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Abstract

This article aims to draw the reader into an interdisciplinary conversation between the co-authors about the use of imagery in dance creation placed under very different disciplinary lenses. The conversation has two points of departure. First, for nearly a decade the choreographer Wayne McGregor has engaged in an interdisciplinary collaborative research with cognitive scientists with the aim to develop new understandings of the choreographic process. A large percentage of this research has focused on imagery in creativity and has resulted in the development of the Choreographic Thinking Tools, currently in use by McGregor and his dance company. One third of this article is dedicated to a description of these developments combined with figures that illustrate the scientific theory lying behind them. The second point of departure and second third of this article brings these ideas into conjunction with somatic practices, as reflected in the writing of an expert practitioner invited to introduce somatics to McGregor's dance company in the framework of the Choreographic Thinking Tools. The final section that concludes the article reintroduces scientific theory with the goal to articulate some of the contrasts and overlaps between the different approaches represented in this conversation.

Keywords: somatics choreography cognitive science imagery creativity dance

Introduction

On 10 July 2011, we shared a presentation at the Dance and Somatic Practices Conference at Coventry University framed by two basic questions: how can a scientific understanding of the organization of the mind provide ideas that can be used to augment creativity in dance and how might somatic approaches both learn from and contribute to this? This article explores the implications of these two questions. The three separate accounts that follow provide the background for our initial meeting and reveal differences and overlaps in approaches. The five accompanying figures and extensive endnotes are provided so the reader can independently continue this research.

Scott deLahunta – background for the conversation

Phil and I have been collaborating for several years with choreographer Wayne McGregor on applying insights and inspiration from science to his creative work (deLahunta et al. 2009: 431–48). This work has moved through several stages, but the ideas we wish to explore in this article were inspired by a moment in the summer of 2007 when Phil drew a diagram of Wayne's choreographic process on a dinner napkin, which

we converted into the Process Model (see Figure 1 and accompanying text following these separate accounts). The model, which has recently undergone some revision, differentiates between conceptualization, generation, selection and integration enabling us to think about how to augment parts of the process while continuing to study the whole.[1]

Our initial research into the development of Choreographic Thinking Tools focused on the *generation* part of Wayne's process when he collaborates with his dancers to create the movement vocabulary for a particular dance. He does this partly through asking his dancers to create movement in response to task instructions requiring the use of *mental imagery*. The use of task-like things is common practice for contemporary choreographers, and it includes rule-based improvisation, scores and game structures used either during the creative process and/or directly in performance.[2] This practice informs the shared imagination landscape underpinning the choreographer's reliance on his or her dancers as co-creators in the process and recruits various types of imagery. Examples from the conference include Stephanie Sachsenmaier's description of Rosemary Butcher's reinvention of Alan Kaprow's *18 Happenings in 6 Parts* when she wrote instructions on cards and handed them to her dancers during the performance. Sue Hawksley described asking her dancers to stand still and imagine a dance then describe their experience and Natalie Garrett talked about her use of scores in her project with Amy Voris drawing on Body–Mind Centering® principles.

It is important to note imagery is often assumed to be visual, but it can be aural as in imagining sounds or voice, sensorial as in imagining a texture and kinesthetic as in imagining movement without moving. We can also construct abstract mental representations, including emotional feelings and conceptual thoughts. Imagery can correspond to and be derived directly from the real world, but it requires mental effort or focused attention to remain vivid in whatever shapes it takes internally. When we experience something surprising like touching a hot surface or hearing a loud sharp sound, this event draws our attention to it. But we also experience attention as something we can move around through focusing on more subtle things like the feeling of the texture of the clothing we are wearing or quiet sounds occurring around us all the time. In the Choreographic Thinking Tools project, we refer to moving the focus of attention around 'points in mental space' and across the interconnected imagery spectrum.

In their book on creative thinking tools Robert and Michelle Root-Bernstein (1999: 50–69) refer to this as 'polysensory imaging'. They describe cases of visual imaging in musicians and aural imaging in scientists, and they assert, as do other researchers, that imagery skills can be learned and improved with exercise. This said, the vast bulk of the available empirical research on the use of imagery focuses on visualization, and images constructed in response to verbal stimuli (Lutz and Lutz 1978). While enactive or embodied approaches to imagery have received somewhat greater attention in the recent past (Thomas 2011), the ways in which diverse types of imagery might inter-relate remains under-explored territory.

Wayne's task instructions involve the use of one or more forms of imagery as stimuli for the dancers (see Figure 2 for examples). The tasks here are relatively simple but clearly require a lot of mental work, some obvious and some not so obvious. The first involves imagining and holding in focus a geometric spatial image that does not actually exist in space, and this has to be internally generated. The instruction to 'describe or draw it' is a suggestion of the action (with no further directions). The second invokes an internal aural image of something familiar and to then translate this to a visual three-dimensional image, all internally generated in mind. These relatively simple tasks still require a number of unusual decisions to be made, and the dancers approach them in the spirit of creative problem solving, with task constraints limiting the decision making space. Wayne observes the resulting movement solutions, selects and amplifies sections for potential reuse.[3]

In 2009 in collaboration with the psychologist Jon May, we undertook exploratory studies with the company aiming to provide a scientific basis for our understanding of how the use of diverse forms of imagery support movement creation in Wayne's work.[4] These studies used a special questionnaire and procedure designed to gather information (or collect data) about the dancers' experience with and use of imagery. Later the questionnaire was adapted to serve as a reflective tool for the dancers to use independently. The background for these studies is a theory called *Interacting Cognitive Subsystems* (ICS) aimed at understanding how all the different components of the mental mechanism interact dynamically in real time. ICS places great emphasis on the 'whole system' including a central role for embodiment and emotion.[5] While other unified theories of cognition exist, they are not as common as theories focusing on a specific area of mental competence such as memory, language, understanding or visual attention.[6] Theories addressing only a part of one's mental capacities, as micro-theories, seemed to us to be too limited for application in the context of dance creation, which is arguably the most integrative of all artistic practices.[7] It was the emphasis on embodiment, meaning and emotion within the macro-theoretic approach of ICS that convinced us we could work with this particular approach.

