradicije umetniškega upora, kot ga je s svojimi inovacijami izražal Merce Cunningham, ki je izrecno želel prekiniti z umetniškimi idejami zgodnejših modernih plesnih »pionirjev«. Zgodnji moderni ples (Duncan, Humphrey, Graham itd.) je slavil ekspresivni potencial plešočega telesa, Cunningham pa je slavil emancipacijo plešočega telesa od potrebe po ekspresivnosti ali interpretaciji. V primerjavi s prvimi pionirji »moderne« plesa je Cunningham prvi plesni »modernist« ... zanosno poudarjajoč, da je njegov ples »gibanje, ki je samo o gibanju«.

Med plesnimi teoretiki in poznavalci teče vroča razprava o tem, ali je bil Judson Church nadaljevanje modernističnega postopka, ki ga nekateri vidijo v nadaljnjem luštenju (strip down) gibanja v »bistvene« poteze (uporaba hoje), ali je bilo to, tako je menila Sally Banes, obdobje postmodernih postopkov križanja in prilagajanja oblik. Ne nameravam se spuščati v to debato,

ampak želim pokazati, da je dobro dokumentirano, kako so eksperimentalisti skupine Judson Church privedli svojstven tip upornišva tako daleč, kot ga je bilo le mogoče privedi - ples so celo odstranili kot obvezni element plesa. Zanje je bil ples lahko karkoli - osnovno gibanje, hoja, ples z nalogo, na pravih utemeljena koreografija, zapisani ples, ples, izveden zunaj gledališča, ples ljudi, ki ne vedo, da jih drugi gledajo; spisek igre v nedogled. Med izpodiranjem »visoke umetnosti« s piedestala in oblikovanjem plesa v nespecialistični posej se je vseskozi ohranjala močna demokratična ideologija. Izvajalec ali ustvarjalec plesa je lahko postal kdorkoli in vsakdo. Meje med občinstvom in plesalcem, med ustvarjalcem plesa in urednikom so časno izginile.

Pomembno je videti, da brez upoštevanja točno določene trajektorije od Cunninghama prek Judson Church sam ne bi mogel razmišljati o nekaterih razmerjih med plesom in tehnologijo, saj temeljijo na treh KLJUČNIH idejah, povezanih z njo: prvič, da je pomen plesa lahko samo in zgolj v gibanju plesalca, drugič, da lahko plese izvaja kdorkoli, in tretjič, da je način oblikovanja in uokvirjanja plesa mnogo.

Programska oprema za plesalce

Leta 1984 je Pauline Oliveros izdala knjigo z naslovom *Software for People*.² Oliverosova je skladateljica, ki se ukvarja z živo elektroniko, računalniki, improvizacijo in novimi oblikami skupinske interakcije. Knjiga vsebuje članke o novi glasbi, ženskah skladateljicah, zvočni meditaciji, pozornosti in zavedanju ... Vsebuje tudi algoritme za ustvarjanje zvočnih izvajanj.

Najpogostejša uporaba besede "algoritem" je matematični ali računalniški izraz. Foldoc v *Free On-Line Dictionary of Computing* podaja njegov osnovni opis kot »podrobno zaporedje dejanj, ki jih je treba opraviti, da izpolnimo neko nalogo« in navaja, da je poimenovan po

iranskem matematiku Al-Khawarizmi.³

Malce bolj izdelan opis, tudi pobran z interneta⁴, imenuje štiri posebne značilnosti algoritma:

1. Dovršen je; podani so vsi koraki, v pravilnem zaporedju.

Avtor razmišlja o nekaterih razmerjih med plesom in tehnologijo, pri čemer kot izhodišče postavi Mercea Cunninghama in Judson Church, saj se prav tu izoblikujejo tri ključne ideje za razumevanje tega razmerja: prvič, da je pomen plesa lahko samo in zgolj v gibanju plesalca, drugič, da lahko ples izvaja kdorkoli, in tretjič, da je način oblikovanja in uokvirjanja plesa mnogo. Opisuje pomen in vlogo algoritmov v plesu in nato zgodovino plesa na platnu (video), ki se kasneje razširi tudi na plesalca znotraj ekranskega/računalniškega monitorja. Opisuje tudi pomen tehnologij, kot sta Life Forms in Motion Capture, ter predstavi umetnike, ki so se ali se ukvarjajo s tem poljem sodobnega plesa, med njimi so Maya Deren, Merce Cunningham, Ivone Fontijn, Elizabeth Bradley, Guy Hilton, William Forsythe, Bruno Martelli in Ruth Gibson.

2. Pravilen je; vedno prinese pravilen odgovor.

3. Končen je; točno je določeno, kdaj se konča.

4. Izvedljiv je; vsa navodila se da dejansko izpolniti.

Omenil sem že, da so eksperimentatorji skupine Judson Church oblikovali ples s pomočjo struktur, utemeljenih na pravih. Mnoge teh struktur so ustrezale navednim štirim posebnim karakteristikam. Verjetno je bila Trisha Brown najbolj znana koreografinja, ki je snovala svoje delo na algoritemskih postop-



kin. Dve njeni deli, *Accumulation* in *Locus*, sta nastali v 70-tih letih in "algoritma" za oba plesa je mogoče najti v več virih, vključujoč *Contemporary Dance* urednice Anne Livet.⁵

Algoritem za *Accumulation* se glasi: "Akumulacija/kopičenje je postopek dodajanja, ki se začne z gibom 1; vrnitev na začetek (start over) Gib 1; dodamo 2 in vrnitev na začetek. 1, 2; dodamo 3 in vrnitev na začetek, in tako naprej do konca plesa. Primarna akumulacija nakopiči trideset gibov v osemnajstih minutah. Giba 29 in 30 povzročita, da se figura zavrti za 45 stopinj, tako da naredi z vsako dovršitvijo sekvence obrat za 90 stopinj. Torej se v zadnjih dveh minutah plesa zgodi revolucija za 360 stopinj, kar podaja občinstvu tri izmenične poglede na ples, preden se ta dokončno ustavi."⁶

Poanta je v tem, da se ta ples natančno prilaga definiciji "algoritma", ki smo jo navedli zgoraj: je dovršen, pravilen, končen in izvedljiv.

Algoritmi so nekakšni recepti in njihova uporaba v strategiji oblikovanja plesa v 60-tih in 70-tih letih je bila tudi bistveni del prevladujoče demokratične ideologije umetnosti tistega časa. Brown in drugi so jih kot pripomočke za oblikovanje plesa deloma uporabljali zato, da bi jih lahko izvajal kdorkoli. Plesni algoritem omogoča "plesnemu nespecialistu", da ustvari in izdela ples - za izdelavo in izvedbo "akumulacije" ni potreben nikakršen trening. Uporaba predpisanih struktur pri izdelovanju plesa je nadaljevanje procesov naključij, ki sta jih proučevala Cage in Cunningham - procesov naključij, ki tudi vedno "prinesejo pravičen odgovor"

Omenjeno bi rad navezal na delo Williama Forsythea, koreografa Frankfurtskega baleta. Paul Kaiser, sodirektor Riverbeda, multimedijske družbe, ki je sodelovala z Robertom Wilsonom, Merceom Cunninghamom in Billom T. Jonesom pri projektih "virtualnega izvajanja", je s Forsytheom naredil intervju o njegovi metodi izdelovanja plesa.⁷ V delu diskusije sta se osredotočila na ustvarjanje predstave *Alien Action* in Kaiser pravi, da ga Forsytheova pojasnila spominjajo na rekurzivne algoritme, kjer "se postopki sami vzpostavijo, modificirajo rezultate, se ponovno vzpostavijo in tako naprej". Forsythe je odgovoril:

"V bistvu sem pri *Alien Action* prvič dejansko začel ustvarjati gibanje, osnovano na rekurzivnih algoritmihi. Kakorkoli, v dolgotrajnem, mukotrpnem postopku, ki se ne razlikuje od računal-

niškega programiranja, smo ustvarili stalne variacije, kjer se mora vsak korak ponavljati v nedogled."

Na neki ravni Forsythe nadaljuje tradicijo plesnih umetnikov, ki prevzemajo trans-disciplinarno metafore: na misel nam pride metoda filmske montaže. V drugih intervjujih Forsythe omenja svojo "bazo podatkov" gibalnega slovarja in urejevalno strategijo "režanja in lepljenja". Toda algoritem je bolj proces kot metafora ... in predstavlja polje, kjer načini matematičnega in računalniškega konstruiranja stvari sovpadajo z oblikovanjem plesa.

Migracijska telesa

Nicole in Norbert Corsino imata v južni Franciji plesni ansambel, s katerim ustvarjata ples za platno in druge medijske prostore, ne za "pravi" oder. Na nedavni pariški konferenci o "plesu in tehnologiji" je Norbert Corsino govoril o plešočem telesu kot o "migracijskem" telesu, v nasprotju z "nomadskim" telesom.⁸ Tako plešoče telo ne prenaša svojega doma, kamorkoli gre, ampak si vsak kraj, v katerem se znajde, naredi za svojega.



Metafora "migracijskega" telesa je posebno primerna za ples, še posebej, kadar jo uporabljamo v odnosu do platna. Napeljuje na to, da je plešoče telo tam doma, in sam verjamem, da je tako. Odnos med plesom in platnom se najprepričljiveje začne leta 1945 s plesnim filmom avantgardne režiserke Maye Deren *A Study in Choreography for Camera*. Čeprav je posnela le sedem filmov, Derenovo pogosto štejejo za prvo plesno filmsko ustvarjalko ... oziroma z drugimi besedami: priznavajo ji, da je priredila ples posebej za platno. V svojih programskih zapiskih o filmu je napisala: "To je nekakšen duet med

prostorom in plesalcem - duet, v katerem kamera ni zgolj opazujoče občutljivo oko, ampak je sama ustvarjalno odgovorna za izvedbo."⁹

Delo Derenove se umešča na začetek tega, kar se je v zadnjih dveh desetletjih razcvetelo v svoj lastni žanr, o čemer priča naraščajoče število festivalov, tekmovalni in dogodkov, ki se izrecno posvečajo "videoplesu", "plesu pred kamero", "plesu in platnu" itd. V reviji *Tanz Aktuell/Ballet International* Elisa Vaccarino namiguje, da bi lahko bilo ime "videoples" (videodanse) skovano leta 1988 za vitrino v Centru Pompidou.¹⁰ Ples je na televizijo prodiral v 80-tih letih, v Britaniji z oddajo Michaela Kustowsa na programu Channel 4 in v Združenih državah na PBS (Public Broadcasting Service). Te oddaje so uvrstili v posebno kategorijo in so jim začeli namenjati provizije in štipendije.

Zgodovina je dobro dokumentirana in moj namen je samo prikazati trdnost odnosa med plesom in platnom. Ples se na platnu počuti zelo udobno. Merce Cunningham je z video in filmskimi ustvarjalci, kot sta Charles Atlas in Elliot Caplan, leta proučeval ta odnos. V kontekstu našega članka si zastavljamo

vprašanje, kakšen je potencial danes, ko se platno razvija iz nespremenljivega klasičnega prostora kinematografa v interaktivne možnosti računalniškega monitorja.

Leta 1996 je Lev Manovich objavil esej z naslovom *An Archeology of the Computer Screen*.¹¹ Njegova izhodiščna točka, "klasično platno", je slikanje v najširšem pomenu. Nekaj, kar je uokvirjeno, plosko in pravokotno in funkcionira kot "okno v nek drug prostor". Temu v njegovi genealogiji sledi "dinamično platno": kinematografsko platno ali ekran videa.

Naslednji v Manovichevi razporeditvi je



ekran "realnega časa", ki se prvič pojavil med drugo svetovno vojno z izumom radarja. Ta ekran je radikalno drugačen, saj se konstantno obnavlja v odnosu do zunanjega referenta. Kmalu zatem takšen ekran "realnega časa" začnejo uporabljati za vnašanje podatkov (in za njihovo produkcijo) in razvije se v to, kar danes poznamo kot računalniški monitor.

Nekateri plesni umetniki raziskujejo možnosti oblikovanja plesa za tak interaktivni ekran. Trije projekti so se začeli v Veliki Britaniji v kontekstu dogodka

Koreografski vrtovi in odlična telesa

V poskusu določitve odnosa med tehnološkimi/računalniškimi procesi in procesi ustvarjanja plesa sem omenjal delo Trishe Brown in Williama Forsythea. Direktnejši odnos do ustvarjanja plesa omogoča koreografsko orodje, imenovano Lifeforms.¹⁴ Lifeforms so začeli razvijati v poznih osemdesetih v sodelovanju z Merceom Cunninghamom, ki je že daljnjega leta 1968 izrazil zanimanje, da bi pri obliko-

lahko da je Lifeforms res "edini" softver svoje vrste za koreografe, vendar ga ustvarjalci plesa ne uporabljajo veliko. Poleg problema dostopa do računalnika, časa in napora, ki sta potrebna za učenje uporabljanja programa, Lifeforms "utelešajo", če tako rečemo, Cunninghamovo plesno estetiko.

Program s lahkoto prikaže okončine, ki se gibajo čudno neusklajeno, v kombinaciji s precej neverjetnimi liki in zapletenimi gibalnimi prehodi. Omogoča takojšnjo pomnožitev enega plesalca kolikorkrat želimo in to kjerkoli na projekciji trodimenzionalnega odra, ki ga je mogoče iz kateregakoli kota rotirati za opazovanje, od ptičje do žabje perspektive. Kot ustvarjeno za Cunninghama, a z omejeno možnostjo uporabe za koreografe, katerih besednjak in estetika sta načrtana drugače. Najekstremnejši primer bi bila lahko koreografska strategija butoha, pri kateri sta površina kože in gibanje notranjih telesnih organov pomembnejša, kot pa da je roka ali noga v vsakem trenutku v prostoru.

Toda le deloma drži domneva, da je Lifeforms zgolj koreografsko orodje za pomoč pri delu v fizičnem studiu. Lifeforms je vendarle primeren programske opreme in kot tak vsebuje digitalno gradivo, ki omogoča vrsto možnih aplikacij. Tukaj bom omenil dve.



Digital Dancing, ki ga vsako leto organizira Terry Braun iz *Illuminations Interactive*.¹² V dveh od teh projektov sodelujeta koreograf Mark Baldwin in Richard Lord. Lord je za mrežo ustvaril interaktivni ples, ki ga je mogoče najti na njegovi spletni strani <http://www.bigroom.co.uk>.

Drugi projekt je nastal iz sodelovanja med digitalnim umetnikom in koreografino, Brunom Martellijem in Ruth Gibson.¹³ Nedavno sta dokončala CD-ROM, naslovljen *WindowsNinetyEight*, ki uporabniku/gledalcu ponuja mnoge možnosti vstopa v interakcijo s plesom, ki se dogaja na monitorju. Določena sekvenca na primer uporablja "škrate", ki so pravzaprav kratke zanke - video posnetki kratke plesne fraze, ki jo izvaja Gibsonova. "Škrati" se pojavijo približno 12- do 16-krat na nekaj različnih lokacijah na monitorju, ponavljajoč isto zankasto frazo. Z miško jih je mogoče predstavljati v različne medsebojne prostorske odnose. Klikanje nanje povzroči tudi drobne prekinitve v časovnem tempiranju zank in v kratkem času lahko "uporabnik" na ekranu ustvari zapletene koreografske vzorce. To pripelje gledalca v položaj koreografa, ki je sam ustvarjalno odgovoren za izvedbo, če parafraziramo Mayo Deren.

vanju plesa uporabil računalnik.¹⁵ Merce je bil vedno jassen, ko je izražal mnenje o vplivu tehnologije na svoje delo - omogočila mu je nove načine videnja, razmišljanja in ustvarjanja gibanja.

Tehnologija tako "... predstavlja možnosti, ki so vedno že bile tam, tako kot fotografije ujamejo podobo v obliki, ki je naše oko še nikoli ni videlo. Na računalniku lahko spremenimo časovni potek in v počasnem posnetku opazujemo, kako se telo spreminja iz ene oblike v drugo. Očitno zmore ustvariti oblike in prehode (tranzicije), ki človeku niso dostopni. Toda kot se je to zgodilo pri ritmični strukturi, takrat z uporabo procesov naključij, ki jim je sledila uporaba filmske ali videokamere, se z uporabo plesnega računalnika znova zavedam novih možnosti, s katerimi lahko delam."¹⁶

Namiguječ, da "nas tehnologija oblikuje, tako kot mi oblikujemo tehnologijo", se Cunningham obrne na svetnika digitalne dobe, Marshalla McLuhana, ki je seveda hodil po stopinjah množice teoretikov kulture, med drugimi Walterja Benjamina, ki je pisal o tem, kako tehnološki izumi vplivajo na naše dožemanje umetnosti in z njo povezanih procesov in ga radikalno spreminjajo.^{17,18}

Prva-

Poleti leta 1998 je digitalni umetnik Guy Hilton vabil k sodelovanju v projektu *Interferenca: eksperiment iz izvajanja internetne koreografije*, ki bi ga izvedli v Manchestru v Veliki Britaniji kot del Digitalnega poletnega programa "s simultanim predvajanjem na mreži, ki bi zajelo globalno občinstvo. To je plesni trio, ki ga elektronsko ustvarja 40 koreografov z vsega sveta."¹⁹

Hilton je svoj projekt zasnoval na nadrealistični igri *Slastni mrlič*, v kateri igralci končujejo stavke, ne da bi vedeli, kaj je bilo že storjeno. Navajam nekaj navodil Hiltonovega projekta:

"Prejeli boste e-pošto z datoteko LifeForms, ki bo vsebovala en sam začetni ključni posnetek. Vabim vas, da si izmislite zaporedje gibov, ki naj traja od 30 sekund do 1 minute, začnete pa iz priloženega ključnega posnetka. Svojo sekvenco vrnite prek e-pošte in njen končni posnetek bomo kot začetno pozicijo posredovali naslednjemu udeležencu. Tako bomo skupaj ustvarili sekvenco 40 fraz (v stilu slastnega mrliča/cadavre exquise), ki jo bodo interpretirali in izvedli živi plesalci. Izmislite





si lahko katerikoli gib, ki vam ustreza, in se ne ozirajte na težnost ali omejitve človeškega telesa."

Končni izkupiček Hiltonovega pojeta je bila plesna predstava, sestavljena iz več kot petdesetih prispevkov iz Evrope, Severne Amerike, Avstralije in Hong Konga, ki je trajala približno 30 minut. Uvodni in sklepni fragment je prispeval Merce Cunningham. Kot je bilo predvideno, so se živi izvajalci poskušali naučiti koreografijo, kar je bil velik izziv, saj je precej udeležencev ustvarilo gradivo, ki ga je na odru fizično nemogoče povsem ponoviti.

Druge-

Naslednja odstavka navajata obširno informacijo s spletnih strani, povezanih s tem projektom:

Na oddelku za računalniške vede na univerzi v Coloradu vodi Elizabeth Bradley skupino raziskovalcev, ki se sprašujejo, ali "se računalniki zmorejo naučiti plesati".²⁰ Zanima jih redefinicija vloge računalnika v plesu, ki, pravijo, "je bila dosedaj predvsem zunanja: kot orodje reprezentacije (npr. uporaba Lifeforms za prikaz plesa kot animirane sekvence) ali okrasitve (npr. lovljenje plesalčevega srčnega utripa na sintetizator). Nas zanima popolnoma drugačen tip računalniškega orodja: takšen, ki pri kreaciji plesnih sekvenc igra dejavno vlogo".