The ICS theory assumes that the activities of the human mind can be captured by considering how nine subsystems working in different domains concurrently interact with each other as an organized system or *mental architecture*. A good way to understand the essence of this theory is to draw a comparison with a simpler mammalian mind such as that of a cat. Cats have the ability to learn and remember and, in doing so, can bring diverse sensory information together to guide action. It can be argued that all they need to do this is four 'basic units' or subsystems in their mental architecture (see Figure 3 and its explanatory text). With this form in mind we can then illustrate how a number of simple steps can take us to a more complex and intricate human mental architecture. This is seen as having more 'basic units' with the same components, but able to compute more things at one and the same time (see Figure 4). And this architecture has correspondences with the full range of mental imagery (visual, aural, kinesthetic, senses of meaning, etc.) mentioned earlier that is inherent to the tasking work McGregor's dancers often do in the generation phase of a creative process.

In February and March 2010, informed by some early results of the scientific studies, we (Phil and Scott) spent three weeks in residence with Wayne and the company at the Experimental Media and Performing Arts Center at Rensselaer, Troy, NY and the Chicago Dance Center. The aim of the residency was to see if we could augment the generative work with tasks, already familiar to the dancers, through the development of exercises with the use of imagery in movement creation. In this process we used the same background ICS theory as a structured starting point for exploring the dancers' experience of working with imagery.[8] The questionnaire used for data collection in the 2009 study was redesigned as a personal reflective instrument the dancers could use independently. The process involved a mix of increased introspection, aided by the adapted questionnaire, and more sharing of discoveries of useful ways of working between each other. Ways of working included taking more time observing and analysing the sources of inspiration or stimuli that might be associated with a task, for example, noticing and abstracting features of an image (e.g. geometric features of a landscape painting) and clarifying the use of certain rules for the translation of these features, which we referred to as properties, into movement material. This shifted the focus within the work towards the affordances of a particular task, and it seemed to free the individual dancer to make intuitive discoveries of novel movement material and to be able to reflect on their process of movement creation. It also aided Wayne in refining the tasks he would give them as differentiating between different types of imagery led to a better understanding of how they were working including optimal time requirements for certain parts of the generative process.

Critical to the success of the workshop was the concept of the three loops explained in Figure 5, particularly the possibility to move and map or translate across and between forms of imagery. Experiencing rather than just theorizing how 'points in mental space' could be restructured or reset relative to the tasks or other forms of stimuli affirmed that a skillful attunement to ways of working with the imagery to create movements could be achieved. The exercises and various recording instruments we developed demonstrated how this skill might be practiced and improved.[9] Additionally, expecting to develop novel movement material the dancers were constantly looked for ways to break movement habits. Since the Choreographic Thinking Tools actually draw on a previous training and acquired skills with ways of moving (see Figure 5 for explanation of the Deep Schema Loop), we could better integrate the breaking of movement habits with individual background. The dancers found they could explore and use what they knew from their prior training, without rejecting it outright.

Recognizing and acknowledging an individual's training background also helped us realize that the participating dancers, whose training fell more in the area of ballet and contemporary dance, seemed to lack tools for accessing a wider range of sensing experiences and the language to describe this. Many were unfamiliar with the range of known techniques associated with somatic practice.[10] This insight inspired us to approach Gill Clarke to work with the company. With her diverse and rich background in contemporary dance and performance and teaching deeply informed by somatic practice we felt she would be able to help the dancers access both states and language for exploring a fuller sensorial range. Gill worked with the dancers of Wayne McGregor |

Random Dance during four sessions in spring and early autumn 2010. Before and after these we had a number of conversations with Gill exploring how the use of imagery in her sessions with the dancers contrasted and overlapped with our concept of how attention, in the framework of the Choreographic Thinking Tools, might be creatively recruited and directed within mental space. The following account from Gill reveals differences in both language and approach and reflects her concern with how the use of specific imagery might establish the conditions for discovery and transformation. In the final account that concludes this article, Phil explores how some of Gill's discourse might be reframed in relation to the psychological theory.

Anna Nowak generating movement material in Studio 6, Dartington, September 2011. Photo: Kate Mount.

Gill Clarke – give the imagination space to play

Given the background of the dancers – predominantly in codified techniques in contemporary dance and ballet[11] – I was impressed by their capacity to turn attention and curiosity to noticing small changes and proprioceptive feedback from their own moving, just so long as the task invited responses motivated by 'tasting' sensation rather than the forming of movement, and was therefore able to be apprehended as an unfamiliar territory dissociated from their habitual dancing.

This reinforced for me how we can too readily attribute the restriction or expansion of our creative responses to the *what* of the physical skills and the accumulated vocabularies of movement that we bring to the studio from our training. Yet what is thereby overlooked is the importance of developing skills of focused attention to tune into the *how* of the movement as it is being embodied moment by moment. We can draw on well-drilled habitual pathways and movement patterns in choreographic problem-solving,

where thinking remains detached, somehow 'thought-alongside' or we can skillfully pay attention to and through the passage of the movement whilst it is in process, whether in response to internal environment or external image, intention or 'affordance', allowing the movement to become 'thought-filled', itself the instrument of cognition. Tim Ingold writes of the expert as being superior to the novice 'not because she has acquired mental representations that enable her to construct a more elaborate picture from the same corpus of data, but because her perceptual system is attuned to picking up critical features of the environment that the novice simply fails to notice' (2001: 142).