Skupina Elizabeth Bradley se ukvarja z izdelavo dveh računalniških programov, ki prodirata "v notranjost" plesa - eden deluje kot "mešalec kart" gibalne frazeologije na način, soroden določenim postmodernim koreografskim strategijam, drugi "se uči" iz korpusa plesnih fraz (na tej točki je uporabna knjižnica fraz iz Lifeforms), vendar ustvarja popolnoma izvirne gibalne sekvence, ki ohranjajo stilni pečat danega gradiva. Prvi program, imenovan *Chaographer*, uporablja matematiko kaosa, tako da najprej razdeli animirano gibalno sekvenco na manjše enote in jih nato premeša. Rezultati tega pristopa, pišejo, "spominjajo na nekatere Cunninghhamove procese naključij". Drugi program, *MotionMind*, uporablja algoritme za učenje strojev, da bi ujel zapovedi stila, implicitnega danemu korpusu plesnih fraz. Nato uporabi to znanje tako, da avtomatično generira inovativne in stilistično ustrezne gibalne sekvence med poljubnimi začetnimi in končnimi pozami.²¹

Čprav seveda ni verjetno, da bi *MotionMind* kdaj zamenjal koreografa, pa so po mojem mnenju in kot izpričuje-

jo njihove izjave ti procesi v polju računalniške znanosti neposredno nadaljevanje eksperimentov Cunninghama in skupine Judson Church. Zaradi navdihovanja pri teh koreografijah bodo delo Bradleyjeve in njenemu podobna raziskovanja vplivala na oblikovanje plesa v prihodnosti.

Motion capture: kjer se srečata animacija in koreografija

Lahko bi rekli, da se zgodovina tehnologije motion capture začenja v 19. stoletju z mehanskimi izumi. Znanstvenik/inženir Etienne-Jules Marey je skonstruiral aparat za merjenje trajektorije ptičjega krila v prostem letu. Marey je razvil pripomoček, ki je po njegovih besedah zmožgal "na daljavo prenesti katerikoli gibanje in ga zabeležiti na ravni površini".²² To zgodnje popisovanje gibanja se je oblikovalo z mislijo na napredek znanstvenega vedenja in se je končalo v beleženju, ki je bilo bolj informacija kot podobnost, bolj meritev kot prikaz.

Sledeč razvoju digitalnih tehnologij, se je motion capture preoblikoval v mehanizem, s katerim je mogoče uloviti gibanje in ga prenesti v računalniško analizo, ki je podobna, a precej kompleksnejša od zgoraj omenjene. To prinaša merljive raziskovalne koristi zdravstvenim, športnim in vojaškim institucijam. Digitalne tehnologije in motion capture so se tudi hitro razrasli na področju specialnih animacijskih efektov, ki jih uporabljata zabavna (filmi in računalniške igre) in oglaševalska industrija. Na tem področju razvoja je specialni računalniški grafični softver zmožen prenesti podatke o gibanju v tridimenzionalni virtualni prostor in s tem gibanjem animirati predmete katerekoli predstavitelne oblike.²³

Na tej točki se stekata animacija in koreografija, dve poglavitni umetniški formi 20. stoletja. Toda digitalno tehnologijo-motion capture so redko uporabljali v zgolj umetniškem kontekstu, ker so bili stroški za umetnike previsoki, rezultati pa nezanesljivi. Vendar v zadnjih nekaj letih vidimo več odskih in digitalnih umetnikov, ki s pomočjo teh tehnologij redno delajo (npr. Susan Kozel in Kirk Woolford, Sally Jane Norman, Richard Lord in Christian Hogue, Paul Kaiser in Merce Cunningham/ Bill T. Jones, Bruno Martelli in Ruth Gibson, Yvonne Fontijn in Karin Post itd.) S svojim delom ustvarjajo "kritično maso", zaradi česar se tehnologija vedno bolj integrira v polje plesa.

Že omenjeni Paul Kaiser in Riverbed ter njihov projekt motion capture z Merceom Cunninghamom in plesnim umetnikom Billom T. Jonesom so dobili močno podporo kritikov. Ampak namesto da pišem o delu, ki ga je mogoče precej podrobneje proučiti na Riverbedovi spletni strani www.reverbed.com, bom raje opisal delo nizozemske umetnice Yvonne Fontijn, ki trenutno še nima spletne strani niti ni deležna velike mednarodne medijske pozornosti.

Yvonne Fontijn in nizozemska koreografinja Karin Post že nekaj let sodelujeta pri projektih motion capture in animacijskih projektih. Fontijnova dela kot animacijska umetnica za Motek, komercialno hišo za motion capture iz Amsterdama.²⁴ To ji omogoča enkratni dostop do tehnologij, ki jih potrebuje za svoj projekt, in ji daje možnost dolgotrajnejšega eksperimentiranja in raziskovanja. Približno pred poldrugim letom sta naredili dogodek motion capture, v katerem sta ujeli gibanje trupa in rok plesalke Karin Post in gibanje medenice in nog plesalca stapa.

To gradivo je nekaj mesecev ležalo shranjeno v računalniku, preden se ga je Fontijnova odločila uporabiti pri ustvarjanju animacije za razstavo *Traces of Science in Art* v Het Trippenhuis v Amsterdamu pozno jeseni 1998. Da bi se čim bolj oddaljila od reprezentacije človeške podobe, pri čemer bi ohranila posebno kvaliteto osvojenega gibanja ..., je trup Postove naložila neposredno na spodnjo polovico telesa plesalca stapa.

V animaciji vidimo zaporedje abstraktnih podob, ki so animirane s človeškim gibanjem. Ko izvemo, da je bila narejena s tehnologijo motion capture, je mogoče v bežičnih oblikah identificirati naključni in prepoznavni ritem nog plesalca stapa. Kdor ne bi bil obveščen o tem, bi verjetno gledal film zgolj kot "animacijo". Drugi umetniki, kot skupina Riverbed, raziskujejo koreografijo, motion capture in animacijo s prepoznavnejšimi človeškimi oblikami.

Kratka definicija animacije je "podariti gibanje stvari" in koreografijo bi lahko definirali kot "kompozicijo gibajočih se teles v kartezijskem času in prostoru". Pred iznajdbo možnosti animiranja z digitalnimi tehnologijami za motion capture so morali klasični umetniki animacije, da bi karseda natančno narisali gibanje junakov v risankah, vedno natančno preštudirati človeško gibanje. Animatorski mojster Virgil Ross, ki je umrl maja 1996, je v svojem poklicu veljal za legendo. V svoji 60-letni karieri je



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prejel množico nagrad, mnoge so mu podelili za njegovo izredno sposobnost upodabljanja plesa. Naj Bugs Bunny pleše step na ulici ali cakewalk na vari-etejskem odru, Ross je znal ustvariti iluzijo človeškega gibanja.

Zdaj, ko iluzija izhaja neposredno od vira/plesalca in nam to omogoča zelo velik razpon novih možnosti, bomo v prihodnosti pričali nadaljevanju medsebojnega prekrivanja animacije in koreografije.

(Izognil sem se podajanju tehničnih podrobnosti o tehnologijah motion capture, saj je ta informacija z lahkoto dosegljiva v drugih virih, vključujoč nekatere spodaj navedene spletne strani).

Sklep: Iščejo se dramaturgi

Ob koncu članka, ki obravnava tako široko razpršene primere in opažanja v umetnosti digitalnega plesa, je težko priti do sklepa - jaz bi končal s temle umovanjem:

Dramaturgija plesne predstave, ki vključuje tehnologijo, je matematična dramaturgija. Zanaša se na jasno razumevanje nujnosti natančnih izračunov, ki bodo omogočili uresničitev umetniških idej. Zahteva poznavanje renesančne vede o perspektivi in restriktivnih zakonov oblikovanja, ki so zapuščina Bauhauša, ter naklonjenost do redukcionističnega mišljenja, ki ga zahtevajo od računalniškega programerja. Nekateri moji kolegi umetniki radi rečejo, da bomo nekaj dosegli, ko ples in tehnologija ne bosta več ples IN tehnologija, ampak preprosto »ples«. Ampak to se ne bi smelo zgoditi. Kot je bilo v tem stoletju že večkrat izrečeno, je prihodnost umetnikov, inženirjev in znanstvenikov ŠE VEDNO v prizadevanju, da premostijo, ne pa tudi izbrišejo prepade med posameznimi disciplinami. Tako bi v empirično, pozitivistično mišljenje vnesli ustvarjalnost in zmanjšali mističizem, ki ga umetniško podjetje še vedno romantizira.

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Scott delahuntra se je pričel

ukvarjati z umetnostjo kot plesalec

in koreograf. Od leta 1992 je kot

partner Writing Re-search

Associates(huizen-dds.nl/

-sdela/wra) organiziral vrsto sim-

pozijev in delavnic. V letih 1994 -

1998 je učil teorijo in kompozicijo

na The School of New Dance

Development v Amsterdamu; dela pa

tudi kot svetovalec na Laban Centre

London. To pomlad je gostujoči pro-

fesor na Oddelku za dramaturgijo,

Univerza v Aarhusu (Danska) in

koordinator Digital Theatre

Experimentarium.

SCOTT DELAHUNTA

COREOGRAFIE IN BIT E BYTE: MOTION CAPTURE,
ANIMAZIONE E SOFTWARE PER LA DANZA*

Per Motion Capture si intende un tipo di hardware e di software per computer che rende possibile la rappresentazione 3D di corpi in movimento. Una sessione di ripresa di motion capture si svolge collocando in posizioni strategiche sul corpo del danzatore o della persona di cui si vuole catturare il movimento, dei marcatori o sensori, che forniscono le informazioni al software. Le spese per l'utilizzo di questi sistemi, che comprendono sia il costo dell'attrezzatura che quello dell'equipe che la sappia far funzionare, sono enormi e la conseguenza principale è che gli studi in questo campo sono prevalentemente condotti da quei settori dell'industria, come quello medico, quello militare, quello dell'entertainment o della pubblicità, che dispongono del capitale necessario.

I costi esorbitanti, associati a un diffuso senso di sfiducia nei confronti della «tecnologia», hanno fatto sì che le produzioni artistiche interessanti nell'ambito della danza fossero, fino a poco tempo fa, limitate a poche esperienze condotte, con molto impegno, da una piccola parte dell'avanguardia artistica molto determinata, frutto della collaborazione tra danzatori e artisti digitali. Fra questi possiamo citare Paul Kaiser e Shelley Eshkar che lavoravano con Merce Cunningham e Bill T. Jones (Stati Uniti); Kirk Woolford con Susan Kozel (Inghilterra); Bruno Martelli con Ruth Gibson (Inghilterra), Yvonne Fontijn con Karin Post e Michael Schumacher (Olanda); Richard Lord con Christian Hogue (Inghilterra); Sally Jane Norman (Francia); Dorte Persson (Danimarca) ecc.

* Traduzione di Laura Lirussi.

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RENDERE VISIBILE L'INVISIBILE: PROGRESSO SCIENTIFICO NEL XIX SECOLO

Ripercorrendo la storia della motion capture, i maggiori e più significativi contributi sono da ricondurre al lavoro di Etienne-Jules Marey e Eadweard Muybridge. Verso la fine del XIX secolo, entrambi furono dei pionieri nell'ambito della registrazione e dell'analisi del movimento, e a entrambi va il merito di aver contribuito enormemente all'evoluzione delle tecniche fotografiche che hanno condotto all'invenzione del cinema. Tuttavia, come sottolinea Marta Braun nel suo libro su Etienne-Jules Marey, le enormi differenze tra lo studio fotografico sulla locomozione di Marey e quello di Muybridge non sono state pienamente valutate¹. Il libro di Braun è il primo a sottolineare la particolare importanza e l'impatto del lavoro di Marey, e pone le basi, in modo estremamente convincente, per un più completo riconoscimento dell'influenza di Marey, in particolare nel campo della fisiologia, scienza in pieno sviluppo nel corso del XIX secolo.

Etienne-Jules Marey iniziò gli studi di medicina a Parigi nel 1849, proprio nel periodo in cui la fisiologia iniziava a divenire una scienza a sé stante. Secondo Braun, una tra le molte ragioni che hanno dato nuovi impulsi a questo processo, andava identificata nella «assimilazione della fisica e della chimica come modelli esplicativi dei processi fisiologici»².

La teoria fisiologica di Marey concepiva e rappresentava il corpo come una «macchina animata», il cui movimento era soggetto alle leggi universali della fisica che potevano essere applicate a qualsiasi oggetto (animato e inanimato) capace di movimento. Inizialmente, verso la fine degli anni cinquanta del XIX secolo, l'obiettivo dei suoi studi era proprio dimostrare questa ipotesi, inventando una serie di strumenti che producevano dei grafici. Con tali apparecchiature era possibile monitorare movimenti che parevano invisibili all'occhio umano, rendendoli visibili attraverso delle tracce lasciate su un «cilindro annerito con del fumo». Marey fabbricò innumerevoli strumenti per la registrazione meccanica del movimento, inventando non soltanto dei meccanismi di tracciatura, ma creando anche marcatori e sensori e studiando quale fosse la maniera più appropriata di collocarli.

¹ M. Braun, *Picturing Time. The Work of Etienne-Jules Marey (1830-1904)*, Chicago, University of Chicago Press, 1994.

² *Ibid.*, p. 9.

Tra questi strumenti c'era anche un dispositivo costruito per registrare la traiettoria dell'ala di un uccello in volo libero, un congegno che registrava simultaneamente i movimenti dell'ala verso l'alto e il basso, in avanti e indietro (fig. 10): «Poteva trasmettere a distanza qualsiasi tipo di movimento e registrarlo su una superficie piana»³. Questi studi sul volo degli uccelli hanno avuto una notevole importanza per l'istituzione dell'aviazione in Europa e in America.

Verso la fine dell'Ottocento, Marey aveva iniziato a usare la macchina fotografica nei suoi studi scientifici sulla locomozione umana e animale, sostituendo lentamente tutti i suoi strumenti meccanici per la tracciatura di grafici. L'invenzione di nuovi dispositivi e congegni rimase, in ogni caso, una prerogativa essenziale del lavoro di Marey, il quale alla fine riuscì a sviluppare un tipo di apparecchiatura paragonabile a una sorta di cinepresa (uno strumento precursore della cinepresa commerciale per l'animazione di immagini) che gli permise di affinare ulteriormente le sue ricerche.

Durante il xx secolo gli artisti che si sono occupati di animazione hanno continuato a studiare le immagini del movimento tracciate da Marey e da Muybridge, per l'accuratezza dei dettagli e della decostruzione dei movimenti. Tuttavia, negli ultimi vent'anni, e in particolare negli ultimi dieci, le tecniche di animazione al computer si sono evolute a tal punto che hanno praticamente sostituito la capacità manuale di disegnare scene di animazione, in particolare quando si tratta di ricreare il movimento umano. Dall'inizio degli anni ottanta, il mondo dell'animazione ha impiegato dei sistemi di software capaci di simulare la locomozione umana e animale. Ed è proprio in questo tipo di software che possiamo riconoscere l'influenza di Etienne-Jules Marey. Con il suo lavoro scientifico Marey ha infatti contribuito alla scoperta delle leggi che governano i processi fisiologici, riformulandole ed esprimendole in formule matematiche. Alcune di queste espressioni matematiche sono tuttora utilizzate negli algoritmi che stanno alla base dei programmi dei software di animazione e di analisi del movimento.

Possiamo citare come esempio il *simm*, un programma che permette di creare e analizzare modelli grafici del sistema muscolare e osseo umano⁴. Il *simm* è stato ideato per essere utilizzato da ricercatori, nell'ambi-

³ Etienne-Jules Marey, citato in *Ibid.*, p. 35.

⁴ *simm* (Software for Interactive Musculoskeletal Modeling, software per la modellizzazione interattiva dell'apparato muscolare e scheletrico). www.musculographics.com.

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to della biomeccanica, da neuroscienziati, da kinesiologi, da biologi, da informatici, da ingegneri genetici e da animatori. Nell'architettura di questo complesso sistema «knowledge based» (basato sulla conoscenza⁵) ci sono equazioni matematiche derivate dalle leggi della fisica nella loro applicazione al movimento del corpo umano. Alcune di queste equazioni hanno origine dalle ricerche di fisiologi e scienziati del XIX secolo, come Marey⁶.

MOTION CAPTURE E SIMULAZIONE NEL XX SECOLO

Alcuni tra i primi animatori del XX secolo utilizzavano un dispositivo di motion capture chiamato rotoscopio, nel quale «il movimento fotografato veniva usato come sagoma dall'artista animatore che ricalcava i singoli fotogrammi del film per ottenere un'animazione di fotogrammi disegnati⁷. Un esempio spesso citato di utilizzazione di questo metodo è il film *Biancaneve*, prodotto dalla Disney nel 1937. Il rotoscopio veniva usato in ogni occasione in cui si rendesse necessaria una rappresentazione più umana di personaggio in opposizione a una versione stilisticamente più vicina a un fumetto.

All'inizio degli anni sessanta, per provare i decolli e gli atterraggi dei loro aerei, i progettisti della Boeing Airplane costruirono il primo ambiente per la simulazione grafica. Crearono anche il primo esempio di figura umana digitale per simulare i movimenti del pilota nella cabina. Tuttavia ci vollero altri venti anni prima che i laboratori di biomeccanica avessero a disposizione hardware abbastanza potenti con i quali costruire sistemi di software più sofisticati per simulare il movimento umano, sempre più presente nell'ambito della grafica informatica. Questi software sarebbero stati «knowledge based», dei software quindi che utilizzano alcune delle formule matematiche di leggi fisiche della natura studiate da Marey. Da questi sviluppi sono emersi due potenti strumenti software per la modellizzazione di movimento umano animato in un

⁵ Software che utilizza informazioni biomeccaniche su come il corpo umano si comporta nelle fasi di movimento.

⁶ Per una breve descrizione di un sistema knowledge based vedere l'articolo di W. Trager, disponibile in rete, intitolato *A Practical Approach to Motion Capture*. Acclaim's Optical Motion Capture, scritto per l'edizione 1994 di SIGGRAPH. old.cs.gsu.edu/materials/HyperGraph/animation/character_animation/motion_capture/motion_optical.htm.

⁷ *Ibid.*

ambiente di computer-grafica: la consuetudine di usare uno scheletro per controllare un personaggio 3D e la cinematica inversa, la quale

[...] costituisce una grande scoperta, in quanto fornisce un approccio mirato per l'animazione di un personaggio 3D. Permette, cioè, all'artista di controllare gli arti del personaggio come se fossero delle connessioni meccaniche, o catene cinematiche⁸.

All'inizio degli anni ottanta il MIT Architecture Machine Group e il New York Institute of Technology Computer Graphics Lab hanno condotto degli esperimenti sulla tracciatura ottica del corpo umano⁹. Ancora una volta le limitazioni dell'hardware di quei tempi hanno impedito determinati risultati (anche se gli ingegneri informatici sapevano che sarebbero stati possibili di lì a pochi anni). Verso la fine degli anni ottanta, la motion capture, così come noi la intendiamo oggi, iniziò ad apparire come un dispositivo sofisticato per la registrazione del movimento degli oggetti, di solito esseri umani o animali, che permetteva la riproduzione del movimento in uno spazio digitale, con l'ulteriore possibilità di fargli assumere una varietà di forme animate, umane e non. Una sorta di rotoscopio tridimensionale senza bisogno che mani umane svolgano l'arduo lavoro di disegnare il movimento.

Negli ultimi cinque o sei anni la rapida crescita delle tecnologie di motion capture è stata sfruttata ampiamente dall'industria commerciale dell'entertainment, tanto quanto era stata sfruttata, negli anni sessanta, dalla ricerca medica, scientifica e industriale. Oggi la motion capture è considerata un'alternativa possibile per la produzione di animazione informatica e le tendenze attuali di sviluppo optano per programmi di animazione economicamente più abbordabili, basati su sistemi di cattura con telecamere che utilizzeranno strumentazioni più sofisticate e software basati sulla visione del computer (software che possono simulare il modo in cui l'occhio vede la profondità e il movimento). Ritornerei più avanti su questo argomento con delle previsioni sul possibile utilizzo di questi sistemi, più economici e quindi più accessibili, nel mondo della danza.

⁸ Ibid.

⁹ D.J. Sturman, *A Brief History of Motion Capture for Computer Character Animation*, SIGGRAPH 94. old.cs.gsu.edu/materials/HyperGraph/animation/character_animation/motion_capture/history1.htm.

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TIPI DI MOTION CAPTURE PER DANZATORI

Per la ripresa di punti selezionati del corpo in movimento e per mettere poi queste informazioni a disposizione del software del computer, sono stati sviluppati numerosi sistemi. Si possono avere, per esempio, sistemi protesici, acustici, magnetici e ottici¹⁰. In questa sede tratterò esclusivamente il sistema magnetico e quello ottico nel contesto di alcuni progetti di motion capture che coinvolgono artisti del mondo della danza. Eviterò di addentrarmi troppo nei dettagli tecnici, visto che gran parte della documentazione al riguardo è accessibile via Internet. D'altronde, è difficile definire dei parametri di paragone per quanto riguarda i vari sistemi di motion capture, e ancora più difficile è stabilire quali siano i più adatti per la danza. Ogni produttore sosterrà che il suo sistema è il migliore, e in ogni caso valutare o interpretare le informazioni tecniche senza il supporto di specialisti è un'impresa ardua. Per chi fosse interessato a iniziare a sperimentare queste tecnologie è consigliabile mettersi in contatto con qualcuno degli artisti menzionati.

In breve, la cattura magnetica del movimento (*magnetic motion capture*) implica l'uso di un trasmettitore posto in posizione centrale che emette un forte campo magnetico, e un apparato di sensori attaccati alle varie parti del corpo del danzatore (fig. 11). Ognuno di questi sensori fornisce un flusso di dati che corrisponde alle diverse posizioni e ai diversi orientamenti 3D del sensore. Alcuni di questi sistemi magnetici hanno cavi che partono da ciascun sensore per fare quasi tutto il percorso fino al computer (per esempio Polhemus Flock of Birds). Altri sistemi sono senza cavi e usano radiotrasmettitori e ricevitori per inviare i dati al computer (tra questi Ascension MotionStar Wireless). Questi consentono una maggiore libertà di movimento nello spazio, ma rimane comunque il limite delle dimensioni del campo magnetico di cattura che può avere un diametro soltanto di qualche metro. La cattura magnetica del movimento fornisce una grande quantità ininterrotta di dati di movimento, e offre la possibilità di lavorare in tempo reale, nel contesto di una performance. In altre parole è possibile vedere «in diretta» l'animazione condotta dal danzatore che indossa i sensori (per un progetto di questo tipo, si rimanda a *Figment* di Susan Kozel, descritto più avanti).

Il sistema ottico di motion capture funziona con delle sfere o marca-

¹⁰ Cfr. Trager, *A Practical Approach*, cit.

tori che riflettono il movimento in modo direzionale, posizionate in punti strategici sul corpo del danzatore. Questi sistemi richiedono l'uso di almeno tre telecamere e spesso anche di più. I sistemi ottici offrono al danzatore il massimo della libertà di movimento perché non necessitano di alcun cablaggio. Tuttavia, presentano l'inconveniente dell'«occlusione», che interviene quando un sensore riflettente viene perso oppure rimane nascosto alla telecamera. Ciò provoca un'interruzione nel flusso dei dati al quale il software sopperisce usando algoritmi di tracciatura che possono interpolare le sezioni mancanti del movimento. Questi algoritmi sono estremamente complessi e sono basati sulla conoscenza di come lo scheletro umano si comporta – conoscenza derivata sempre dalla fisiologia.

Al contrario dei sistemi magnetici, a causa dell'«occlusione», i sistemi ottici tendono a non fornire le stesse possibilità di utilizzare la motion capture in tempo reale, ma questa lacuna verrà probabilmente colmata con il progresso dell'informatica. I sistemi ottici sono generalmente considerati molto accurati nella cattura e nella rappresentazione del movimento umano attraverso un ampio uso di sensori riflettenti. Questa è una delle ragioni per cui Paul Kaiser e Shelley Eshkar di Riverbed li hanno adoperati nel loro progetto di motion capture con Merce Cunningham e Bill T. Jones.

Prima di iniziare a considerare alcuni progetti specifici di danza e motion capture, vorrei citare brevemente alcuni sistemi di software e hardware che vengono usualmente impiegati. Ascension e Polhemus producono sistemi magnetici con cavi e senza cavi. Vicon e Qualisys costruiscono e vendono sistemi ottici. Tre delle industrie leader nel settore del software per l'animazione progettato specificamente per lavorare con la motion capture sono Maya, Softimage e 3-D Studio Max. Questi nomi compariranno ancora e i siti internet di queste e altre società saranno riportati in appendice a questo saggio.

WORKSHOP E LABORATORI

Il mondo della danza ha difficoltà nel trovare accesso alle strutture sia umane che tecniche necessarie per esplorare le possibilità di alcune delle tecnologie emergenti. La motion capture, che è una delle tecnologie più interessanti per la danza, non fa eccezione, poiché è molto costosa e richiede specialisti del software utilizzato. Per questo motivo il contesto della sperimentazione con le tecnologie ha bisogno, di solito, di es-

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sere organizzato formalmente e di trovare i finanziamenti necessari. Desidero citare alcuni eventi organizzati sotto forma di workshop per dare agli artisti del mondo della danza una possibilità di accesso alla motion capture. Da questi progetti si è sviluppata una larga base di esperti e di conoscenze del potenziale di queste tecnologie ma anche l'intenzione di esplorare ulteriormente le sue possibilità.

Digital Dancing è stato un workshop, della durata di alcune settimane, organizzato a Londra ogni autunno dal 1994 al 1998, da Terry Braun del gruppo Illuminations¹¹. Per qualche anno, Braun è stato in grado di rendere possibile l'accesso alle tecnologie di motion capture, esplorate durante il workshop da Ruth Gibson e Bruno Martelli (una collaborazione tra un coreografo e un artista multimediale), da Richard Lord (coreografo) e Susan Kozel (coreografa e ricercatrice).

Nel settembre 1996, il Theater Lantaren-Venster di Rotterdam ha organizzato Cyberstudio in collaborazione con Motek, una società commerciale di motion capture di Amsterdam¹². Questo workshop ha fatto incontrare artisti del mondo della danza e del mondo dell'animazione digitale e ha permesso loro di esplorare le possibilità offerte dalle tecnologie di motion capture. Motek ha fornito sia l'attrezzatura che il personale specializzato.

Real Gestures/Virtual Environments è stato un laboratorio di due settimane organizzato da Sally Jane Norman nell'agosto 1998, strutturato in due fasi, la prima presso l'International Institute of Puppetry di Charleville-Mézières, Francia, e la seconda presso il Zentrum für Kunst und Medientechnologie (zkm) di Karlsruhe, Germania¹³. Questo progetto è stato ideato per investigare le interrelazioni fra burattini tradizionali e animazione digitale, utilizzando i sistemi di motion capture.

Il Digital Theatre Experimentarium, un progetto al quale ho partecipato anch'io, si è tenuto presso l'Università di Aarhus, in Danimarca, nei mesi di febbraio-maggio 1999¹⁴. Sono stati organizzati numerosi seminari e workshop per esplorare il potenziale teatrale della motion capture, dell'animazione attraverso il computer e delle tecnologie di proiezione. Gli attori e artisti digitali Yvonne Fontijn, Susan Kozel, Paul Kaiser e Shelley Eshkar sono stati consultati e invitati a contribuire al semi-

¹¹ Terry Braun, Illuminations/Braunarts: www.braunarts.com. Digital Dancing: www.braunarts.com/digidancing.

¹² Future Moves/Cyberstudio: www.ipr.nl/~future-moves. Motek: www.motek.nl.

¹³ Il Centro per l'arte e tecnologie dei media, Karlsruhe: www.zkm.de.

¹⁴ Digital Theatre Experimentarium: www.daimi.au.dk/~sdela/dte.

nario. Un sistema di tipo Ascension Motion Star senza cavi con sette sensori, prestato dalla ex Denmark Lego Wizard Group, è stato utilizzato con un software di animazione, Maya.

Gli obiettivi del progetto Experimentarium erano sperimentare cosa catturare e come (per esempio, parti del corpo, diversi tipi di movimento, bambini ecc.); usare i dati della cattura e sperimentare programmi di animazione con rappresentazioni umane e non umane; analizzare le interazioni di performance dal vivo e proiezioni di movimento catturato – sia in tempo reale che in postproduzione (materiale preregistrato); usare i dati di motion capture per lavorare al di fuori dell'ambito dei programmi di animazione per guidare altri effetti (per esempio il suono); riflettere sui concetti di movimento, tempo e spazio – reali e basati sul software.

Durante il mese di maggio, due progetti sono stati portati a termine e presentati pubblicamente. Uno di questi era uno spettacolo di danza che cercava di integrare su un unico palco interpreti dal vivo e animazioni elaborate in postproduzione di movimento catturato. Un mese è più che sufficiente per la sperimentazione di questi procedimenti possibili per raggiungere obiettivi come questo.

Il primo passo del progetto è stato compiuto dal coreografo: creare il materiale, delle sequenze di movimenti che potessero essere catturate. Sono stati condotti degli esperimenti per scoprire cosa avrebbe funzionato meglio con il sistema magnetico e Maya. Sulla base di quanto è stato scoperto, sono stati realizzati vari minuti di coreografia e poi catturati. Dato che c'erano a disposizione soltanto sette sensori, tutto il materiale è stato catturato due volte, la prima con i sensori localizzati sulla parte alta del torso del danzatore (testa, spalle, gomiti, polsi), la seconda con i sensori piazzati nella parte bassa del corpo (tre scendendo lungo la spina dorsale, le ginocchia, le caviglie). I due gruppi di dati sono stati poi assemblati, uno sopra all'altro, usando lo «hierarchical skeleton system» di Maya e la cinematica inversa (entrambi questi elementi di software knowledge based sono illustrati alla fig. 12).

Dopo che i dati del movimento catturato sono stati assemblati e ripuliti con Maya, abbiamo iniziato la ricerca di una forma appropriata (a volte chiamata *pelle* o *geometria*). Gli esperimenti andavano da forme estremamente astratte a forme più umane. Alla fine abbiamo scelto una forma che dava soltanto una minima indicazione di dove fossero la testa, le mani e i piedi. È interessante notare che una buona parte di questo processo è stata svolta via Internet. L'animatore poteva spedire dei suggerimenti via e-mail al coreografo. Ci sono diversi livelli nella

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parte iniziale del processo di animazione, quando i dati del movimento catturato vengono combinati con lo *hierarchical skeleton system*, in cui la mole di dati è ancora relativamente piccola e può essere facilmente spedita via e-mail.

Il disegno scenografico dello spazio è stato sviluppato con l'assistenza dell'artista italiano Luca Ruzza, esperto di proiezioni. È stato concepito un progetto che usava le proiezioni sia frontali che da dietro per dare all'animazione una qualità tridimensionale. Usando due pezzi di Altoglass di 3,5 x 4 metri sul retro per la retroproiezione e un grande pezzo unico di Trevira – un materiale a rete trasparente che cattura la proiezione –, per la proiezione frontale, siamo stati in grado di creare un corridoio di tre metri tra le due aree di proiezione, dove i danzatori potevano lavorare (fig. 13). Le proiezioni dell'animazione erano sincronizzate così che l'azione su uno schermo avesse le conseguenze coreografate sull'altro.

Molte scoperte sono state fatte durante la parte finale di Digital Theatre Experimentarium, specialmente per quanto riguarda la differenza nella scala temporale tra le procedure di animazione e di produzione delle performance dal vivo. Questa differenza implicava una conseguenza: non era possibile vedere l'animazione definitivamente renderizzata prima dell'ultimo giorno, quindi era praticamente impossibile integrarla con del materiale dal vivo. Inoltre, sarebbe stato meglio coinvolgere animatori e coreografi insieme sul posto per più tempo. Gli artisti che si occupano di animazione al computer sono abituati a lavorare a distanza a progetti commerciali di animazione, ma in questo caso le richieste astratte del coreografo erano impossibili da trasmettere attraverso gli storyboard standard o altri mezzi. Alla fine soltanto un paio di minuti del materiale originale catturato è stato utilizzato, ma ripetutamente e con prospettive diverse, quindi non soltanto di lato, davanti e dietro, ma anche da prospettive impossibili, da sopra e da sotto (uno dei vantaggi del «fare coreografie» in spazi digitali).

PROGETTI ARTISTICI

Workshop e laboratori sono contesti importanti per scoprire e imparare, ma raramente producono dei lavori realmente artistici. Per due motivi: di solito non durano un tempo sufficiente e spesso fanno collaborare per la prima volta artisti della danza e del digitale. I progetti di cui parlerò ora rientrano invece nella categoria di «progetti artistici»,

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perché coinvolgono collaborazioni già in corso e tempi di lavoro più lunghi. Ognuno di essi ha anche raggiunto, secondo la mia opinione, un importante risultato come «opera d'arte», e non soltanto come «ricerca». In ogni caso, preferisco non riferire nei dettagli le implicazioni estetiche di ogni opera, particolare che potrebbe creare disappunto nei lettori che affrontano questo tipo di discorso, limitandomi a focalizzare l'attenzione su alcuni aspetti pratici del lavoro e delle relazioni che sono di particolare interesse per la ricerca attraverso i diversi sistemi di produzione di conoscenza.

CINESTETICA DEL SOFTWARE: LA CONVERGENZA TRA COREOGRAFIA E ROBOTICA

Due dei lavori recenti più interessanti sono stati creati da Riverbed, la società di arti digitali di Paul Kaiser e Shelley Eshkar¹³. Il loro progetto con Merce Cunningham, intitolato *Hand Drawn Spaces*, è stato presentato per la prima volta, sotto forma di videoinstallazione di quattro minuti, alla mostra internazionale di grafica SIGGRAPH, nel luglio 1998. *Ghostcatching*, con movimenti catturati da Bill T. Jones, è stato presentato per la prima volta come videoinstallazione di otto minuti e mezzo, alla Cooper Union a New York nel gennaio 1999. Entrambi i lavori hanno contribuito a dare un nuovo livello di visibilità ai progetti di danza e tecnologia in generale.

Per *Hand Drawn Spaces*, Cunningham ha coreografato e catturato 71 piccole sequenze. L'animazione mappata su questi dati aveva l'aspetto di un disegno a mano libera, da cui il nome del progetto (fig. 14). La selezione e il montaggio delle sequenze catturate sono stati eseguiti con l'aiuto di un nuovo software per l'animazione, sviluppato specificamente per il progetto, che si chiama Motion Flow editor. Nel progetto con Bill T. Jones, la sfida era in parte anche quella di «testare» il potenziale della tecnologia di motion capture riprendendo le sfumature personali del movimento di un danzatore così particolare e unico.

Dato che anche Paul Kaiser darà il suo contributo a questo volume, mi limiterò ad accennare a questi due progetti, come anticipazione, lasciando a lui il compito di descriverli nei dettagli. Il sito internet di

¹³ Riverbed: www.riverbed.com.

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Riverbed è, in ogni caso, una ricca fonte di informazioni sul loro lavoro.

Hanno collaborato con Riverbed, per la rifinitura del software di animazione per i progetti con Merce Cunningham e Bill T. Jones, gli artisti e innovatori dell'animazione al computer Michael Girard e Susan Amkraut. In un'intervista con Paul Kaiser, hanno discusso l'evoluzione di alcuni dei loro lavori di animazione decisamente rivoluzionari. Negli anni ottanta, Girard fu uno dei primi a introdurre la dinamica gravitazionale nei processi di animazione al computer. Fino a quel momento, si lavorava sviluppando soluzioni di software che avrebbero «imitato ciò che gli animatori tradizionali fanno – utilizzare, cioè, dei fotogrammi chiave e interpolarli con quello che succede tra l'uno e l'altro»¹⁶. Girard è stato uno dei primi a comprendere che i software a base fisica (o «knowledge based») potrebbero imitare meglio le nozioni sul movimento e sulla fisiologia umana che l'animatore umano, quando disegnava le scene intermedie tra i fotogrammi, aveva sempre saputo intuitivamente.

Girard e Amkraut hanno finito con l'occuparsi sempre meno dell'aspetto delle loro animazioni e sempre più del loro funzionamento, in termini di resa del movimento. Tra i vari campi da loro esplorati, per trovare degli algoritmi a base fisica che potessero essere usati nell'animazione al computer, una particolare importanza è rivestita dalla robotica. Gli ingegneri che si occupano di robotica sono più interessati alla locomozione autonoma dei robot che al loro aspetto.

Abbiamo avuto la fortuna che la Ohio State University stesse elaborando uno dei primi programmi per macchine che camminavano e correvano nella campagna. Le sperimentazioni di Marc Raibert sulle macchine che corrono erano piuttosto sorprendenti. Alcuni degli algoritmi impiegati per far camminare e correre i robot potevano essere applicati anche nell'animazione al computer, in particolare la nozione cruciale di cinematica inversa¹⁷ (fig. 15).

I ritocchi che Michael Girard e Susan Amkraut hanno apportato al progetto di danza di Riverbed erano focalizzati sullo sviluppo di Motion Flow Network. Il Motion Flow Network era un programma innovativo che permetteva di connettere una sequenza di danza catturata con un'altra. Il software usava, tra gli altri, degli algoritmi con cambio di andatura

¹⁶ Michael Girard in un'intervista con Paul Kaiser, disponibile in rete nel sito: www.riverbed.com/ (cercare «Conversations» e «Unreal Pictures»).

¹⁷ *Ibid.*

(*gait shifting*), su base fisica (provenienti dalla robotica), che permettevano una facile interpolazione tra due sequenze. Qui appaiono di nuovo le equazioni matematiche, alcune delle quali rappresentano l'origine delle innovazioni e delle scoperte della fine del secolo scorso, che vengono usate per fornire soluzioni ai problemi posti dal software dei computer contemporanei. In questo caso, si tratta di una convergenza poetica: una conoscenza del movimento umano che deriva dalle ricerche di un secolo fa, usate nel software di un computer ideato per muovere robot del xx secolo che partecipa, infine, alla coreografia di un progetto di danza digitale.

CAMBIO DI TEMPO: DANZARE CON IL TUO IN-BETWEEN

Susan Kozel e Kirk Woolford formano la compagnia MESH Performance Partnerships. Kozel, danzatrice, coreografa e ricercatrice, ha esplorato nel suo lavoro per molti anni le sovrapposizioni di danza e tecnologia. Woolford è un artista visivo e programmatore, che ha collaborato in passato a progetti di danza e tecnologia. Il loro recente lavoro, *Figments*, impiega le tecnologie di motion capture e l'animazione al computer in una maniera unica. *Figments* è una performance dal vivo di un danzatore che indossa numerosi sensori di motion capture (una combinazione di sistemi magnetici e ultrasonici). La posizione e l'orientamento di questi sensori viene riprodotta in tempo reale su uno schermo, animando una figura stilizzata molto semplice. Sullo schermo viene proiettata anche una sequenza preregistrata che usa gli stessi punti di immissione dati e la stessa figura stilizzata. Tra queste due figure c'è un terzo corpo/figura creato dal software del computer, che Kozel chiama il «corpo virtuale», e che, in sostanza, è una modulazione tra il movimento in tempo reale e la sequenza preregistrata (fig. 16). Secondo le parole di Kozel, la danzatrice, questo «corpo virtuale», generato computazionalmente come qualcosa di «intermedio» (*in between*) tra lei stessa nel passato e lei stessa nel presente, a tratti assumeva le caratteristiche di un altro essere senziente¹⁸.