Codified techniques tend to have their roots in a specific set of movement principles that promote a particular organization of the body, or in a particular aesthetic emphasis, for example, where movement is initiated in the body or the relationship to gravity. These are then built upon through a series of developmental stages so that more and more complex coordination can become available to the body with the least amount of mental and physical effort, so that in turn more complexity can be achieved. In contrast, skills of attention are focused on paring away the clutter in awareness so as to develop discrimination and differentiation of fine nuance in the process of moving. In this way more possibilities are opened up and clarified as to how that movement might evolve, and a greater awareness of the multifarious choices one has at any moment to shift in quality, direction, coordination becomes a 'felt sense' through the body. Reinforcing Ingold, Moshé Feldenkrais writes: 'most of the time we fail to achieve what we want by enacting more than we are aware of, rather than missing what is essential' (1985: 20).

Our habitual movement vocabularies can be brought as tools to solving choreographic problems, the thinking somehow remaining at one remove from the moving, but the solutions suggested by the body are likely to stay within the limits of our habitual movement patterning. Yet with practiced skills of attention and imagination the mindful, moving body itself can become the instrument of thought, opening up an enriched palette of possible solutions from the felt sense within the process of moving.

The challenge for both dancers and choreographers in embarking on the generating phase of a new work is often how to find oneself in a movement territory one has not felt oneself in before, and the daily frustration is a recognition of: 'oh here I am again'! For the dancer in a busy touring company the previous work can have become so engrained in the body that its answers remain the most readily accessible, rising to the surface to offer solutions to new questions. As mentioned earlier taking time to notice and experience are key in this process, to give the imagination space to play.

My job with the dancers, then, in our few sessions together, was not to introduce a lot of new concepts but to set up an environment that opened up the experiential time and space to explore sensations and images that might invite an unhabitual and more subtle movement response. We drew on tools that might focus, limit or amplify certain sense perceptions: a partner's touch, closing the eyes, moving slowly, using small, subtle movements so as to differentiate more keenly a pathway, the use of metaphoric or skeletal images. Language also plays a very important part in this facilitating, the words carefully chosen. It becomes a language that is conditional, that asks questions of the

individual's experience, and suggests rather than states. It tries to avoid abstract generalizations and instead stay close to the particular, aiming to disturb the individual experiencing as little as possible. The tone of the voice, its modulation become as important as the semantic content in conveying what is important in the exploration, or in trying to sustain a noticing state of attention.

So with the work of skull and spine, for example, we worked through a partner's light touch to bring attention to volumes and connections, asking if it is possible to allow your partner to slowly, smoothly, subtly rotate your skull – to free it from your own intention and control? 'And what if you then allow any small movements to arise that might explore the freedom of its volume in relation to the spine…, or the flow of movement sequentially through from one place in the spine to the next…?' 'What leads… what follows?' 'Can you sense very particularly where this movement begins… how it flows through the body and where it ends or moves out into space… ?' I also introduced various anatomical images that

… work like metaphors: flat reproductions that insist on their incompleteness requiring the dancer to make an imaginative effort to make sense of their information and translate it through the felt sense within their own body. The simplicity and framing of the images on the page also enable them to be absorbed as mental pictures that can be conjured up as mental pictures whilst moving. (Clarke et al. 2010: 225)

The findings of these experiences, residing as a felt sense in the body or a remembered image, can then be appropriated to whatever aesthetic and choreographic preferences pertain. It is not inherent in somatic practice that the solutions that emerge from its practices need for example, to manifest in slow, organic movement. Any movements can be arrested, diverted, broken, the timing and scale modulated across a broad spectrum without necessarily losing the felt sense. There are implications here for training if seen in the context of the changing nature of the dancer's role in the choreographic process. Now embraced as creative contributors to the generation of a work and its movement language, these skills of attention, imagination and curiosity 'thought through' the body become tools as essential for the dancer to develop as their physical proficiency.

Phil Barnard – reintroducing psychological theory

There is, unsurprisingly, a contrast between the language Gill is using when elaborating her experience, based in deep practical knowledge, of working with the dancers and that used when we seek to ground our choreographic thinking tools in the science base of mental architecture and 'processing loops'. Yet the two frames of reference intersect and are mutually informing.

Intuition, metaphor, felt senses and expertise, all terms used by Gill, are also how we would characterize the 'implicational' meanings referenced in Figures 4 and 5 with their potential for blending affect and cognition. Elsewhere, the state of mindfulness has been described, and its features analyzed, within the ICS model. In mindful states the focus of attention is directed, non-judgmentally, at senses of implicational meanings being formed

in the moment to moment operation of our Deep Schema loop (see Figure 5) (Teasdale and Chaskalson 2011). The theory of cognitive science places clear constraints on how that particular form of meaning arises. It emerges out of a deep blend of bodily, and distal sensations with concepts and emotions. Much implicational meaning is embodied, latent and ineffable. Yet the theory makes clear how that latent meaning is used in the generation of specific ideas (propositional meanings) in the central loop of Figure 5 and how these specific ideas are rendered thinkable in the two other loops of Figure 5 – verbal expressions, or more visually dimensionalized forms in the mind's eye. Bodily sensations, in the theory and in Gill's practice, feed latent capability to blend senses of meaning to give rise to new movement forms.

Importantly, cognitive theory can also help us to understand *why* some ways of internally transforming ideas into action are easier than others, why we get stuck in the kind of frustrating familiar movement habits that Gill notes, and how strategies for breaking those habits might most usefully be framed. *A key component of what science offers here are ideas about mental images and how we attend to them*. The particular theory we work with holds that we can experience nine forms of image – one for each of the subsystems shown in Figures 4 and 5. But sensory images, central and effector images have different properties. Sensory images are built out of what the eyes, ears and body senses tell us. They can be inspected selectively and their content altered by eye movements, postural adjustments or head movements to focus sound. Central images are formed within the mind often from a blending of current thought content with the products of attending to our senses. Ineffable senses of meanings and awareness of 'facts' are cycled, inspected and reformed within our three loops and that is what supports both controlled familiar action selection as well as innovation. Images of vocal and other bodily muscular configurations, while assumed to be available, are different again since their effects are realized in the physical word and subsequently sensed via proprioception. Notice, for example, that Gill's reference to Ingold pointing out that expertise involves the noticing of properties missed by novices can readily be translated into the language of mental loops and tools for their use – attention to specific aspects of sensation are, in effect, 'propositonalized' within the Deep Schema Loop and translated into spatial-praxic images (see Figure 5). When executed in movement the bodily feedback is again processed within the deep schema loop to support a decision about the value of that movement in which affect can play a role. A knowledge of this kind of mental mechanics provides routes to formulating choreographic thinking tools – or strategies – for breaking habits. In developing such tools we can draw on experience of using this self same theory to treat the repetitive thought, bodily correlates and action patterns characteristic of depression or anorexia nervosa (Park et al. in press).