¹⁸ S. Kozel, K. Woolford, *Utterance 5: Mesh Performance Partnerships*, «Performance Research» iv, 2, estate 1999, p. 61.

APPLICAZIONI

DATA DRIVEN: MOVIMENTO UMANO IN FORME NON UMANE

Yvonne Fontijn e la coreografa olandese Karin Post collaborano a progetti di motion capture e di animazione ormai da alcuni anni. Fontijn lavora come artista di animazione per Motek (la società commerciale già citata sopra, che lavora con la motion capture ad Amsterdam). Questo le consente un accesso incondizionato a tutte le tecnologie necessarie per i suoi progetti e le dà l'opportunità di sperimentare ed esplorare per un periodo di tempo sufficientemente lungo. Fontijn utilizza sia i sistemi di motion capture ottici che quelli magnetici e i programmi Softimage di computer grafica. Circa due anni e mezzo fa, Fontijn e Post hanno organizzato una sessione di motion capture in cui il movimento del torso e delle braccia era catturato da una danzatrice (Karin Post) e il movimento del bacino e delle gambe da un danzatore di tip tap.

I dati rimasero nella memoria del computer molti mesi prima che Fontijn decidesse di usarli per creare un'installazione con un film di animazione intitolato *Upper/Lower* per la mostra *Traces of Science in Art* presso Het Trippenhuis ad Amsterdam nella tarda primavera del 1998. Per allontanarsi il più possibile dalla rappresentazione della figura umana, ma mantenendo la qualità speciale del movimento della motion capture, Fontijn ha sovrapposto la parte superiore del torso di Karin Post direttamente sopra la metà inferiore del danzatore di tip tap. Quello che appare in questa animazione ipnotica è una serie di forme astratte animate con movimenti umani. Una volta informati del fatto che si tratta di movimento catturato, è possibile identificare nei mutamenti delle forme, in modo occasionale ma riconoscibile, il ritmo dei piedi del danzatore di tip tap. Se invece si è all'oscuro del processo con cui le immagini sono state costruite, si percepisce il video come un'animazione con un movimento altamente organico, la cui origine è difficile da determinare.

AFFERRARE IL TEMPO: DALL'EFFIMERO ALLA FORMA SOLIDA

In Danimarca la coreografa e danzatrice Dorte Persson, dopo avere ascoltato per caso alla radio un'intervista a una struttura commerciale che si occupava di motion capture a Copenhagen¹⁹, ha deciso di contat-

¹⁹ Mocap Copenhagen: www.mocap.dk.

tarla e di proporre uno scambio: dati di motion capture (lei stessa mentre balla), che avrebbero potuto usare in lavori di animazione, in cambio di assistenza tecnica per i suoi progetti. Usando un sistema di cattura magnetica con quattordici sensori, Persson ha improvvisato e catturato varie sezioni di movimento. Lavorando soltanto con le traiettorie del movimento di ogni sensore, ha selezionato una sequenza di due minuti e mezzo di movimento del sensore del suo piede sinistro e una sequenza di dieci secondi dal sensore della mano destra²⁰. Sempre lavorando soltanto con le traiettorie del movimento, ha ottenuto una rappresentazione dei percorsi effettuati dai sensori nelle tre dimensioni create con un software di animazione (3-D Studio Max). L'intenzione era di fondere queste traiettorie in una scultura tridimensionale di tubi di alluminio solido (1,2 cm di diametro; fig. 17).

Originariamente, si sperava che delle macchine (come quelle usate per costruire mobili) collegate con un computer potessero fondere l'alluminio in una forma 3D, sfruttando direttamente i dati digitali. Tuttavia, questi macchinari non erano abbastanza flessibili per conformarsi alla complessità dei percorsi del movimento catturato da Persson. Alla fine, è stato necessario stampare delle cianografiche di varie visioni della scultura da diversi punti di vista e portarle da un artigiano gioielliere che avesse sia gli strumenti sia la competenza adeguata per realizzare la scultura a mano. La sezione di movimento di due minuti e mezzo ha richiesto approssimativamente ottanta metri di tubi di alluminio.

Il titolo dell'opera di Persson è *Moments of Invisibility*, titolo che coglie con precisione l'essenza del pezzo. È stata esposta nel contesto dell'*Art Crash Festival* di Aarhus, Danimarca, nel maggio 1999, e da allora è conservata al Modern Art Museum di Brandts Klædefabrik, Danimarca. Un concetto semplice, che mostra elegantemente alcune delle potenzialità delle tecnologie di motion capture per il mondo della danza. Rendendo solide sia le qualità effimere della danza che dell'immaginario digitale, *Moments of Invisibility* cattura il tempo e traspone una forma articolata in quattro dimensioni in un fenomeno visuale di tre dimensioni. Per questo aspetto, il lavoro è simile alla produzione di Etienne-Jules Marey, il quale, per capire il movimento, spazializza il tempo con i suoi strumenti grafici e le sue telecamere.

²⁰ Per vedere un esempio di dieci secondi di traiettoria della mano destra, consultare il sito web di Dorte Persson: www.koreograf.dk.

APPLICAZIONI

IL FUTURO DELLA MOTION CAPTURE

I workshop/laboratori e i progetti artistici di cui ho parlato non rappresentano che l'inizio. Alcune delle organizzazioni che si occupano di documentare e salvaguardare la danza (come la National Initiative to Preserve American Dance) stanno già prendendo in considerazione la possibilità di usare la motion capture. Si stanno stabilendo dei collegamenti fra strumenti software per la coreografia, come Lifeforms, e motion capture che permetteranno una maggiore manipolazione ed elaborazione dei dati raccolti con la motion capture. Progetti di ricerca sulla creatività artificiale, come *Coppelia* della Surrey University in Inghilterra, stanno sviluppando software che possono generare danza da repertori di materiali di motion capture²¹. Con la semplicità di trasmissione via Internet, dati di cattura in fase grezza possono essere spediti via e-mail ovunque nel mondo. Questo potrebbe essere un vantaggio per la diffusione e l'insegnamento della danza e della coreografia, una volta risolto il problema dei diritti d'autore.

In futuro, quando ci saranno sistemi di motion capture più semplici ed economici, basati sull'utilizzo della telecamera, e quando i prezzi di hardware e software saranno diminuiti, vedremo danzatori usare le tecnologie di motion capture per osservare il loro stesso materiale in 3D, come parte integrante del processo creativo in studio. Probabilmente questi sistemi utilizzeranno forme di software di progettazione che vanno sotto il nome di computer vision, a volte chiamati anche «image understanding». Come già detto, si tratta di un tipo particolare di software che può simulare il modo in cui l'occhio umano percepisce la profondità e il movimento. Come alcuni aspetti della modellizzazione del movimento, è anch'esso «knowledge based», in quanto possiede delle conoscenze di fisiologia della percezione sotto forma di algoritmi²². Questi sistemi non renderanno più necessario l'utilizzo di cavi ingombranti per i sistemi magnetici e a ultrasuoni, e perfino dei marcatori rotondi che riflettono il movimento degli attuali sistemi ottici. Sarà inoltre possibile catturare il movimento di più persone contemporaneamente.

²¹ *Coppelia*: www.cc.surrey.ac.uk/EE/vss1/groups/human/coppelia.html.

²² Per descrizioni di «computer vision» cfr. le informazioni fornite in rete dai vari dipartimenti di scienze computazionali nei siti web delle diverse università, tra cui: www.cs.umass.edu/autogen/cmposcidescf99.html o www.cc.gatech.edu/classes/cs7322_97_spring/info.html. Per consultare un sito commerciale che fornisce un interessante sistema basato sull'utilizzo di una telecamera: [simi/Reality Motion Systems all'indirizzo www.simi.com/en](http://www.simi.com/en).

COREOGRAFIE IN BIT E BYTE

Queste forme di cattura più efficaci e più economiche non sostituiranno certamente il video perché la fedeltà delle immagini bidimensionali sarà, ancora per molti anni, di una qualità nettamente superiore. Anche se sono stati sviluppati tre sistemi di motion capture che possono tracciare il movimento delle dita e delle espressioni facciali, rimarranno comunque fuori dalla portata della maggior parte dei danzatori ancora per lungo tempo. Quello che vedremo in studio sarà una combinazione di entrambe le fonti di informazione usate per osservare il proprio materiale di danza da ogni punto di vista possibile e per riprodurlo e fondere sequenze di movimento insieme a software, come il già citato Motion Flow Network. Questi sistemi dovrebbero essere a disposizione degli artisti nel giro di una decina d'anni. Come tutte le nuove tecnologie di produzione di immagini, questa nuova maniera di guardare materiale di movimento durante il processo di produzione influenzerà l'arte di fare danza.

POSTSCRITTO

Non sono il primo a suggerire che video e computer un giorno saranno utilizzati insieme negli studi di danza. Merce Cunningham, sempre all'avanguardia quando si tratta di esplorare nuove possibilità tecnologiche nel processo di creazione della danza, ha fatto le seguenti osservazioni verso la fine degli anni sessanta:

Mi sembra chiaro che la tecnologia elettronica ci ha dato un nuovo modo di vedere. Delle sequenze di danza possono essere fatte al computer, immagini possono essere estratte da esse, quindi perché non immaginare un sistema di notazione della danza immediatamente visibile? So che ci sono state delle ricerche in questa direzione, e con ogni probabilità attualmente ce ne sono ancora di più. Una situazione che mi sembra immediatamente accessibile al danzatore si presenterebbe all'incirca in questo modo: due schermi, video o altro, sincronizzati temporalmente e delle stesse dimensioni. Uno mostrerebbe una sequenza di danza così come viene rappresentata, assolo, gruppi, costumi e tutto quanto vi sia di essenziale. Di fianco, sul secondo schermo, immagini stilizzate che lavorano in profondità²³.

Amsterdam, novembre 1999

²³ M. Cunningham, *Changes. Notes on Choreography*, New York, Frances Starr Something Else Press, 1968. Il sito internet di Merce Cunningham è www.merce.org.

APPLICAZIONI

APPENDICE

Sistemi di motion capture

Ascension: www.ascension-tech.com
Polhemus: www.polhemus.com/home.htm
Vicon: www.vicon.com
Qualiysis: www.qualisys.com

Software di animazione

Maya: www.aliaswavefront.com/pages/home/index.html
Softimage: www.softimage.com
3-D Studio Max: www.softimage.com
Kayadera's FilmBox: www.kaydara.com

Studi commerciali di motion capture

Motek: www.motek.org
Mocap Copenhagen: www.mocap.dk

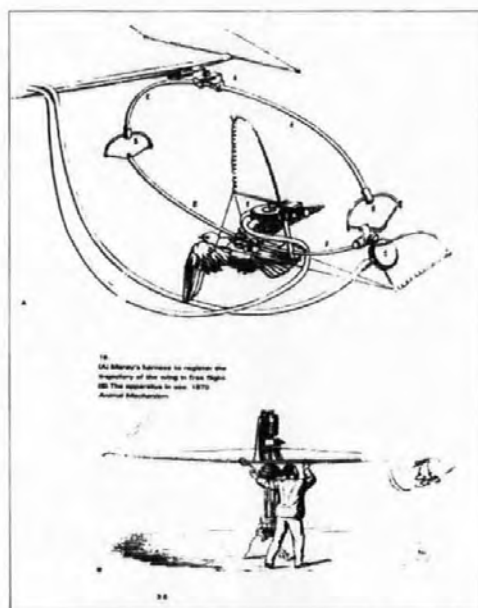
Siti internet degli artisti

Riverbed: www.riverbed.com
Dorte Persson: www.koreograf.dk

Siti internet per la ricerca sulla motion capture

www.visgraf.impa.br/Projects/mcapture/index.html

10. Illustrazione dell'apparato di un uccello di Marey.
11. Sistema magnetico usato da danzatori.
12. Lo scheletro di base con l'illustrazione di quattordici punti controllabili da sensori.
13. Un semplice progetto per lo spazio.
14. *Hand Drawn Spaces*, coreografia di Merce Cunningham.



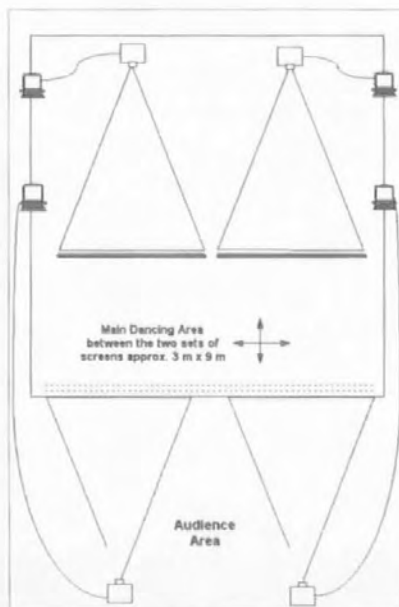
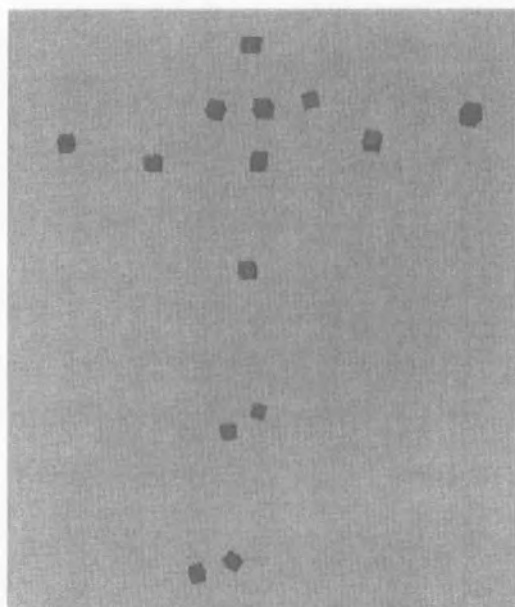
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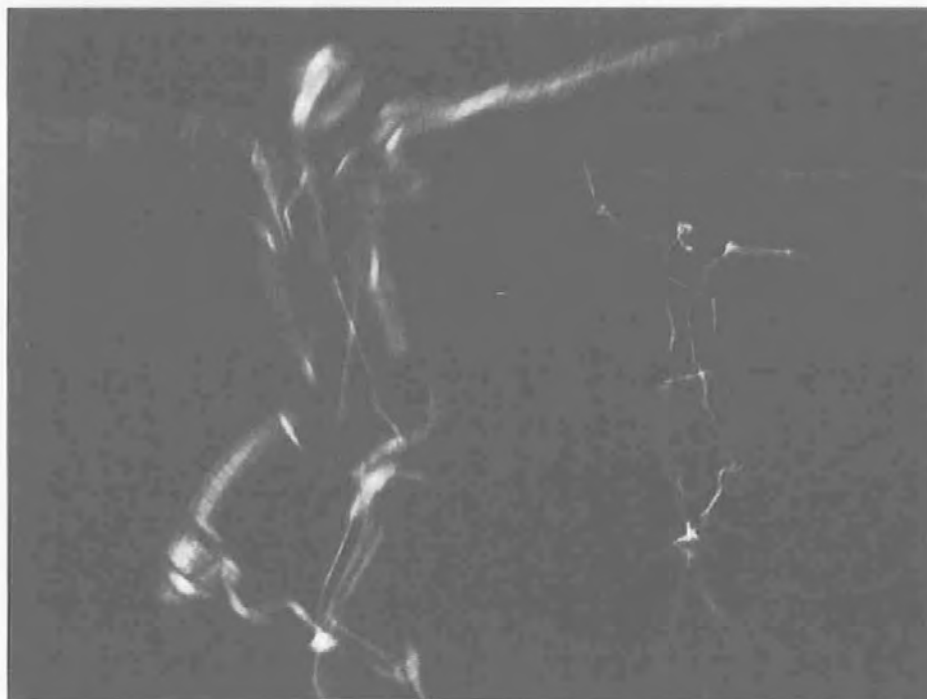
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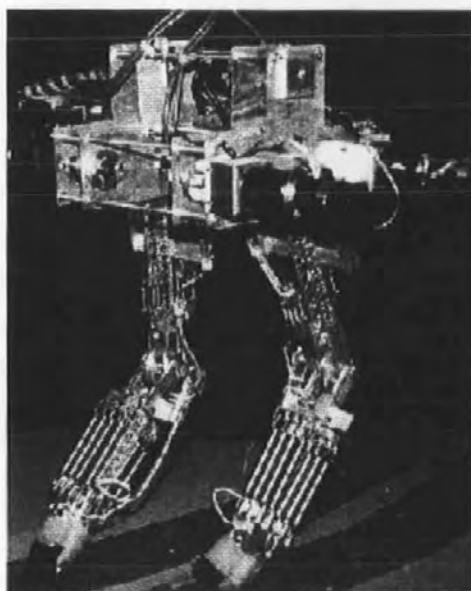
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[13.]



[14.]





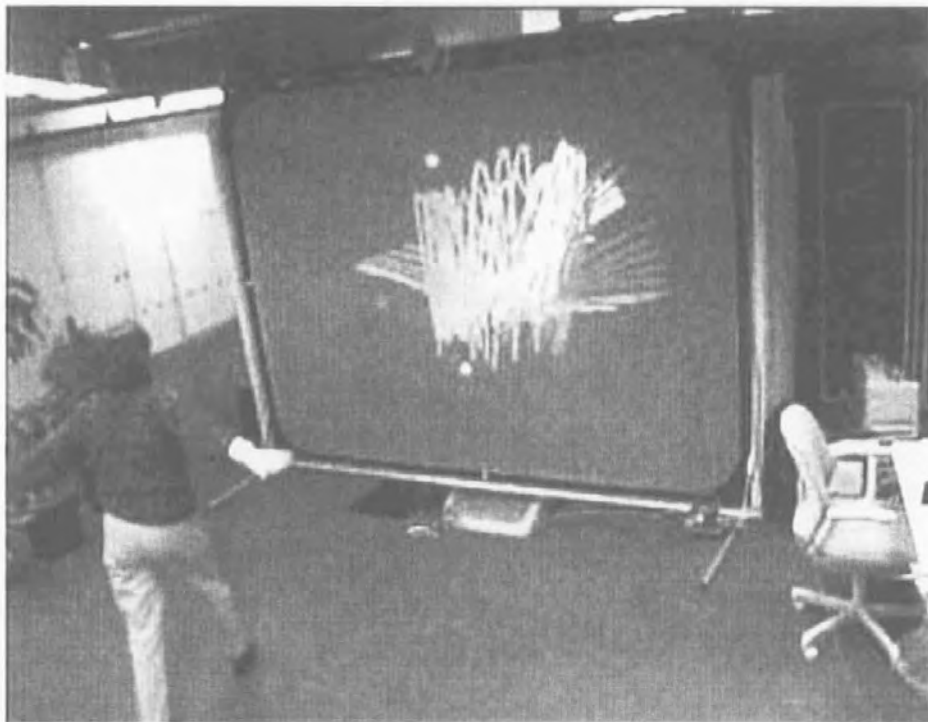
[15.]

[16.]



[17.]

[18.]



[19.]

15. Immagine del robot «spring turkey», del MIT LegLab sotto la direzione di Raibert.

16. Immagine della scultura dell'artista.

17. La performer Susan Kozel in *Figments*, compagnia MESH Performance Partnerships.

18. Palco iVE (Interactive Virtual Environment).

19. La performer Jennifer DePalo in *DanceSpace*.

ESPACES DISTINCTS: QUELQUES DIMENSIONS COGNITIVES DU MOUVEMENT

Scott deLahunta

LA CARTOGRAPHIE COGNITIVE

Les sciences cognitives sont définies d'habitude comme l'étude interdisciplinaire de l'esprit ou de l'intelligence, à laquelle contribuent plusieurs domaines tels que l'informatique, la philosophie, la neurobiologie, la linguistique et la psychologie. L'un des objectifs des sciences cognitives a été d'étudier, de comprendre et de décrire l'organisation et le fonctionnement du cerveau, pendant biologique de l'esprit, en particulier au niveau du traitement de l'information.

Au début du XIX^e siècle, les phrénologues avaient élaboré les premières théories établissant un rapport entre certaines parties du cerveau et les bases de la cognition⁽¹⁾. Développées sans référence à aucune méthode scientifique, ces premières théories furent dénoncées en tant que fondamentalement inexactes; cependant, les phrénologues ont conservé une place dans l'histoire de la cartographie du cerveau/esprit. Leur approche trouve actuellement un prolongement dans les techniques d'imagerie non invasives du cerveau, utilisées depuis l'invention du PET-scan (Positron Emission Topography) au milieu des années 1970⁽²⁾. Alors que ces techniques en sont encore à leurs débuts et soulèvent encore davantage de questions qu'elles n'en résolvent, les images qu'elles fournissent, aux couleurs et formes représentant des domaines d'activité locale, prolongent les activités des phrénologues dans la mise au point de théories à propos de l'espace du cerveau/esprit.

Certains scientifiques cognitifs ne se réfèrent pas directement à des images du cerveau, mais établissent la cartographie des systèmes dynamiques de la réflexion à travers des références à des espaces et processus abstraits qui ne sont pas moins réels. On attribue le concept d' "espaces mentaux" à Gilles Fauconnier, professeur au département des Sciences cognitives de l'Université de Californie à San Diego. Dans un article resté inédit, résumé des travaux qu'il a entrepris dès le milieu des années 1970, Fauconnier écrit: "Les espaces mentaux sont des assemblages tout à fait partiels, construits à mesure que nous pensons et parlons, pour permettre la compréhension et l'action au niveau local." Ces espaces sont des territoires dynamiques qui s'amplifient au fil de nos conversations. Leur création est guidée par le langage dans un processus où "la réflexion et le discours (...) sont liés entre eux par différents types de représentation"⁽³⁾.

Une autre scientifique, Margaret Boden, professeur de Sciences cognitives à la Sussex University, emploie le concept d' "espaces conceptuels" dans son ouvrage *The Creative Mind*, dont la première édition date de 1990. Elle définit les cartes de l'esprit comme des "systèmes génératifs guidant la pensée et l'action" et elle affirme que ces espaces peuvent se modifier eux-mêmes. Elle cite plusieurs exemples de nouveaux espaces conceptuels qui sont créés par des artistes ou des scientifiques en faisant appel à différents processus d'exploration⁽⁴⁾.

Ce bref aperçu de différentes approches du concept de cartographie cognitive nous fournit un cadre de référence pour le reste de cet article, où nous décrivons certains aspects de l'initiative *Choreography and Cognition*. Elle associait l'exploration des espaces mentaux et la création d'espaces physiques.

CHORÉGRAPHIE ET COGNITION*: INTRODUCTION

Il y a quelques années, en collaboration avec Wayne McGregor, le directeur artistique de Random Dance à Londres, j'ai commencé à explorer de nouvelles façons de comprendre le processus chorégraphique, permettant de susciter de nouvelles approches de la création chorégraphique. Intrigués tous deux par l'intelligence artificielle et les réseaux neuronaux, nous avons été amenés au fil de nos discussions à lancer un projet d'exploration de notions pouvant être fournies par le domaine d'études interdisciplinaire que sont les sciences cognitives.

Dans un premier temps, en novembre 2002, nous avons organisé une série de réunions avec des chercheurs en sciences cognitives anglais et français; l'accueil favorable nous a encouragés à lancer d'autres échanges. Nous avons pu obtenir des subventions d'un nouveau programme favorisant la recherche associant l'art et la science; cela nous a permis de poursuivre la collaboration avec cinq de nos interlocuteurs des réunions de novembre 2002: Alan Wing, SyMoN (groupe de recherche en neurobiologie sensorielle et motrice) de l'Université de Birmingham; Rosaleen McCarthy du département de psychologie expérimentale de l'Université de Cambridge; Anthony Marcel et Phil Barnard de l'unité de sciences cognitives et cérébrales MRC et Alan Blackwell du laboratoire d'informatique Crucible de l'Université de Cambridge. Par ailleurs, nous avons invité James Leach, un anthropologue effectuant des recherches sur le terrain consacrées aux collaborations entre artistes et scientifiques, à se joindre à nous⁽⁵⁾.

Cette seconde phase de *Choreography and Cognition* devait durer six mois, de septembre 2003 à fin février 2004⁽⁶⁾. Elle a débuté par une session de deux jours réunissant tous les participants, lors d'un week-end en novembre 2003, dans la salle de répétition à Londres. Notre emploi du temps était le suivant: le matin, nous observions McGregor et ses danseurs effectuer de nouveaux exercices d'élaboration du matériel gestuel, et nous en discussions l'après-midi. Pendant ces discussions, les scientifiques étaient invités à réagir à ce qu'ils avaient vu, à partir de leur domaine de recherche personnel. Nous avions réservé deux semaines en décembre et une semaine fin janvier 2004, pour permettre aux scientifiques de retourner en salle de répétition pour approfondir les questions qui se seraient imposées à eux entre-temps. Notre objectif lors du premier week-end était de déterminer quelques points de départ pour les recherches qui auraient lieu pendant ces périodes ultérieures.

LA RÉOLUTION DES PROBLÈMES

Au cours des matinées des sessions communes, McGregor générait un matériel gestuel en donnant à ses danseurs des tâches à accomplir ou des problèmes à résoudre par le biais de brèves séquences dansées. Il inventait ces exercices et les communiquait le plus souvent aux danseurs en se servant de descriptions et d'instructions verbales et d'images (graphiques ou picturales) existantes, ou de dessins exécutés pendant les sessions du matin. Ayant reçu ces instructions, les danseurs

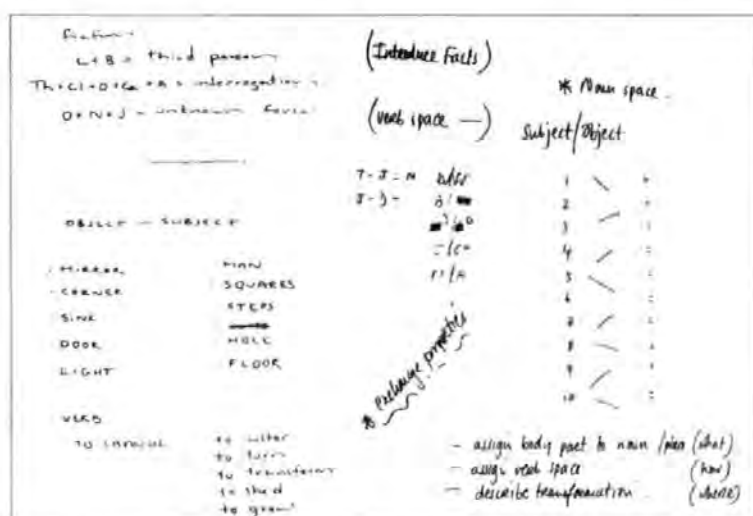
disposaient d'un certain laps de temps pour créer leur séquence. Ces courtes séquences dansées, le plus souvent créées individuellement, ne duraient pas plus qu'une minute ou deux; elles étaient conservées, abandonnées ou divisées en éléments plus petits pouvant être recombinaés plus tard. La réserve de matériel gestuel ainsi constituée formait – pour utiliser la terminologie de McGregor – le “vocabulaire” d'une nouvelle chorégraphie.

En invitant les scientifiques à observer les sessions du matin, puis d'y réagir dans l'optique de leur domaine de recherches spécifique, nous voulions dégager l'espace nécessaire pour que des différences dans la perception, la terminologie et la conception puissent se manifester, non seulement entre les “scientifiques” d'une part et les “artistes” de l'autre, mais aussi – et c'était tout aussi important – entre les cinq chercheurs. Même si ceux-ci se présentent tous comme des psychologues, ils ont chacun une autre approche individuelle de la psychologie. Dans certains cas, les différences sont même fondamentales: Alan Blackwell, qui a une formation d'ingénieur et de psychologue expérimental, étudie les dimensions cognitives des systèmes de conception et de notation. Les recherches d'Alan Wing concernent les fonctions sensorielles et motrices intervenant dans la maîtrise réactive et anticipative des mouvements. Phil Barnard a mis au point une théorie qu'il a intitulée “Interacting Cognitive Subsystems” (sous-systèmes cognitifs en interaction), destinée à appréhender “comment les différentes composantes du mécanisme mental sont configurées (...) et comment fonctionnent dans l'ensemble leurs interactions en temps réel.” Roz McCarthy fait appel à des méthodes neuropsychologiques et neuropsychiatriques pour étudier les représentations cognitives dans la mémoire, l'espace et la perception. Anthony Marcel travaille sur l'intégration de différents aspects de la conscience⁽⁷⁾.

La résolution des problèmes en matinée cédait la place à un autre type de résolution de problèmes au cours de l'après-midi. La différence entre les deux approches était notamment celle entre un espace où le mouvement est valorisé en tant que moyen d'échange et un autre où prévaut la conversation. Le langage était essentiel dans les deux cas, puisqu'il servait à décrire, donner des instructions, expliquer, raconter et interroger. Mais alors que les problèmes posés lors des sessions du matin suscitaient ce que l'on pourrait appeler des “solutions chorégraphiques” exprimées dans l'espace physique, le problème principal à résoudre l'après-midi était de comprendre ce qui se passait dans l'esprit du chorégraphe et des danseurs. Il fallait pour cela explorer leur espace mental; ce processus allait être raffiné et développé plus avant dans le courant du projet.

L'ESPRIT DU DANSEUR

L'après-midi, chacun des chercheurs disposait de vingt minutes pour décrire ce qu'il avait observé lors des sessions d'élaboration des mouvements, pour interroger ses collègues, McGregor et les danseurs et leur demander des explications⁽⁸⁾. Alan Blackwell, s'inspirant de ses recherches sur les systèmes de conception et de notation, a commencé par commenter l'utilisation par McGregor de dessins et diagrammes pendant les sessions de création de mouvements. Blackwell a fait une distinction entre "l'intérieur" de la tête du chorégraphe et l'espace de la page employé comme auxiliaire du processus de création. Le fait que l'espace de la page pourrait servir à décharger l'espace dans la tête a mené aux concepts de "représentation intérieure" et de "représentation extérieure". Le mot "représentation" est très souvent utilisé dans le domaine des sciences cognitives, entre autres pour décrire l'interaction entre les espaces mental et extérieur. La nature de ces représentations intérieures est toutefois sujette à discussion; on avance, par exemple, que la présence d'une image visuelle dans l'esprit exprime "un dualisme subtil", la conviction que l'esprit est distinct du monde matériel⁽⁹⁾. C'est une question que nous n'avons pas abordée directement dans nos discussions, même si elle était présente à notre esprit pendant toute la durée du projet.



Carnets de note, à gauche de Laila Diallo, à droite de Wayne McGregor, utilisés par Alan Blackwell.

Après la proposition initiale de Blackwell, les questions et les réponses du groupe ont aidé à clarifier les perspectives adoptées par McGregor, ses intentions au niveau du processus de création et de la collaboration avec les danseurs, et les rapports entre cette approche et les recherches des autres membres du groupe. Phil Barnard disait qu'il ne savait pas comment saisir les méthodes d'élaboration de mouvements qu'il avait vues à l'œuvre au cours de la matinée, car à ses yeux, il était clair que la partie du processus de conception qui se déroulait dans l'espace mental du chorégraphe et des danseurs était plus importante que ce qui pouvait être représenté par des notations sur une page. Phil Barnard et Anthony Marcel allaient finalement collaborer pour mettre au point des méthodes de recherche permettant d'obtenir systématiquement davantage d'informations de la part des danseurs et de McGregor sur les dimensions cognitives du processus de création (voir l'expérience d'analyse grammaticale ci-dessous).

Chacun des chercheurs a ensuite présenté ses réactions à la session du matin. Si les processus à l'œuvre dans la tête de McGregor et des danseurs ont très souvent été mentionnés, ils n'étaient pas les seuls sujets de ces discussions. Marcel et Barnard ont tous deux posé des questions relatives au contexte culturel plus vaste dans lequel les œuvres chorégraphiques de McGregor pourraient être vues et interprétées. Marcel a lancé le concept de "immersion et conscience non observationnelle de ses propres actions" pour décrire l'expérience qu'ont les danseurs de leur prestation. Alan Wing, dont les études de la fonction et maîtrise sensorielles et motrices font appel à des systèmes de pointage continu des mouvements, hautement spécialisés, a affirmé qu'il faisait la distinction entre le mouvement que l'on perçoit ou dont on est conscient (le percept) et le mouvement en termes de forces, positions et timing (la physique). Ses réactions à la session du matin concernaient surtout les rapports entre la maîtrise consciente et inconsciente du mouvement et leurs conséquences pour la variabilité des processus de création. La réflexion de Wing à propos de ce qu'il avait vu le matin a incité Marcel à préciser que la physique à laquelle il faisait référence englobait les "aspects fondamentaux de l'esprit" que la psychologie ignore trop souvent.

(Introduces fails)

* Room space

(web space →)

7-12 in 2/55
8-10 in 5/55
10-12 in 1/55
12-14 in 1/55

Performance Practice
→



Kristen Hollands et Alan Wing. Photo: James Leach



Laila Diallo et Alan Wing durant la session de Sadler's Wells.
Photo: James Leach

Roz McCarthy a repris le concept de la représentation intérieure pour se demander quels types d'informations, déjà en possession des danseurs et de McGregor, contribuaient au processus d'élaboration du vocabulaire gestuel. Elle a demandé quelle était l'influence du résultat esthétique imaginé sur les exercices de résolution de problèmes imposés par McGregor; ce dernier lui a répondu qu'à ce stade précoce du travail, il préférerait s'en tenir à la tâche, tout simplement. Pour finir, cette interrogation allait inspirer à McCarthy plusieurs expériences servant à explorer l'espace mental des danseurs et ses représentations sous-jacentes.

La conversation s'est également prolongée l'après-midi du deuxième jour, après une nouvelle session d'observation pendant laquelle McGregor et ses danseurs ont fait appel à un autre ensemble d'exercices pour élaborer le matériel gestuel⁽¹⁰⁾. Comme nous l'avons mentionné plus haut, trois semaines en salle de répétition avaient été réservées pour retravailler avec les scientifiques; l'objectif final de cette session initiale commune consistait donc à définir des points de départ pour les recherches à effectuer lors des sessions ultérieures avec les psychologues. McGregor a lancé la dernière discussion de l'après-midi en pointant ce qui l'avait intéressé dans les observations et travaux des scientifiques. Il a notamment mentionné que la recherche en neurobiologie pourrait l'aider à imaginer des exercices d'élaboration des mouvements perturbant les schémas habituels de la perception et de la maîtrise du mouvement.

LES EXPÉRIENCES

À la fin de la dernière après-midi, nous avons distingué trois pistes de réflexion liées au processus de création de McGregor, et pouvant être explorées dans plusieurs optiques scientifiques, c'est-à-dire par les approches cognitive, neurologique, psychophysique et biomécanique.

Il s'agissait de:

- [1] la perturbation, ou l'introduction d'éléments perturbateurs et le dérèglement du mouvement dansé en tant que stratégie créatrice;
- [2] l'analyse grammaticale, ou la perception de la segmentation des séquences dansées;
- [3] la représentation, ou l'examen de processus de création chorégraphique faisant appel aux représentations extérieures (notations) et les comportements associés.



Léo Lerus et Rosaleen McCarthy au laboratoire de l'University of Birmingham. Photo: Scott deLahunta

Avant d'en arriver à la période prévue en salle de répétition en décembre et janvier, ces trois thèmes ont été repris et développés. Alan Blackwell a choisi le troisième thème de recherche, la représentation. Il a réuni les carnets de notes et partitions utilisés par McGregor et quatre des danseurs, et il s'est servi d'interviews et de méthodes analytiques dérivées de ses recherches sur les dimensions cognitives des systèmes de notation pour découvrir où le chorégraphe et les danseurs situaient les limites de ces outils de création. Le but était de découvrir comment McGregor pourrait optimiser l'emploi d'un système de notation dans le cadre de son processus de création.

Marcel et Barnard ont pris le deuxième thème, celui de l'analyse grammaticale, en partant de l'idée que les séquences de mouvement pouvaient être divisées en unités plus petites; lors du processus de création, cela permet de séparer les séquences et d'en recombinaer les éléments constitutifs. Mais quelles sont ces unités de mouvement et comment sont-elles sélectionnées ou perçues? Les unités perçues sont-elles différentes pour différents types d'observateurs, par exemple un danseur, un chorégraphe ou un spectateur? Les unités perçues sont-elles diffé-

rentes dans les séquences de mouvements élaborées à partir d'instructions différentes, par exemple des instructions très simples (il faut passer par certains points dans l'espace) ou plus complexes (verbales, liées aux émotions)? Pour obtenir des données expérimentales fiables fournissant une réponse à ces questions, les chercheurs ont invité McGregor à charger les danseurs d'effectuer deux types d'exercices pour créer des phrases chorégraphiques très courtes. Ces phrases ont été enregistrées en vidéo, et huit d'entre elles ont été sélectionnées pour être visionnées et divisées en unités par McGregor et les dix danseurs. Ils ont noté leur résultat personnel (nombre d'unités et longueur respective) sur des formulaires de collecte de données, qui ont été soumis ensuite à une première analyse. D'après ce que chacun des danseurs perçoit comme des unités distinctes, certains résultats initiaux fournissent des indications intéressantes sur la possibilité de comparer les perceptions par rapport à différents types d'instructions données pour l'élaboration du matériel gestuel, tout en livrant une image comparative pour l'ensemble de la compagnie. Alors qu'il était clair que l'expérience obligeait les participants à adopter un mode d'observation analytique, et ce par rapport à des séquences de mouvements d'une ampleur limitée, des questions intéressantes à propos de ce qui est perceptible et ne l'est pas sont ressorties de l'analyse des résultats. Ces notions pourraient contribuer au processus de création collectif.

Alan Wing et son assistante de recherche Kristen Hollands ont adopté comme point de départ un vaste ensemble de questions telles que: Dans quels "cadres de référence" les mouvements de la danse sont-ils maîtrisés? Les mouvements sont-ils orientés dans l'espace en fonction de caractéristiques de l'espace où se déroule la danse ou en fonction du méridien du corps? Quels sont les systèmes sensoriels essentiels pour décrire ces cadres de référence? Comment le dérèglement et la perturbation peuvent-ils aider à le déterminer? Afin d'étudier ces questions, quatre danseurs ont appris et interprété une séquence de mouvements consistant à passer par trois points de référence dans l'espace autour du corps, arbitrairement choisis. Leurs évolutions ont été enregistrées par un système optique de captation du mouvement qui enregistre à très haute résolution le minutage et la position de mouvements dans un espace tridimensionnel. Différents types de dérèglement ou de perturbation ont été introduits, par exemple l'exécution des mouvements en fermant les yeux, en bougeant différentes parties du corps à des vitesses différentes, en inversant le mouvement, en déplaçant les points de référence (reflet, rotation), etc. Les données réunies ont subi une analyse préliminaire. Celle-ci indique que certains avantages pourraient en être retirés, allant d'une meilleure compréhension scientifique de la manière dont le mouvement est préparé et exécuté à une

meilleure compréhension des manières possibles d'encourager la variabilité artistique du mouvement et d'étendre les vocabulaires gestuels.