Science and creativity in artistic practice are often uncomfortable bedfellows. In our own project we have found reciprocal synergies where one enriches the other. In this case, science draws on the richness of practical multimodal experience evidenced in dance expertise while offering back a vocabulary through which difficult to express ideas can be crystallized and exchanged in a different register. A distinguished psychoanalyst recently pointed out (Fonagy 2009) that a psychoanalytic approach to a condition like depression addresses individual contents of mind that are subjectively experienced and

details structures and processes across patients, but that is not enough. The way forward is to link the richness of first-person data – which can equally well derive from artistic practices – to the kind of third-person cognitive science constructs like those shown in our more technical figures that provide a different form of intellectual scaffolding for understanding how to break out of depressive ruminations or habitual movements.

Acknowledgement

Sadly, in the final editing stages of this article, Gill Clarke passed away. Gill had an immeasurable impact on dance practice in the United Kingdom, Europe and beyond. We were so fortunate and privileged to have had the opportunity to collaborate with her and have her reflections as part of this piece of work.

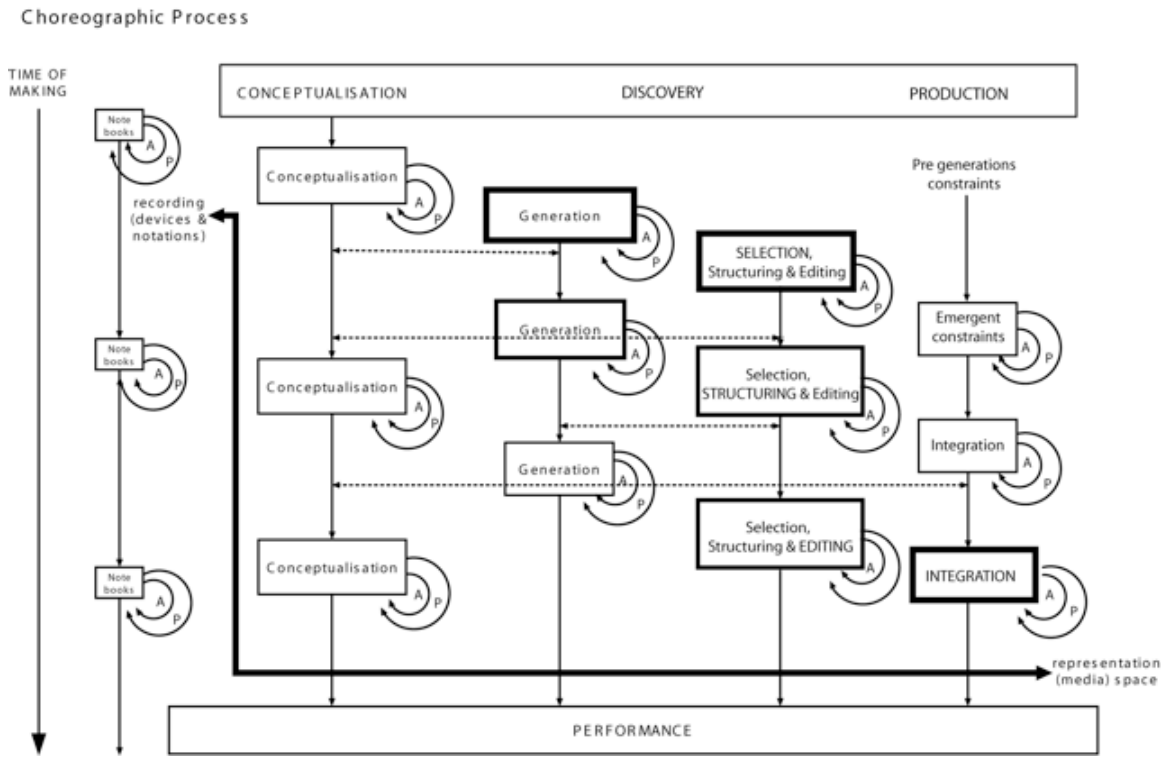

Figure 1: *Process Model (version 1) – downward pointing arrows capture what goes on at the time of making.*

The conceptualization of the piece develops as a result of what goes on in generation, selection and how the products are integrated into the full production constraints. We believe it is helpful to think of the main boxes here as representing stages – that is when there is a change in some aspect of conceptualization, generation methods used, the way in which selection is done and so on. Each of these boxes has two circular 'loops' labelled 'A' and 'P'. The Ps stand for choreographic processes that are characteristically used (such as the tasks). The As stand for possible augmentations to existing processes i.e. places where additions can be factored in to support innovation (in this case the *Choreographic Thinking Tools*). The left most sequence represents any ancillary

activities of note-taking or recording (might be video) undertaken by the choreographer to support making, decision rationales or anything else.