Roz McCarthy s'est intéressée aux aspects de l'expérience cognitive individuelle pouvant être révélés en perturbant d'une manière réfléchie certains processus perceptifs choisis. Elle avançait que cette exploration de la "boîte à outils" cognitive du chorégraphe et du danseur pourrait conduire à une meilleure compréhension de la communication entre eux au cours du processus chorégraphique. Elle a posé les questions suivantes pour cadrer son approche: Comment le chorégraphe encourage-t-il la créativité du danseur en fonction de ce qu'il souhaite obtenir? Comment les danseurs comprennent-ils ce que dit le chorégraphe? La créativité est-elle favorisée ou gênée par des tensions dans la communication? S'appuyant sur sa connaissance des méthodes neuropsychologiques pour l'étude des représentations cognitives, elle a monté quelques expériences simples en situation de double tâche; les danseurs faisaient appel à des mouvements imaginés pour essayer de répondre à ces questions. Les expériences en condition de double tâche partent de l'idée que lorsqu'une personne accomplit deux actions à la fois, une perte d'efficacité générale se manifeste au niveau cognitif, et une perte spécifique si les outils nécessaires empiètent les uns sur les autres. Elle a demandé aux danseurs d'imaginer une brève séquence de mouvements qu'ils connaissaient déjà et l'a minutée sans intervenir, puis elle les a invités à imaginer la même phrase en exécutant toutes sortes d'autres tâches, par exemple des actions haptique/visuelle, verbale/spatiale, visuelle statique, etc. McCarthy a ainsi commencé à collecter des données qui pourraient être utiles à McGregor pour présenter autrement les exercices d'élaboration des mouvements à ses danseurs. Autrement dit, elles pourraient l'aider à savoir quels types d'instructions ou de stimuli il doit utiliser, dans quel ordre, etc.

CONCLUSION(S)

La majeure partie des informations ou données réunies par les cinq chercheurs sont toujours en cours d'analyse. L'observation et la conception d'expériences ne constituent qu'un aspect du processus scientifique; l'analyse et l'interprétation des résultats prend nettement plus de temps. Voilà peut-être la plus grande différence entre les modes et procédures de recherche du chorégraphe et ceux du chercheur en sciences cognitives. En juin 2004, McGregor présentera à Londres une nouvelle chorégraphie dont la création a été influencée par ces

échanges. En revanche, il faudra attendre plusieurs mois avant que les résultats finaux du projet d'Alan Wing, par exemple, soient disponibles. Entre-temps, la seconde étape du projet *Choreography and Cognition* s'est terminée; toutes les parties concernées s'accordent pour affirmer que les trois objectifs ont été atteints (voir référence n° 6). L'initiative a démontré qu'il est possible de découvrir et d'entretenir des rapports intéressants, à la fois d'un point de vue scientifique et artistique, entre des processus chorégraphiques et l'étude du mouvement et du cerveau/esprit⁽¹¹⁾. Des corrélations utiles et fructueuses ont été produites par le croisement des différents vocabulaires, perspectives et conceptions que nous avons partagés au cours de ce projet. Si de tels échanges pouvaient se poursuivre, ces rapports pourraient influencer très favorablement la création dans un grand nombre de domaines.

La danse et la création chorégraphique font appel à un ensemble unique de processus physiques et mentaux, à l'interaction de nombreux aspects de l'esprit, du cerveau et du corps, liés à la sensation, la perception, la cognition, les émotions et la maîtrise des mouvements⁽¹²⁾. La grande force des sciences cognitives est le fait qu'aucune discipline ou domaine ne peut à lui seul fournir une image complète de l'interaction de tous ces processus. Ce n'est que grâce aux recherches interdisciplinaires, effectuées dans un effort commun, que nous pouvons apprendre à connaître ces interactions et mieux comprendre notre manière de concevoir les choses. Cela nous amène à l'énigme fondamentale que doivent résoudre les sciences cognitives: comment arriver à une conception des espaces mentaux et physiques alors que nos descriptions de ces espaces sont un produit de ces espaces mêmes? Le projet *Choreography and Cognition* a apporté une réponse à nombre de questions, mais il n'a pas tenté de résoudre ce problème-là; nous avons cependant considéré l'esprit du danseur par rapport à la pratique chorégraphique d'une manière qui prend en compte les espaces physique, mental et conceptuel.

Au stade actuel, notre projet préfère les résultats qui restent ouverts et qui pourront éventuellement être amplifiés plus tard: il n'a pas tenté de construire une théorie de la cognition chorégraphique comme l'a essayé une initiative comparable en Australie⁽¹³⁾. L'esprit chorégraphique que nous avons pris en considération refuserait une telle explication à ce stade. Il serait peut-être plus exact de définir la chorégraphie comme une physique dotée de dimensions cognitives du type suggéré par le travail de Wing et Holland. Ou d'imaginer l'espace cognitif commun des danseurs comme le décrit l'expérience d'analyse grammaticale,

offrant un cadre comparatif à la perception collective. Imaginons ce qui pourrait se passer si les danseurs et le chorégraphe connaissaient mieux la “boîte à outils” cognitive dont disposent les autres, ou si l'utilisation d'un système de notation pouvait être améliorée par une meilleure prise de conscience des rapports entre les représentations intérieure et extérieure. Les espaces physique et mental sont toujours distincts et il n'y a pas de danger qu'ils s'entremêlent. Cependant, notre compréhension de ces espaces s'épanouit bien au-delà du dualisme. Cette initiative semble l'occasion idéale de faire travailler côte à côte des chorégraphes et des chercheurs en sciences cognitives.

Traduction: Martine Bom

(Merci à Susan Rethorst pour son assistance lors de la rédaction du texte)

Cet article a été publié en anglais sous le titre *Separate Spaces: some cognitive dimensions of movement in Species of Spaces* (a DIFFUSION eBook Series). London, Proboscis, 2004, <http://diffusion.org.uk/>.

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*ndlr: Cognition: Fonction complexe multiple regroupant l'ensemble des activités mentales (pensée, perception, action, volonté, mémorisation, rappel, apprentissage) impliquées dans la relation de l'être humain avec son environnement et qui lui permettent d'acquérir et de manipuler des connaissances (associations, rétroaction, traitement de l'information, résolution de problèmes, prise de décision etc.).

Références:

(toutes les adresses Internet étaient valables au 20 janvier 2006).

1. Gazzaniga, Michael S., Richard Ivry, George Mangun. *Cognitive Neuroscience: the Biology of the Mind*, 2e éd. New York, W. W. Norton & Co, 2002, pp. 2-3.
2. Raichle, Marcus E. *Brain Imaging*. In: *Conversations in the Cognitive Neurosciences*. Éd. M. S. Gazzaniga. Cambridge, MA, MIT Press, 1997, p. 16.
3. Fauconnier, Gilles. *Mental Spaces* (article en ligne résumant et reprenant des travaux antérieurs: 1985, 1997, 2002). pp. 1-2. <http://cogsci.ucsd.edu/~faucon/151/mental%20spaces.pdf>
4. Boden, Margaret. *The Creative Mind: Myths and Mechanisms*, 2e éd. London, Routledge, 2004, p. 59.

5. Le programme pilote "Arts and Science Research Fellowships" était subventionné conjointement par The Arts Council England et The Arts and Humanities Research Board.
6. Pour préparer la seconde phase, nous avons défini trois objectifs permettant de créer des circonstances propices à l'émergence de pistes de réflexion ou points de départ spécifiques: [1] un objectif commun: rechercher les rapports entre les processus chorégraphiques d'une part et l'étude du mouvement et du cerveau/esprit d'autre part, intéressants du point de vue scientifique et artistique; [2] un objectif artistique: intégrer la participation et la contribution des chercheurs au processus de création chorégraphique, tout en conservant les modes d'observation et d'interrogation propres à leurs domaines de recherche respectifs; [3] un objectif scientifique: commencer à formuler des questions et méthodes de recherche spécifiques découlant des domaines d'intérêt individuels, dans le contexte du processus de création chorégraphique.
7. Certains des chercheurs disposent de sites Web proposant une abondance de matériel sur leur domaine de recherches:
 Phil Barnard: www.mrc-cbu.cam.ac.uk/personal/phil.barnard/
 Alan Wing: www.bham.ac.uk/symon/people/alan.htm
 Alan Blackwell: www.cl.cam.ac.uk/users/afb21/
8. Les dix danseurs permanents de Random Dance – Claire Cunningham, Laila Diallo, Fred Gehrig, Khamlane Halsackda, Odette Hughes, Léo Lerus, Ngoc Anh Nguyen, Matthias Sperling, Hilary Stainsby et Amanda Weaver – ont tous participé à différents degrés au projet.
9. Berthoz, Alain. *The Brain's Sense of Movement*. Cambridge, MA, Harvard University Press, 2000, p. 21.
 & Clark, Andy. *Mindware: an Introduction to the Philosophy of Cognitive Science*. Oxford, Oxford University Press, 2001, p. 162.
10. Au cours de la première matinée, McGregor avait fait effectuer un exercice lié à des points dans l'espace autour du corps; le second jour, il avait donné des instructions d'un ordre plus émotionnel et narratif au niveau des connotations et des références.
11. Pour plus de détails concernant le travail de Wayne McGregor, consultez le site Web de Random Dance: www.randomdance.org. Des documents et analyses relatifs au projet seront présentés sur le site www.choreocog.net. Une nouvelle demande de subvention permettant de poursuivre le projet en réseau a été adressée à l'EPSRC (Engineering and Physical Sciences Research Council) au Royaume-Uni.
12. Cette phrase, rédigée par Alan Wing et Kristen Hollands, figure dans la demande de subvention adressée à l'EPSRC, mentionnée en note n° 11.
13. Stevens, K., S. McKechnie, S. Malloch, & A. Petocz. *Choreographic Cognition: Composing Time and Space*. Rapport de la 6e International Conference on Music Perception & Cognition, 2000. www.aus-dance.org.au/unspoken/research/cognition.html

L'APPAREIL DE LOCOMOTION: UNE ÉPISTÉMÉ TECHNOLOGIQUE

Scott deLahunta

Introduction

Frank Popper, dans son ouvrage historique *L'art à l'âge électronique*, situe à la fin du XIX^e siècle les débuts de l'influence directe de la technologie sur l'art, en une période où les effets de la Révolution Industrielle "se manifestent dans la vie quotidienne..."⁽¹⁾. Les années 1950 et 1960 sont également des années importantes dans l'histoire de la technologie et des arts de la scène car elles inaugurent un rapport très ouvert entre le public et les interprètes – dans les happenings par exemple –, ouvrant la voie à une forme d'art interactive⁽²⁾. Plus directement liée aux arts du mouvement, une autre phase historique commence dans les années 1960-1970 au moment où la "danse post-moderne" s'empare du Computer Art naissant, et que, vingt ans avant l'avènement de *Life Forms*, le chorégraphe Merce Cunningham commence à se servir de l'ordinateur comme outil de création⁽³⁾. D'évidence, ce sont là des moments qui eurent une influence considérable sur les pratiques contemporaines telles que la danse et les arts de la scène qui recouraient aux technologies naissantes. Mais si l'on se reporte à une période antérieure, on constate déjà à quel point certains développements technologiques et scientifiques ont modelé la perception du corps et du mouvement.

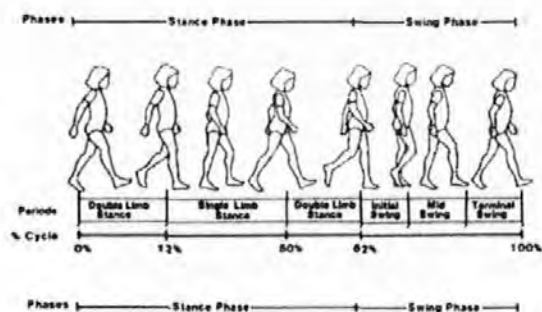
En d'autres termes: l'approche contemporaine du corps et du mouvement est technologique en ce sens qu'elle procède d'un savoir scientifique qui définit le corps comme un système, à la fois – ou tour à tour – organe, outil, récepteur

sensoriel, et esprit. C'est ainsi qu'il apparaît dans un certain nombre de textes clefs – connus des nombreux lecteurs de *Nouvelles de Danse* – comme *Sentir*, *Ressentir et Agir* de Bonnie Bainbridge Cohen et l'ouvrage de Lulu Sweigard *Human Movement Potential* qui inspirent nombre de pratiques de danse contemporaine et de projets pédagogiques. Tant B. B. Cohen que L. Sweigard, avec, respectivement, le Body-Mind Centering et l'Ideokinesis, ont développé des approches du travail du corps et de l'esprit qui mettent en avant des conceptions spécifiques d'observation et de conscience de soi. Toutes deux sont considérées parfois comme faisant partie des techniques d'entraînement en body-mind (corps-esprit) ou de thérapies connues comme pratiques somatiques ou comme éducation psychophysique⁽⁹⁾. L'on a tendance à attribuer à ces techniques des origines remontant à la pensée orientale par le fait qu'elles explorent les rapports entre le corps et l'esprit, mais elles sont tout autant influencées par une pensée du corps élaborée dans le contexte de la pensée philosophique et scientifique occidentale.

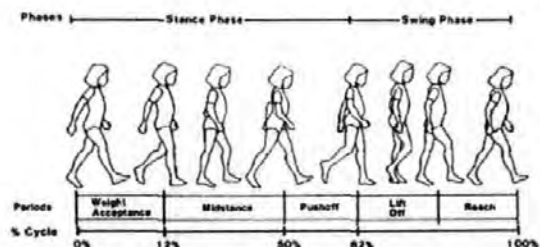
Ceci semble indiquer l'existence d'une épistémologie – une théorie de la connaissance – des pratiques du corps, qui serait à même de révéler comment le mouvement est perçu et compris et qui montrerait à quel point la technologie marquait déjà le corps et l'esprit dès avant le XX^e siècle, et par conséquent le rôle implicite qu'elle a tenu dans le développement de la danse contemporaine. La place nous manque pour développer ce point de vue ici, mais il nous est cependant possible d'ébaucher quelques aspects de cette vaste question. Dans cette épistémologie technologique du corps, la machine (en tant que mécanisme, appareil, outil) occupe une position centrale comme métaphore du fonctionnement du corps. Dans la suite de cet article, nous exposerons partiellement les implications de cette notion en nous centrant sur un moment crucial de l'histoire des sciences du mouvement qui devrait nous amener à examiner de plus près la nature des relations corps/machine.

Mécanique de la locomotion

Des textes d'Aristote sur la locomotion animale aux environs de 350 avant J. C. aux théories actuelles sur la locomotion chez l'homme, l'intérêt pour le sujet ne s'est jamais démenti. De l'Antiquité aux Lumières, cependant, une poignée seulement d'hommes de science et de philosophes a contribué de façon décisive à une théorie du mouvement. Ces contributions naissaient le plus souvent dans la foulée de découvertes dans d'autres domaines, mais les avancées de la



Divisions du cycle de la marche de l'enfant par le docteur David Sutherland
qui a fondé le laboratoire d'analyse du mouvement à l'hôpital des enfants de San Diego en 1974.
(<http://www.univie.ac.at/cga/history/modern.html>)

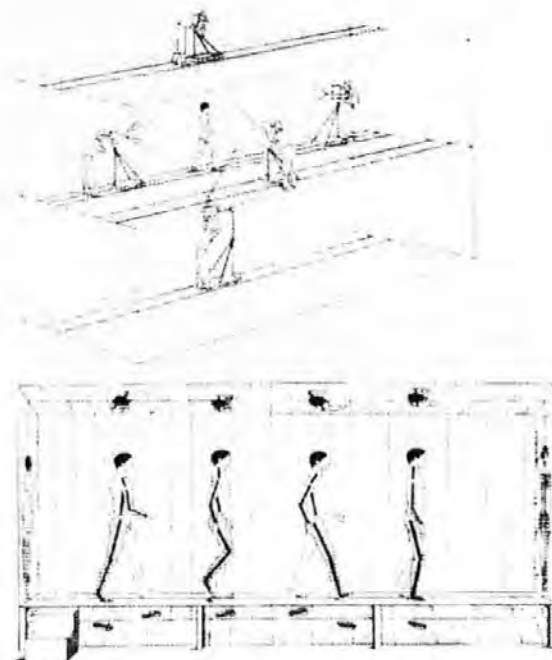


Divisions du cycle de la marche de l'enfant par le docteur David Winter
qui a fondé le premier laboratoire clinique sur l'étude de la marche au Canada en 1969.
(<http://www.univie.ac.at/cga/history/modern.html>)

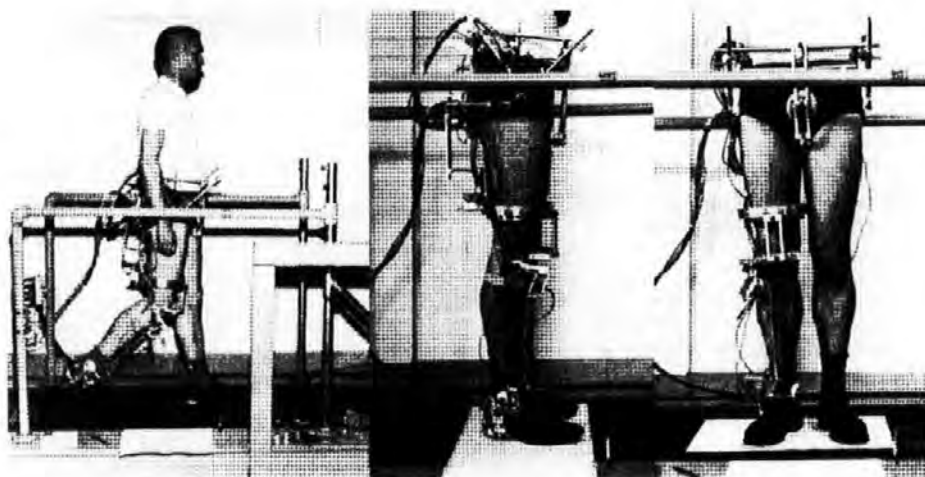
physique aux XVII^e et XVIII^e siècles ont accouché d'un socle théorique fondamental qui vaut aujourd'hui encore. Le tournant du XX^e siècle a vu un développement rapide des connaissances dans le domaine des sciences du mouvement en partie grâce à l'invention de nouveaux instruments de mesure et d'observation et, de nos jours, les applications de la biomécanique et de la kinésiologie, deux disciplines qui ont pour objet le mouvement, sont utilisées dans un grand nombre de domaines, du sport à la danse en passant par l'ergonomie, l'ingénierie biomédicale ou l'ergothérapie.

Mais c'est au XIX^e, en 1836, que les frères Weber – Wilhelm et Eduard –, publièrent leur traité *Mechanik der Menschlichen Gebwerkzeuge* (Étude sur les mécanismes de la locomotion chez l'homme), un ouvrage considéré comme la première "somme théorique sur la locomotion reposant sur l'expérimentation systématique"⁶⁹. Réédité en 1894, *Mechanik der Menschlichen Gebwerkzeuge* fut traduit en anglais en 1992, ce qui atteste de son importance historique. Mettant en œuvre des méthodes d'expérimentation rigoureuses servies par les techniques les plus récentes de l'époque, utilisant l'appareillage optique du département de physique de Göttingen et étudiant les cadavres de l'Institut d'Anatomie de Leipzig, les frères Weber posèrent les fondements de la recherche moderne sur le mouvement chez l'homme. Avec un certain nombre d'innovations méthodologiques et un équipement relativement rudimentaire, ils percèrent nombre de secrets de la locomotion. Même les techniques actuelles d'enregistrement tridimensionnel du mouvement n'ont pu produire une "somme de connaissances proportionnellement aussi importante de ce phénomène si complexe"⁷⁰.

Dans un commentaire de son ouvrage, Wilhelm Weber fait remarquer que les tentatives antérieures pour mesurer et analyser le mouvement humain ont été "pour la plupart infructueuses"⁷¹. Il cite le travail des iatromathématiciens, une école de physiciens italiens du XVII^e qui tenta d'appliquer les lois de la mécanique et des mathématiques au corps humain. Voici ce que Weber en dit: "Ils suscitérent l'espoir de comprendre de l'intérieur cette extraordinaire machinerie qu'est le corps humain selon l'idée que la compréhension du monde avait été dérivée des découvertes exceptionnelles de Galilée, Kepler et Newton"⁷². Leur échec ne signifiait pas pour autant que les mathématiques n'étaient d'aucune utilité dans l'étude du mouvement. Les frères Weber eux-mêmes, comme d'autres, y recoururent pour calculer les forces agissant lors de la marche et de la course⁷³. Ce qui manquait véritablement, c'était une approche nouvelle du mouvement et plus précisément une façon de "voir" ce qui ne pouvait être vu. Disposant des



Études de la locomotion de Charles Ducroquet aboutissant au livre *Walking and Limping: A study of Normal and Pathological Walking* (J. B. Lipincott Co., 1965). Plusieurs nouveaux outils sont décrits dans le livre, y compris la "cage de verre" et la "cage de verre simplifiée". (<http://www.univie.ac.at/cga/history/ww2.html>)



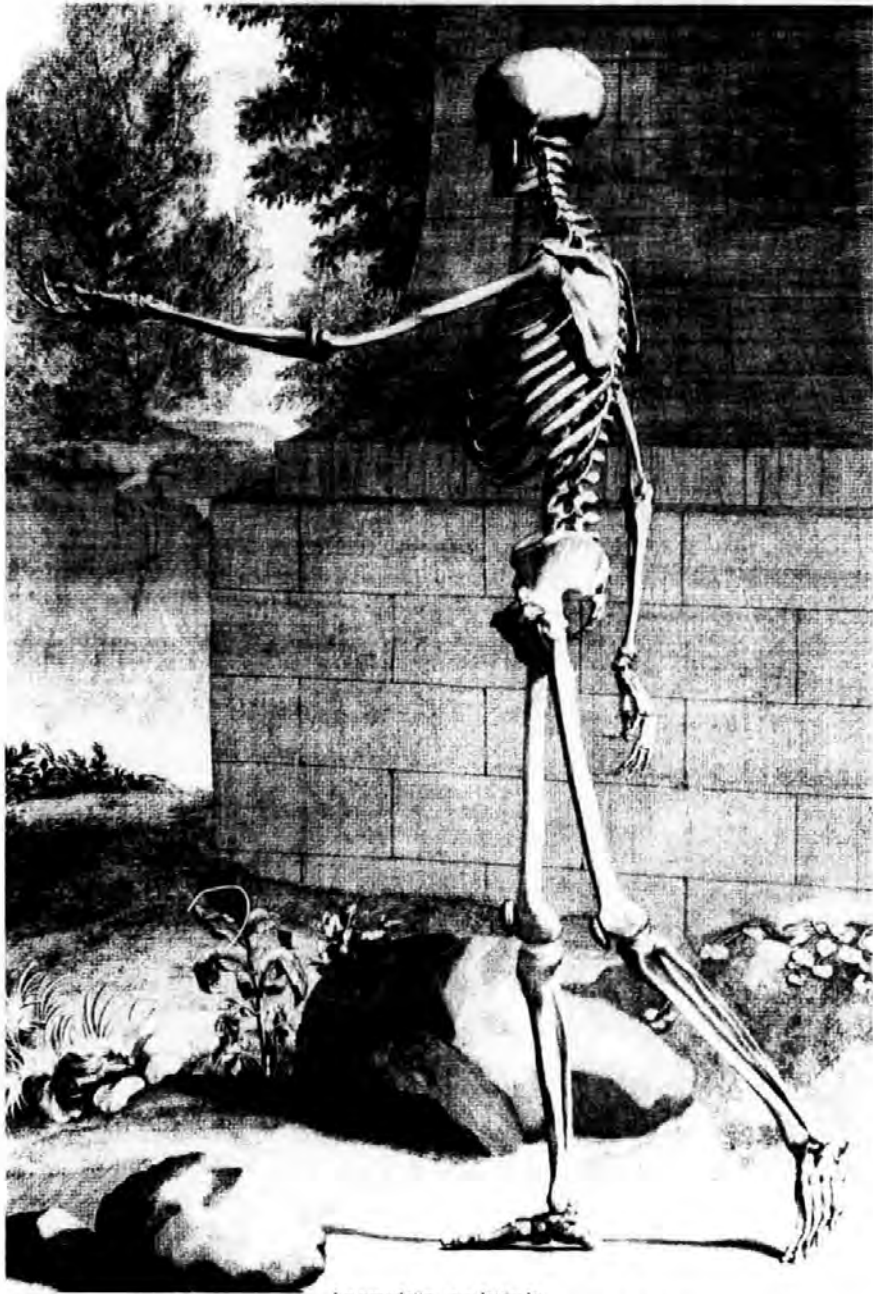
L'examen squelettique au goniomètre des mouvements de la jambe lors de la marche à des vitesses différentes. Extrait de la thèse de Larry W. Lamoreux: *Experimental Kinematics of Human Walking*, Université de Californie à Berkeley, 1970. (<http://www.univie.ac.at/cga/history/ww2.html>)

(4) Scott deLahunta

techniques qui se prêtaient à cela, les frères Weber réfutèrent systématiquement toutes les conclusions des recherches antérieures et contemporaines aux leurs, d'Aristote à P. N. Gerdy. Ce dernier avait publié une recherche sur la locomotion humaine en 1829 en s'appuyant sur un corpus de données recueillies par la simple observation et par là même impuissante à révéler les phénomènes mécaniques des mouvements les plus simples.

Les deux frères résument leur critique de l'observation simple de la façon suivante: "Il apparaît clairement que les méthodes utilisées à ce jour n'ont pas produit – et ne produiront jamais – une idée claire de ce type de mouvements. Le nombre et la diversité des mouvements du corps à l'œuvre simultanément lors de la marche ou de la course est trop important pour distinguer par la seule observation ce qui est essentiel de ce qui est secondaire (...). La seule façon d'y parvenir est de passer de l'observation à l'expérimentation. Plutôt que de se limiter à la simple observation globale d'individus marchant ou courant, il convient d'utiliser tous les moyens disponibles pour réduire ce phénomène complexe à ses composantes élémentaires et de les étudier ainsi en elles-mêmes et dans leurs rapports réciproques. Il faut étudier chacune des parties selon sa taille, sa forme, ses relations (...). Il est nécessaire, enfin, d'étudier la marche en fonction de mesures de temps, d'espace, de masses et de forces. Ces expériences doivent être renouvelées autant de fois que nécessaire de façon à disposer de toutes les mesures qui s'imposent, celles-ci ne pouvant toutes être prises en une seule fois. Il faut varier ces expériences afin de distinguer ce qui, dans ces mouvements, est constant de ce qui est variable, et pour cette dernière catégorie, cerner les lois qui régissent leur interdépendance"⁽¹⁾.

D'après les frères Weber, d'autres que les scientifiques souffraient eux aussi des limitations de l'observation simple. Les relations entre les différentes parties du corps sont trop changeantes pour "qu'elles s'impriment complètement dans l'instant sur les sens et dans la mémoire", si bien que les artistes qui représentent le corps humain manquent eux aussi de moyens pour "percevoir les faits véritables tels qu'ils surviennent réellement selon la Nature", comme ils le font remarquer dans leur ouvrage⁽²⁾. À la suite de cette remarque, ils exposent leur découverte essentielle qui eut d'ailleurs une conséquence directe pour les peintres et les dessinateurs du corps humain: l'inclinaison exacte du bassin par rapport à la colonne vertébrale. D'après les frères Weber, les anatomistes et les scientifiques qui s'étaient intéressés au mouvement n'avaient jamais auparavant mis en évidence les données essentielles de la locomotion chez l'homme, à



Le squelette, vue latérale.
Albinus On Anatomy. R. B. Hale, T. Coyle, Dover, New York.



Les mesures de l'inclinaison du bassin des frères Weber.
Mechanics of the Human Walking Apparatus. Berlin, Heidelberg, New York: Springer-Verlag, 1992.

savoir l'inclinaison considérable du bassin qui, fonctionnellement, soutient l'incurvation lombaire inférieure de la colonne. Ceci les amena à "re-dessiner" en la rectifiant une planche du célèbre anatomiste allemand Bernard Albinus, parue dans *Tabulae sceleti et musculorum corporis humani* en 1749. Les frères Weber déclarent que leur version de l'illustration d'Albinus, où le bassin est incliné vers l'avant selon un angle de 21 degrés, "est destinée à démontrer combien cette illustration, considérée de l'avis général comme étant une des meilleures, est erronée"⁽¹³⁾.

Albinus avait la réputation d'utiliser pour ses recherches un large éventail d'instruments de mesure, et de recouper inlassablement ses observations qu'il menait par ailleurs avec une attention méticuleuse au détail. Ses planches étaient

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par conséquent considérées comme “la nouvelle référence remplaçant les planches de Vésale qui avaient été durant plus de deux cents ans la référence en matière de planches anatomiques”⁽¹⁴⁾. Que les frères Weber s’autorisent à corriger ce qui était indiscuté démontre assez la confiance qu’ils avaient dans leurs recherches. Enhardis par leurs découvertes, les deux frères en vinrent à concevoir une application plutôt extraordinaire de celles-ci. Ils imaginent ainsi que leurs recherches permettront de concevoir dans le futur des “machines qui marchent” : elles “remplaceront les chameaux et autres animaux même dans des pays difficilement praticables par des véhicules [munis de roues]”. “S’il est démontré (...) que la marche et la course sont des mouvements mécaniques d’une nature telle qu’ils puissent être reproduits par l’application de calculs et sans l’intervention aucune de la volonté (...), il est alors imaginable de concevoir, par exemple, une machine à vapeur qui se déplacerait toute seule sur deux, quatre, six membres ou davantage”⁽¹⁵⁾.

Plus réaliste était l’idée que leurs recherches trouveraient “des applications pour le déplacement des troupes”⁽¹⁶⁾. Les recherches sur la locomotion bénéficiaient d’une attention toute particulière aux XVIII^e et XIX^e, car, selon l’historienne Mary Mosher Flesher, leurs applications pouvaient être décisives dans le succès d’une bataille. Flesher publia en 1997 un article sur les rapports entre les recherches des frères Weber et la “théorie de la marche” des théoriciens prussiens de l’art de la guerre⁽¹⁷⁾. Elle indique que les recherches des deux frères développent l’idée d’une “auto-régulation naturelle”, une conception à l’opposé de ce qui inspirait l’entraînement de précision auquel les militaires soumettaient, avec succès d’ailleurs, leur infanterie jusque-là. Flesher observe que l’orientation des recherches des deux frères semble suivre les changements de la stratégie militaire du XIX^e, qui progressivement, privilégie les escarmouches entre des groupes réduits d’hommes sur les déplacements massifs de bataillons sur le champ de bataille. Ainsi, bien qu’ils se soient déclarés dans la préface de leur ouvrage “peu au fait” de l’art de la guerre, il semble bien que les recherches des frères Weber sur la locomotion y aient contribué considérablement⁽¹⁸⁾.

Ainsi que nous l’avons signalé ailleurs, les frères Weber utilisaient pour leurs recherches différents instruments optiques ; ils employaient plus particulièrement un télescope muni d’un verre gradué permettant d’observer le déplacement d’une personne et d’enregistrer avec précision une série de mesures⁽¹⁹⁾. Ils procédèrent aussi à la vérification de leurs théories en utilisant, sans jamais le

ZOETROPE.



Le Zoetrope
(<http://www.thebigcamera.com.au/Zoetrope.html>)

L'appareil de locomotion, une épistémé technologique 45

mentionner explicitement, un zootrope, une invention récente qui permettait de donner l'illusion d'une image en mouvement à partir d'une série de dessins. Inventé en 1834 par William Horner, il est considéré comme une des nombreuses inventions d'animation du XIX^e qui menèrent, à la fin du siècle, à l'apparition du cinéma. "Il n'est pas sans intérêt, écrivent les frères Weber, d'éprouver les données absolues de temps et d'espace que la théorie établit en reconstituant et en dessinant les différentes positions successives des jambes à chaque instant de la marche ou d'une course régulière puis de coller la série d'illustrations résultante sur la surface interne d'un cylindre ou d'un tambour.(...) Le périmètre de la construction doit être égal à la représentation de deux enjambées. Le tambour est mis en rotation à une vitesse constante pendant la durée d'une double enjambée. On observe les silhouettes en mouvement à travers des fentes ménagées dans les parois du cylindre (...). Leurs mouvements sont étonnamment proches de ceux d'un homme qui marche ou qui court."⁽²⁰⁾

Quarante à cinquante ans plus tard, l'invention de techniques photographiques permettant de prendre en séquence rapide des images fixes donnera la possibilité aux sciences de la locomotion de progresser encore. Braune et Fischer à Leipzig, doivent en effet partiellement à la photographie d'avoir pu "corriger et compléter" les recherches des frères Weber. Ils communiquèrent les résultats de leurs travaux entre 1895 et 1904 dans une série d'articles parus dans les *Proceedings of the Royal Saxon Society of Sciences*⁽²¹⁾. Ils furent traduits, édités et rassemblés en un ouvrage en 1987 sous le titre *The Human Gait*⁽²²⁾.

Mechanik der Menschlichen Gehwerkzeuge des frères Weber occupe incontestablement une place importante dans l'histoire de l'étude du mouvement mais c'est cependant l'approfondissement de leurs recherches par Braune et Fischer qui a pour nous le plus grand intérêt scientifique. Tout comme les frères Weber qui avaient utilisé les méthodes et les outils scientifiques les plus récents pour corriger les erreurs de leurs devanciers, jusqu'à redessiner le célèbre squelette d'Albinus, c'est en recourant à des instruments et à des connaissances qui faisaient défaut aux deux frères que Braune et Fischer furent en mesure de révéler et d'expliquer les secrets de la locomotion.

Conclusion

Mechanik der Menschlichen Gehwerkzeuge témoigne de ce que le binôme corps/machine et la perception technologique du corps remontent bien au delà du vingtième siècle. Le corps tel qu'il apparaît dans les recherches des frères Weber, objectivé à la fois comme une machinerie et un appareil régi par les lois de la physique n'est en vérité pas très loin des "machines qui marchent" qu'ils avaient imaginées. Les frères Weber ont fait de nombreuses découvertes. Certaines d'entre elles sont encore valables aujourd'hui, comme par exemple celle qui concerne l'inclinaison du bassin et l'incurvation de la colonne vertébrale. Mais certaines d'entre elles dérivait directement du constat que la simple observation ne permettait en aucune façon de voir ce qui était à l'œuvre, ce qui présida au développement de techniques nouvelles pour y parvenir. Leur œuvre demeure une épistémé dans ce sens qu'elle a constitué et constitue encore un ensemble de connaissances propres à un moment historique donné. Le fait que certaines de leurs conclusions aient été altérées par la suite n'enlève rien à la force avec laquelle leur représentation du corps a marqué l'imagination, et celle-ci, qui est aussi le terrain d'élection de l'art – demeure sous l'influence d'idées nées à l'aube du XIX^e siècle.

Aujourd'hui, théories du corps et théories de la pensée se mêlent. En dépit des développements extraordinaires qu'a connus la physique, nous vivons encore dans l'univers de Newton: le problème de l'inertie des corps autant que son explication demeurent. Néanmoins, ce qu'on étudie aujourd'hui dans le système complexe du mouvement c'est davantage le cerveau que l'ensemble de leviers et de pivots qui constituaient le corps-machine des frères Weber. La recherche produit des modèles complexes qui rendent compte des relations unissant la perception et l'action afin de mieux saisir de quelle façon le mouvement résulte de l'effet conjugué de différents sens⁽²³⁾. L'analyse du mouvement se fait aujourd'hui à l'aide d'une panoplie complexe d'outils modernes très élaborés, des ordinateurs et des logiciels qui peuvent enregistrer et traiter toujours plus d'informations et de données. À mesure que l'informatique prend une place croissante dans le traitement des données expérimentales, la métaphore du corps-machine évolue vers un corps d'information, et l'image du corps s'éloigne d'une représentation mécanique pour devenir plus abstraite.

Ainsi que nous l'avons signalé au début de cet article, il existe de nombreux ouvrages retraçant l'histoire des relations qui unissent l'art, la danse et

la technologie au XX^e siècle. Pour bref qu'il soit, l'examen détaillé de *Mechanik der Menschlichen Gehwerkzeuge* auquel nous nous sommes livrés tend à démontrer que notre perception du corps et du mouvement avait déjà intégré la technologie antérieurement, mettant ainsi ces travaux historiques dans une perspective nouvelle.

Amsterdam, le 28 juin 2004

(tous mes remerciements à Susan Rethorst pour l'aide qu'elle m'a apportée dans la rédaction de cet article)

Traduction: Tarquin Billiet

Références: (les URL mentionnées sont valables au 28 juin 2004)

(1) Frank Popper. *Art of the Electronic Age*. London: Thames and Hudson, 1993, p. 10, traduction chez Hazan, Paris, 1993.

(2) Noah Wardrip-Fruin et Nick Montfort. *The New Media Reader*. Cambridge, MA: MIT Press, 2003. p. 83: "Le Happening, en tant qu'il relève de l'interactivité dans l'art, est la pierre de touche de toute réflexion sur les nouveaux médias."

(3) Voir: Scott deLahunta. *Periodic Convergences: Dance and Computers*. In *Dance and Technology: Moving towards Media Productions* (eds. Söke Dinkla et Martina Lecker). Berlin: Alexander Verlag, 2002. pp. 66-87.
Merce Cunningham. *Changes: Notes on Choreography* (ed. Frances Starr). New York: Something Else Press, 1968, référence de page absente: "L'ordinateur permet d'élaborer une danse et il permet aussi de tirer des cartes perforées; pourquoi alors ne pas imaginer une notation visuelle directe de la danse?"

(4) Voir: Hillel Schwartz. *Torque: The New Kinaesthetic of the 20th Century*. In *Incorporations* (Zone, vol. 6, eds. Sanford Kwinter et Jonathan Crary). Cambridge, MA: MIT Press, 1992. pp. 70-127.

(5) Bonnie Bainbridge Cohen. *Sensing, Feeling and Action: the experiential anatomy of Body-Mind Centering*. Northampton, MA: Contact Editions, 1993.

Traduction française: *Sentir, ressentir et agir – 1. anatomie expérimentale du Body-Mind Centering*. Bonnie Bainbridge Cohen. *Nouvelles de Danse* n° 50, éd. Contredanse, Bruxelles, 2002.

Lulu Sweigard. *Human Movement Potential: Its Ideokinetic Facilitation*. New York: Harper & Row, 1974.

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Différents sites abordent les dimensions somatiques. Ceux que cette question dans le contexte de la médecine occidentale intéresse liront avec profit: Jeffrey Ives et Jacob Sosnoff. *Beyond the Mind-Body Exercise Hype in The Physician and Sportsmedicine*. vol. 28: no. 3, March 2000.

URL: http://www.physsportsmed.com/issues/2000/03_00/ives.htm

(6) Paul Maquet. *Translators Preface* in Wilhelm Weber et Eduard Weber. *Mechanics of the Human Walking Apparatus*. Berlin, Heidelberg, New York: Springer-Verlag, 1992. [*Mechanik der Menschlichen Gehwerkzeuge*. Dieterich'sche Buchhandlung, 1836; Berlin: Verlag von Julius Springer, 1894]].