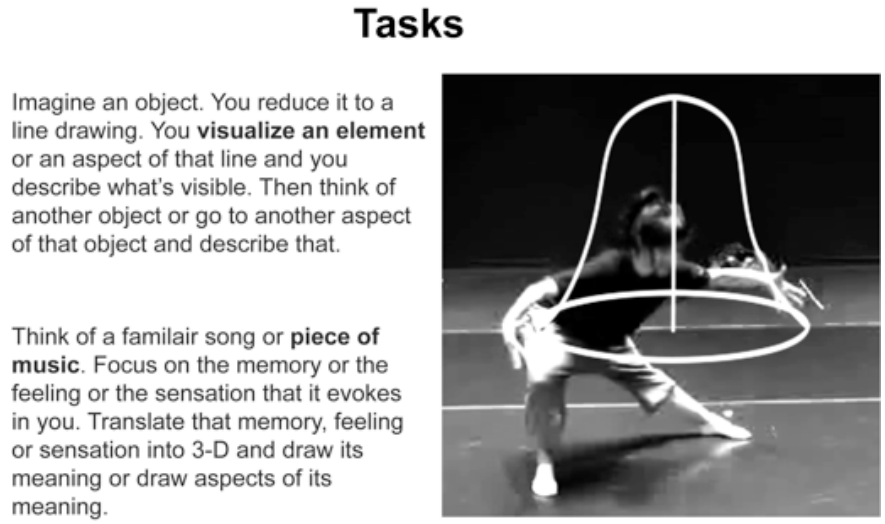

Figure 2: *Sample tasks Wayne McGregor invented for the purpose of conducting the data collection for the experiment reported on in this article. Under normal creation conditions tasks are derived from the space of conceptual inspiration McGregor is working in for a particular choreography (see Figure 1).*

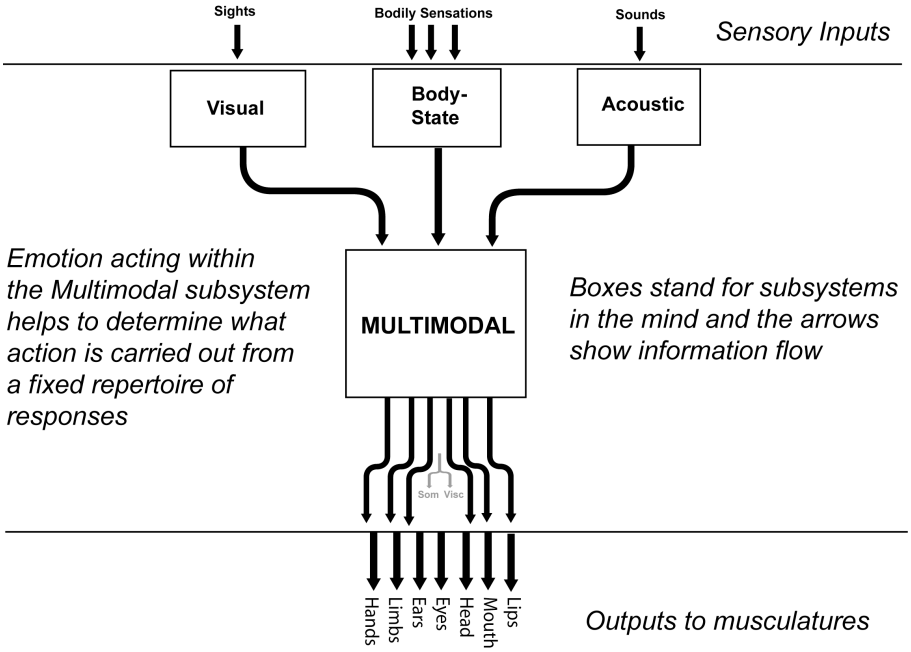

Figure 3: *A four subsystem mental architecture thought to be sufficient to account for the mental capabilities of most mammals. The signature of this ancient evolutionary link between perception, meaning and emotion remains in the mental architecture of modern humans.*

Within our theoretical approach, we consider a mental architecture with four subsystems to be sufficiently powerful to account for the mental capabilities of most mammalian species like cats, etc. (but not, e.g. great apes). Two aspects of Figure 3 are worth mentioning. The first concerns how different kinds of information are used to guide behaviour. In this mental system the three sensory subsystems (handling sights, sounds and bodily sensations) all communicate directly with the fourth, multimodal subsystem. This multimodal subsystem draws together the information conveyed in different senses and uses their intersection to determine how to act. The diagram shows that the multimodal subsystem directly controls muscular, somatic and visceral responses. Emotion is crucial. In this, and many other theories, emotional states that are invoked and experienced guide the selection of appropriate action. Notice that for the classic case of Pavlovian conditioning, where a sound is paired with an electric shock to the body, these two sources of experience only come together in the multimodal subsystem.

It is now relatively easy to grasp the point that our cat would experience, and learn about, visual patterns, aural patterns, bodily patterns and quite separately in the fourth subsystem, how they all intersect as multimodal patterns. These latter patterns encapsulate the 'significance' of what is going on in the external world and internal world of the body and once established, those patterns enable the animal to act in one way when similar things happen in world/body combinations and in another way when different things happen. These multimodal mental models of experience and action are the essence of our cat's system of 'meaning'. They can be thought of as abstract schemata that capture what is related to what and how. Within that system of meaning bodies are clearly important. The products of bodily sensations, be they to do with proprioceptive aspects of the dynamics of muscle control and posture, or somatic and visceral states, play an equally important role as that played by distal sensations that are more often the focus of discussions of animal cognitions. As we shall see in the case of our own more complex mental architecture, shown in Figure 4, the deep signature of patterns in multimodal blending and their significances remains at the heart of our own more intricate system of meaning.

The second aspect of Figure 3 to note is that it is really too simple to help us grasp the intricacies of our own, human mental functioning. Each of the subsystems shown in Figure 3 must, of course, have intricate brain circuitry inside them for grasping patterns, remembering them, priming relevant states and communicating with the multimodal subsystem or bodily effector systems. Nonetheless, it is very obviously a system that reacts to sensory states and their combinations that are there in 'the now'– there are no circuits inside the system that enable verbal language or images of physical space or senses of meaning about the reactions of others to be generated that are not linked to current states. To this extent our cat and most other core mammals can be regarded as intrinsically living and experiencing very much in the moment.

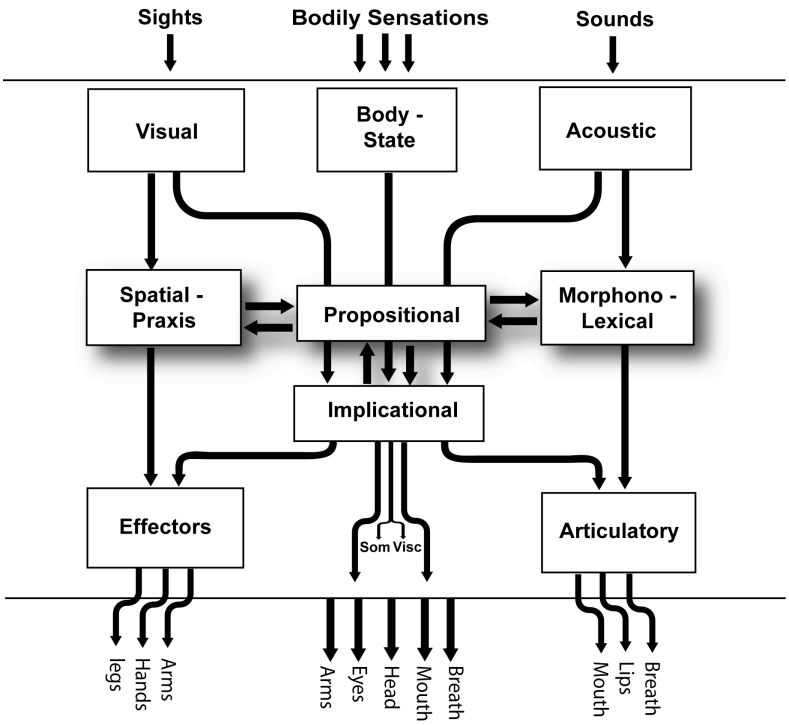

Figure 4: *The nine-subsystem mental architecture needed to account for human cognition and emotion. The presence of two levels of meaning means that the owner can think about ideas (innovate) while doing everything that precursor minds could do (concurrency).*

The mental architecture shown in Figure has nine subsystems rather than the four shown in Figure 3. Notice that at the very centre of this diagram there are two meaning subsystems. One subsystems supports conceptual meaning – specific ideas, labelled here *propositional* meaning. That is the stuff of what we express in sentences or interpret by looking at specific entities in our environment, their properties and relationships (e.g. a blue cup to the right of a silver teaspoon). If we observe a child then stirring liquid in that cup, we can grasp the propositional meaning of that sentence simply from observing the action. The other box is labelled *implicational* meaning. Notice that this subsystem retains the feeds from visual acoustic and body state information just as they were in our presumed mental architecture for a cat, but it now also has a feed from propositional meaning. This meaning subsystem is what supports intuition, senses of meaning, wisdom, deep expertise or feelings about people and things as well as raw emotional experience. It is where all the 'mental stuff' that is hard to talk about resides.

Notice too, that there are now not only one-way arrows from sensation to the control of action, but also two-way, or reciprocal, arrows supporting dialogues between four of the subsystems. This is what is known as a highly concurrent architecture and the ability to do many things in the mind at once is what enables its owner to walk, talk, chew gum, 'think' and feel all at the same time. Unlike Figure 3 what goes on in this system is not wholly driven by sensory inputs and their simple integration in a multimodal system. However, the ancient signature of that integration is very much still there. Note again that the three sensory systems still directly feed a subsystem now labelled 'implicational

meaning'. But much else is going on. Notice, for example that a single multimodal subsystem no longer controls bodily responses – the descendent of the original multimodal subsystem still controls some basic patterns of somatic visceral and bodily reactions but the finer aspects of controlling our skeletal musculature and vocal articulation are now devolved to specialist output subsystems.

Similarly, mediating between the three sensory subsystems and the new subsystems controlling the details of behaviour are four purely mental subsystems. One of these subsystems (spatial-praxic) 'knows about' abstractions of physical space and organizations of actions within it. These organizations will encompass the recognition and generation of all kinds of human actions, including day-to-day movements in space and time as we interact with objects and people in our social worlds. It will also support more specialized organizations as may apply with the generation of movement phrases in contemporary dance. Another subsystem (morphonolexical) knows about structures and dynamics in vocal space – words and their ordering in the verbal phrases of our native language. Notice too that in Figure 4, spatial-praxic and verbal forms can be generated from the products of visual and auditory sensations, or internally from another mental subsystem labelled here 'propositional meaning'.

Propositional meaning is the kind of meaning that underlies verbal or written sentence production and comprehension. Importantly, in this model it also enables us to generate (and imagine) action sequences for the kinds of complex physical tasks we humans accomplish with objects and spaces in the world. When we 'see' that cup standing on a table we can grasp not just the 'propositional' relation that the cup is 'on' the table and hence have conceptual properties of meaning in mind but we can also grasp its significance in context. In some states, coffee can keep us awake or ice cold lager can cool us down and the schemata of implicational meaning enable us to make context dependent decisions or generate novel, innovative patterns of meaning. The presence or spatial-praxic intelligence, verbal intelligence and propositional intelligence are now overlaid, or augment the original central multimodal subsystem of Figure 4. The signature of patterns in an embodied sensory world is now overlaid with a deeper grasp of dynamic forms and meaning.

Implicational meaning carries that augmented signature in what amounts to an ineffable or latent form. These are the rich deep schemata that shape our understandings and behaviours. The content of those deep schemata, is not only difficult to talk about, often only small parts can be readily realized in propositional meanings and then translated into tangible form as sentences or texts. Poetic form, narrative, metaphor, parables, visual art, music and dance are all vehicles for directly expressing attributes and schematic aspects of implicational meaning and the affective feelings that may accompany them, that could be readily expressed as raw verbally expressed propositions. In many cases, artistic expressions can eloquently, straightforwardly and compactly convey significance in the presence of considerable propositional ambiguity.