- (7) Aurelio Cappozzo et John P. Paul. *Instrumental Observation of Human Movement: Historical Development*. In *Three-dimensional Analysis of Human Locomotion*. P. Allard, A. Cappozzo, A. Lundberg et C. Vaughan. New York: John Wiley & Sons, 1997. p. 7.
- (8) Wilhem Weber et Eduard Weber. *Mechanics of the Human Walking Apparatus*. Berlin, Heidelberg, New York: Springer-Verlag, 1992. p. 226.
- (9) Ibid.
- (10) Pour prendre un exemple plus tardif citons le physiologiste Nikolai Bernstein qui, dans les années 1930, produisit à l'occasion d'une étude sur la coordination des mouvements la première équation différentielle permettant de rendre compte d'une fonction motrice.
Hans-Christian von Herrmann a écrit un article fort intéressant sur le sujet, dans ses rapports à l'évolution du travail de Rudolf Laban. Voir: Hans-Christian von Herrmann. *Movement Notation: An Examination of Rudolf von Laban's Kinetography around 1930 in the Context of the History of Science and Media History*. In *Dance and Technology: Moving towards Media Productions* (eds. Söke Dinkla et Martina Lecker). Berlin: Alexander Verlag, 2002. pp. 134-161.
- (11) Weber et Weber. p. 216.
- (12) Idem. p. 3.
- (13) Idem. p. 222.
- (14) Voir: Fisher Rare Book Library, Digital Collections, University of Toronto. *A Brief History of Anatomical Illustration*. In *Anatomia 1522-1867*. <http://digital.library.utoronto.ca/anatomia/> et http://eic.library.utoronto.ca/anatomical_plates/application/history_illustration.cfm
- (15) Weber et Weber. pp. 1-2.
- (16) Idem. p. 4.
- (17) Mary Mosher Flesher. *Repetitive Order and the Human Walking Apparatus: Prussian Military Science versus the Webers' Locomotion Research*. In *Annals of Science*. September 54(5), 1997. pp. 463-487.
- (18) Weber et Weber. *Foreword*. p. VIII.
- (19) Cappozzo et Paul. p. 4.
- (20) Weber et Weber. p. 218.
- (21) Paul Maquet. *Translators Preface*. In Wilhem Weber et Eduard Weber. *Mechanics of the Human Walking Apparatus*. Berlin, Heidelberg, New York: Springer-Verlag, 1992.
- (22) Wilhelm Braune et Otto Fischer. *The Human Gait*. Traduction des articles originellement écrits en allemand (1895-1904) par P. Maquet et R. Furlong. Berlin, Heidelberg, New York: Springer-Verlag, 1987.
- (23) Voir: Alain Berthoz. *Le Sens du Mouvement*, Éditions Odile Jacob, Sciences, Paris, 1997. Trad. anglaise, *The Brain's Sense of Movement*. Cambridge, MA: Harvard University Press, 2000.
Voir aussi *Le Sens du Mouvement, interview d'Alain Berthoz*, in *Nouvelles de Danse*, n°48-49, *Un du Corps*, éd. Contredanse, Bruxelles, 2001.

DANZA Y TECNOLOGÍA

¿Cambian las nuevas tecnologías la conciencia que tenemos del cuerpo y cómo esperamos que se mueva o pare o respire en el espacio? Los nuevos medios suman interrogantes y crean un nuevo ecosistema en el que el viejo medio expresivo que es la danza debe encontrar nuevas respuestas. No puede ser mera supervivencia. ¿Será una super vivencia?

POR SCOTT DELAHUNTA

Cuando me trasladé a Amsterdam para dar clases en la School for New Dance Development, en septiembre de 1994, los Países Bajos ya eran un entorno importante de desarrollo de una nueva cultura de la comunicación. Probablemente ésta fue una de las razones por las que la tecnología y los medios de comunicación fueron el tema principal de un simposio sobre coreografía que organizamos en junio de 1996. Con el título de *Connecting Bodies*, «simposio internacional sobre las conexiones entre los discursos y las prácticas de danza y tecnología que se centran específicamente en el impacto de las nuevas tecnologías de la información en las coreografías de danza», éste fue el primer simposio de este tipo en el país (web del simposio: <http://www.sdehla.dds.nl/bai/sympo.htm>). Todos los URL han sido comprobados el 12 de septiembre de 2006).

Entre el gran número de ponentes del simposio, se encontraban la artista e informática Thecla Schiphorst, que presentó *LifeForms*, el *software* 3-D de animación de figuras humanas que había desarrollado con Merce Cunningham como herramienta para la creación coreográfica; Heidi Gilpin, dramaturga de danza para William Forsythe, que mostró las primeras versiones del CD-ROM que se publicaría en 1998 como *Improvisation Technologies*; y la coreógrafa Amanda Steggall y el músico Per Platou, con sede en Oslo, que hablaron de su trabajo *M@ggie's Love Bytes*, uno de los primeros en utilizar Internet para conectar espacios remotos como parte de la obra. Se presentó también un proyecto de Peter Mulder, de la NOB (compañía de radiodifusión holandesa), que conectaba a un intérprete en un complejo sistema 3-D de captación de movimiento con imágenes gráficas durante un concierto orquestal en vivo. Asimismo, se mostró una breve pieza de danza «interactiva» creada especialmente para el simposio que utilizaba Big Eye, un *software* de seguimiento del movimiento que se estaba desarrollando en el Estudio para Música Electroinstrumental (STEIM) de Amsterdam.

Los trabajos que se mostraron en el simposio cubrían el «catálogo» básico de tecnologías a menudo conectadas con la coreografía y la danza, desde herramientas creativas digitales hasta instrumentos de interpretación interactivos en tiempo real. Pero el simposio no sólo fue un pedestal para

la tecnología. Todos los ponentes reflexionaron seriamente sobre el impacto de las tecnologías en la danza y viceversa. El debate colectivo fue rico e incisivo, y nuestra presidenta, Diana Theodores, resumió los dos días en un «inventario de temas» y cuestiones que siguen siendo pertinentes hoy día, como por ejemplo: ¿produce la tecnología una idea diferente del cuerpo y podría ser esto liberador?; ¿puede la danza ofrecer una resistencia a la noción de incorporeidad tecnológica?; ¿en qué consiste una buena interpretación «tecnográfica» (danza y tecnología)?; ¿podemos mantener una cultura de memoria del movimiento mediante la tecnología? (véase el resumen de Diana Theodores en <http://www.art.net.dtz/diana.html>).

Inspirado por este amplio abanico de artistas, ideas y materiales nuevos, me implicé más de lleno en esta comunidad profesional denominada «danza y tecnología» como escritor, investigador, impulsor, conferenciante y organizador (el origen del término es probable que proceda de las conferencias I-III de Danza y Tecnología que se celebraron en las universidades de Wisconsin —Madison, 1992—, Simon Fraser —Columbia Británica, 1993— y York —Toronto, Ontario, 1995—. Las actas de las conferencias I y III pueden consultarse en <http://www.surrey.ac.uk/NRC/DJConferences.html>). Junto con Mark Coniglio, codirector de Troika Ranch, trabajamos para reanimar debates en una lista de correo que se había lanzado anteriormente con el nombre de «dance-tech», y creamos el web de recursos Dance and Technology Zone a principios de 1997 (web de Troika Ranch: <http://www.troikaranch.org/>; y web de la Dance and Technology Zone: <http://art.net.dtz/>). Eso marcó el comienzo de un período en el que el aumento de información a la que tenía acceso a diario parecía reflejar un incremento real de actividad artística. La sensación en aquel momento no era sólo de crecimiento, sino de una especie de rápida expansión y de maduración. Dos años después, en febrero de 1999, los organizadores de la Conferencia Internacional de Danza y Tecnología (IDAT) que tuvo lugar en la Arizona State University confirmaron esa sensación con la siguiente afirmación: «Ahora podemos empezar a analizar históricamente y críticamente cómo se ha desarrollado la convergencia entre estos campos, cómo nos afecta, y cómo la danza y la tecnología

pueden seguir enriqueciéndose mutuamente en el próximo siglo» (archivos de IDAT 99: <http://www.cphgeneral.org/IDAT99/IDAT99.html>).

Sin embargo, el trabajo artístico que se llevaba a cabo tenía algunos críticos. Fuera de la comunidad profesional de danza y tecnología, la percepción general era a menudo alguna variación de «demasiada tecnología y demasiada poca danza». A mí me parecía que hacían falta distintas perspectivas e intentaba ampliar la reflexión sobre el abanico de relaciones inherentes en esta clase de manifestaciones artísticas, sobre todo con respecto a su creación. Por ejemplo, una de las virtudes intrínsecas a la comunidad de danza y tecnología era la conjunción de dos disciplinas o campos creativos que trabajan con materiales radicalmente diferentes. Convencido de que la producción de trabajos artísticos potentes dependía, en parte, de la mejora de las condiciones para la creación interdisciplinaria, participé junto con otros en la organización de una serie de «laboratorios de investigación» (documentación de Digital Dancing: <http://www.brunart.com/digitaldancing/>). Cortos e intensivos, estos proyectos dieron lugar a nuevos equipos colaboradores, prestaron apoyo a los que ya existían, y potenciaron el acceso a una amplia variedad de tecnologías. Además, estaban orientados al proceso y ponían énfasis en la interacción constructiva entre colegas. Por otro lado, se hizo siempre un esfuerzo por hacer accesible la documentación de los resultados de las investigaciones, aunque a veces de forma menos satisfactoria de lo que hubiésemos querido. Algunas muestras de webs de laboratorios de investigación son:

<http://dance.asa.rutgers.edu/ellbyes/2000/scott/index.html>
<http://www.sdehla.dds.nl/transdance-report/index.html>
<http://www.sdehla.dds.nl/mert/index.html>

Al mismo tiempo, seguimos otra línea de investigación llamada «Software para bailarines», con el objetivo de «desarrollar conceptos para una herramienta de ensayo para coreógrafos y para aquellos profesionales para quienes el cuerpo en movimiento es un material fundamental» (artículo de Sanjoy Roy sobre «Software para bailarines», proyecto original: <http://www.sdehla.dds.nl/sjd/sanjoy.html>). Esta investigación ha evolucionado en distintas direcciones, incluyendo «Coreografía y cognición», en que compartimos un proceso de investigación

intensiva con psicólogos y neurocientíficos (web con documentos de «Coreografía y cognición»: <http://www.brown.edu/Research/interdisciplinary/>). Este proyecto desvió el foco de atención de la investigación hacia la mente del coreógrafo/bailarín. Ello dio como resultado el descubrimiento empírico de que la elaboración de herramientas de apoyo al proceso creativo y el estudio de diversos aspectos del funcionamiento del cerebro están estrechamente vinculados. Aunque esto no suponga ninguna novedad en la historia de la ciencia cognitiva, el proyecto «Coreografía y cognición» mostró que es posible integrar los dos campos de conocimiento. La idea del cerebro como un lugar de procesamiento de información quizá no sea la concepción más adecuada en todas las circunstancias, pero hace posible pensar la relación entre la danza y la tecnología de forma distinta.

La premisa de un concepto culturalmente estable de la coreografía y la danza es fundamental para los laboratorios de investigación interdisciplinarios y el proyecto «Software para bailarines/Coreografía y cognición». Este concepto, que tiene una historia compartida, cree que el material básico se halla en el cuerpo en movimiento del bailarín y que el sitio fundamental de la actividad coreográfica es el espacio de ensayo y el escenario. Estas entidades estables son útiles e importantes, sobre todo cuando se trata de organizar intercambios productivos entre el arte y la ciencia. Pero otra perspectiva es desdibujar las fronteras entre disciplinas y prácticas separando algunos de estos conceptos y, por ejemplo, aplicando el concepto de coreografía a trabajos artísticos que utilizan nuevas tecnologías para obtener movimiento de la audiencia a la que se dirige. En cierto modo, esto no sería una idea nueva, ya que la audiencia como intérprete de la obra es una idea asociada al género del «arte interactivo», que se remonta a los *happenings* de 1950 (para más información y referencias, ver *The New Media Reader*, ed. Noah Wardrip-Fruin y Nick Montfort. Cambridge, MA: MIT Press, 2003). A medida que nuestro paisaje social se llena de tecnologías móviles y locativas, esta clase de trabajo artístico, que ya no es posible contener en un solo escenario (a menos que se extienda la idea de escenario para incluir una ciudad entera), puede percibirse como la vanguardia de la práctica de la danza y tecnología (el grupo artístico Blast Theory, con sede en el Reino Unido, ha creado un trabajo paradigmático en este sentido con su *performance* locativa/proyecto de comunicación *Can You See Me Now?*: <http://www.blasttheory.co.uk/>). Además, puede consultarse un ensayo sobre el mismo tema, titulado «Blurring Boundaries: a theory of the artwork», en la primera edición de la publicación en línea COMPAS: <http://www.compasjournal.com/>). No obstante, sin ningún cuerpo de bailarín en movimiento y sin escenario hay una clara ausencia de danza. ¿Cómo reconciliar ambas perspectivas?

Un proyecto reciente ha señalado una manera de conseguirlo. Por su propia definición, todos los proyectos mencionados anteriormente están ligados a la idea de conocimiento especializado. En un taller reciente, organizado en Tanzquartier Wien y llamado *Interfaces ausentes*, «búsqueda de nuevas perspectivas sobre artes escénicas y tecnologías de la comunicación», decidimos seguir explorando la misma relación que abordó el simposio *Connecting Bodies* en 1996. Pero ahora partimos de la idea de que nada era necesario —por ejemplo, ningún conocimiento especializado concreto, ningún instrumento tecnológico específico— y de que era preciso cuestionar la relación clásica entre danza y tecnología: la relación entre

el cuerpo como entrada (*input*), el ordenador como procesador y los medios de vídeo/audio como salida (*output*): *Interfaces ausentes* fue concebido y organizado por Daniel Aschwanden (Austria) y Scott deLahunta, con la supervisión y el apoyo organizativo de Martina Hochmuth, de TQW, como un taller de una semana (del 28 de noviembre al 3 de diciembre de 2005) con los artistas invitados Heine Avdal (Noruega/Bélgica), Myriam Gourfink (Francia), Anne Juren (Austria), Ralo Mayer/Philipp Haupt (Austria) y Veronika Zott y Tomate (Austria).

Aunque todavía no se dispone de los resultados completos de *Interfaces ausentes*, parece que estos apuntan, como mínimo, a tres cuestiones fundamentales. Si una respuesta de la comunidad de danza y tecnología, en la última década, fue aprovechar el incremento de las velocidades de procesamiento, la disminución de costes y el desarrollo de nuevo *software*, ¿qué respuesta

“En la actualidad es menos importante enfatizar distinciones entre prácticas y más apropiado relajar la idea del conocimiento especializado a fin de difuminar las fronteras entre disciplinas y subrayar la libertad de los artistas para usar los medios que sean necesarios para realizar y difundir su obra”

puede darse ahora? ¿Nos hallamos a las puertas de tecnologías con la suficiente profundidad y amplitud de significado cultural como para hacer posible que los artistas de la danza las utilicen metafóricamente y de forma autorreferencial? Y si algunas de las tecnologías más nuevas son biológicas, como parece claramente el caso, ¿cuál será la respuesta artística a esto y el impacto sobre la «danza y tecnología» en el futuro? Una posible respuesta a esta última pregunta es la pieza del coreógrafo suizo Yann Marussich, *Bleu Provisoire* (2001), que consiste en una serie de reacciones bioquímicas (el bioarte es una respuesta artística a la biotecnología, sobre la cual existen numerosas fuentes de información en línea, incluyendo conferencias y exposiciones: por ejemplo, <http://www.a-r.org.uk/dh/ubioart.html>). ¿Cómo pueden cambiar nuestras ideas sobre las relaciones entre «danza y tecnología» obras que penetran de tal modo en la maquinaria interna del cuerpo?

Tras diez años de implicación en este campo, la observación que ahora haría es que «danza y tecnología» no convergirán tal como apuntaba el comentario anterior de los organizadores de la conferencia IDAT 1999. En vez de eso, su evolución ha sido y seguirá siendo periódica y fragmentada, y a menudo estará subsumida en otros géneros o clases de trabajo (para algunas ideas anteriores sobre el tema, he publicado un capítulo titulado «Periodic Convergences: Dance and Computers»

en *Tanz und Neue Medien* —libro y CD-ROM/DVD—, ed. Dr. Söke Dinkla y Dra. Martina Lecker, Berlin: Alexander Verlag, 2002, pp. 66-84. Un informe sobre IDAT 1999 de Dragan Klaić ofrece otra perspectiva: <http://ghum.ac.at/~filip/interdisciplinary/abstracts/abstract.html>). Aunque sigo con las distintas líneas de investigación de «Software para bailarines», he modificado mi idea inicial de laboratorios de investigación interdisciplinarios que reflejen una actitud diferente hacia las distintas disciplinas. Creo que en la actualidad es menos importante enfatizar distinciones entre prácticas y más apropiado relajar la idea del conocimiento especializado a fin de difuminar las fronteras entre disciplinas y subrayar la libertad de los artistas para usar los medios que sean necesarios para realizar y difundir su obra.

Al mismo tiempo, hay creaciones recientes que siguen la tendencia de convergencia de «danza y tecnología» en las que el seguimiento gestual y el análisis del movimiento de forma automatizada se combinan con nuevas formas de coreografía e interpretación; por ejemplo, en la pieza reciente de Trisha Brown, creada en colaboración con el artista de *software* Marc Downie y titulada *How long does the subject linger at the edge of the volume...*, en la que agentes de inteligencia artificial generan sus propias respuestas gráficas a la coreografía en tiempo real (para más información sobre la colaboración entre Trisha Brown y Marc Downie, ver: <http://www.operationalresearch.com/arcadia/arcadia.html>). Hemos explorado estas novedades en un simposio reciente titulado *Computos coreográficos: captación y análisis del movimiento para danza*, organizado en el IRCAM (París) en junio de 2006 (vid. en <http://www.ircam.fr/ircam/programme/programme.htm>). En un próximo número de *International Journal of Performance Arts and Digital Media*, <http://www.intellectbooks.co.uk/journals/plays>, se publicará un artículo sobre el tema.

Las cuestiones sobre «danza y tecnología» planteadas por Diana Theodores en junio de 1996 están presentes en todos estos numerosos proyectos surgidos durante la última década: desde *Connecting Bodies* hasta *Interfaces ausentes*; desde *LifeForms* hasta «Software para bailarines»; desde la penetración en la mente (ciencia cognitiva) hasta el arte biotecnológico; y la emergencia del artista no especializado (e ineludible). Lo que está claro es que cada manifestación específica de práctica, dentro de su especificidad y sus relaciones contextuales, ofrece respuestas a estas cuestiones. Artistas, comisarios de exposiciones, audiencias y críticos que hoy generalizan con la opinión de que «danza y tecnología» significa «demasiada tecnología y demasiada poca danza» pasan por alto esta mayor variedad de posibles relaciones en la que ninguna de las dos puede considerarse esencial y, aun así, tanto si están ausentes como presentes, siguen originando nuevas creaciones en cuanto a ideas y obra artística. *

Scott deLahunta trabaja en Amsterdam como investigador, escritor, consultor y organizador de una amplia variedad de proyectos internacionales que acercan las artes escénicas a otras disciplinas y prácticas. En la actualidad (septiembre de 2006), trabaja como investigador a tiempo parcial en varias instituciones: investigador adjunto en la School for the Arts de Amsterdam; artista invitado del Departamento de Danza de la Ohio State University; investigador asociado en Crucible (una red de investigación interdisciplinaria de la University of Cambridge) e investigador asociado en el Dartington College of Arts (Reino Unido) desde septiembre de 2000. También imparte clases en el curso de posgrado de coreografía/nuevos medios en la School for the Arts de Amsterdam, y forma parte de los consejos de redacción de las publicaciones *Performance Research*, *Dance Theatre Journal* y *International Journal of Performance Arts and Digital Media*.

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