The pattern shown in Figure 4 has not been conjured out of thin air – there are sound evolutionary arguments for the initial emergence of spatial-praxic intelligence (supporting tool use in the hominin ancestors of todays great apes and modern humans)

and the subsequent emergence of differentiated vocal utterances and words. Conceptual/propositional meaning lies at the deep intersection of what is seen and heard and therefore its emergence depends on the prior existence of core spatial-praxic and verbal skills (see Barnard et al. (2007) to find details of this argument). The four central subsystems can also all be active at the same time – unlike Figure 3 there are enough boxes and arrows to enable us to analyse how we can concurrently control walking, talking and thinking at the same time. In the creative context of dance, it is vital to note that a deep schema can be generating propositional ideas about what to do and these ideas can in turn feed back to enrich the current deep schemata of implicational meanings. This loop in the mind is what allows us, but not our progenitors to innovate and to attach emotional feelings to abstract ideas and other felt senses.

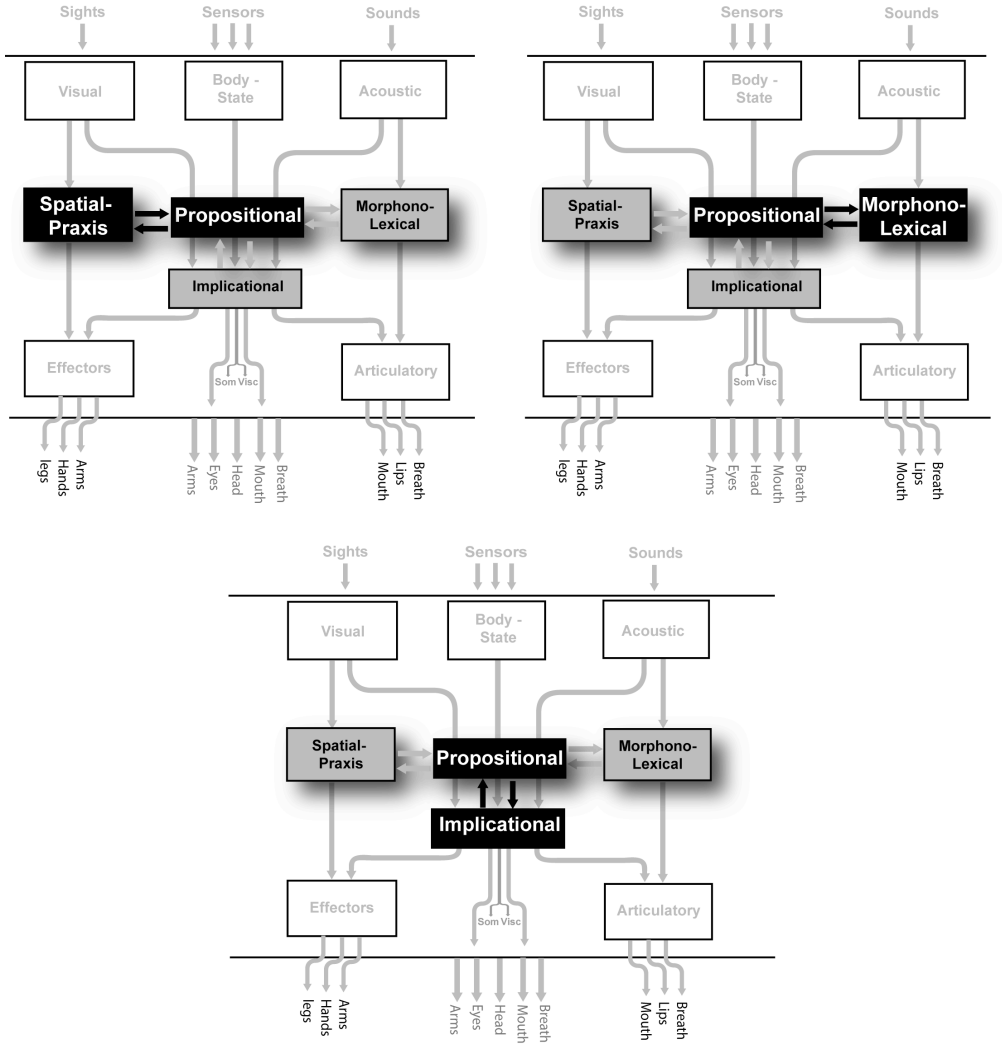

Figure 5: *Three versions of the nine subsystem architecture. Each variant highlights one kind of internal mental exchange supported by a processing loop between two specific subsystems. Top left hand side: the spatial/praxic loop; top right: the Auditory Verbal loop (referred to as morphonolexical in the diagrams); bottom: the Deep Schema loop (where the Propositional and Implicational subsystems come together).*

The upper figures illustrate two loops that involve specific ideas (propositions). The upper left diagram shows how propositions give rise to concrete Spatial/Praxic (Visual) images and the content of those images can, in turn, get fed back for further propositional interpretation. Subjectively this is experienced as 'visual imagery'. The upper right diagram highlights the exchanges that form the Auditory/Verbal loop. Subjectively this is what we 'hear in the head' as sounds and/or words. The lower diagram highlights the third, Deep Schema loop. Within this loop, the propositional and implicational systems exchange material and this dialogue is where intuition and wisdom reside as well as emotion and feelings. It is where ideas and concepts are formulated as things you 'know'; senses of meaning; this is where your dance training, background culture, language and learning from life (social) experience all comes together. It is where the deep parts of your own signature are coming from.

Take a moment to experience the use of imagery yourself. Visual imagery is pretty direct and powerful. Notice now what is directly in front of you. Close your eyes and 'see' the same scene you were just looking at and realize that is generated 'internally'. The loop formed by reciprocal arrows between the propositional and spatial-praxic subsystems is used to generate that image. You can of course build an internal image without the external reference. You might imagine a human body with the head of a bird (as many early cultures did, including the ancient Egyptians). Importantly what is placed in the image is a product of mental decisions – it is a bird's head not a fish head and hence this reflects and is driven by a propositional relationship of head X on body Y. You can do something similar with aural or sonic imagery, which might be further distinguished as verbal imagery, which means it will carry a semantic dimension. Try imagining the voice of someone familiar in your head. Again the propositional subsystem is needed to create *the idea to be expressed* and hence this involves the reciprocal arrows in the figure between the propositional subsystem and the morphonolexical subsystem. But where do the ideas come from? Our approach assigns this to the dialogue between implicational and propositional meanings highlighted in the lower panel of Figure 5. The schemata that organize senses of meaning and their affective correlates are grounded in the existential blend, described in my comment following Gill's reflection, of the products of propositional meanings, perceptual and bodily states. Imagine an emotionally significant encounter – a dialogue within your Deep Schema loop will generate and elaborate material and go on to select properties that can be realized as visual images in the mind's eye and the verbal thoughts. As a trajectory evolves over time it can (and does in post-traumatic stress disorder) lead to the re-experiencing of those emotional states.

The images that can exist in the mind are multiple and hence we also need to consider how the components of our imagination work together and how attention operates in relation to internal as well as external experiences. Think of a multistory building you know well – it might be your home, a friend's home or your workplace. Now imagine the staircase. Informally, we have noted that people seem to report imagining the staircase from the bottom looking up. Why? Why not imagine that you are half way up or looking down from the top or even cleaning a particular step with a vacuum cleaner? First,

accessing a deep schema is guided by the verbal language in this text, or a spoken instruction, and an idea (propositional) relationship will emerge that most likely has you at the bottom of the stairs – it is the default or canonical schema. This task of imagination relies on the three central loops shown in Figure 5.

It is relatively easy to pay attention to these internal images when one is not moving. When moving keeping the images vivid becomes more difficult, the focus of attention on the particular image harder to maintain. However, through practice the dancers we worked with reported being able to improve their use of imagery in task-based movement generation; that is use of imagery in creative work became an acquired skill. In this brief outline we have focused on distinguishing how different types of information and mental activities play distinct roles in our imaginations. Attention to information across the mental architecture is a vital component of our analysis and part of our theoretical approach holds that we can only pay attention to a subset of our mental images of meanings in exactly the same way as we can only attend to parts of our visual aural or bodily worlds. This too has important consequences for how our imagination is managed.

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Contributor details

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Gill Clarke studied English and Education, and more recently Social Sciences, and has spent her career as an Independent Dance Artist: performer, teacher, director, researcher. She was a founder member of the Siobhan Davies Dance Company, as well as a working with Janet Smith and Rosemary Butcher and performing with many other choreographers. Gill was Head of Performance at Laban, co-directs Independent Dance (ID) and developed a new M.A. in professional practice: a partnership between ID, TrinityLaban and Siobhan Davies Dance. Her teaching practice is influenced by her studies of Alexander, Feldenkrais method and Ideokinenis techniques and her ongoing independent research.

Philip Barnard worked for the Medical Research Council's Cognition and Brain Sciences Unit in Cambridge, where he carried out research on how memory, attention, language, body states and emotion work together. His ICS model of the human mind has been applied to the design of computer interfaces, and to help understand emotional disorders. He is currently using it to account for the way in which human mental and emotional skills have evolved. Since 2003, he has been collaborating with Wayne McGregor | Random Dance to develop productive synergies between choreographic processes and our knowledge of cognitive neuroscience.

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Notes

[1] This was the unofficial start of the Choreographic Thinking Tools research project that until recently has had two main objectives: (1) to uncover more about the kinds of intelligences involved in contemporary dance making (2) to make this information available to choreographers in a format that is useful.
[2] A list of contemporary choreographers who use scores, tasks, etc. would include William Forsythe, Siobhan Davies, Deborah Hay, Jonathan Burrows, Trisha Brown and Xavier Le Roy.
[3] David Kirsh, another of our science collaborators, has recently published his initial study of Wayne's generation process including tasking (Kirsh et al. 2009).
[4] Jon May is a cognitive psychologist from the University of Plymouth. The results of these initial studies are published in *Dance Research* (May et al. 2011).

[5] For more information on ICS visit: http://www.mrc-cbu.cam.ac.uk/research/emotion/cemhp/phil.barnard/. Accessed 22 December 2011.
[6] Phil Barnard spent his career as a researcher in cognitive psychology dedicated to the development of the ICS through comparative study, e.g. evolution of cognition and application of the model to real-world situations in human–computer interface design and clinical therapy for conditions such as depression and anorexia (Barnard 1985; Barnard et al. 2007).
[7] It involves a complex set of cognitive, emotional and embodied sensory and sense-making modalities and expresses these in rich social and cultural settings.
[8] We would like to thank the company for their part in this project and their input to the development of the tools – Wayne McGregor, Odette Hughes and the dancers: Neil Fleming-Brown, Catarina Carvalho, Agnès Lòpez Rio, Paolo Mangiola, Daniela Neugebauer, Anna Nowak, Maxine Thomas, Antoine Vereecken and Jessica Wright.
[9] Robert and Michele Root-Bernstein write

creative thinking in all fields occurs preverbally […] manifesting itself through emotions, intuitions, images and bodily feelings. The resulting ideas can be translated into one or more formal systems of communication, such as words, equations, pictures, music or dance, only after they are sufficiently developed in their pre-logical forms. […] Learning to think creatively in one discipline therefore opens the door to understanding creative thinking in all disciplines. (1999: vii)

They also draw examples from contemporary dance, which makes their book unique, as dance is an art form often missing from studies of creativity. The Root-Bernsteins' ideas about how to 'exercise the imagination' come closest to the Choreographic Thinking Tools we have been developing. However, their references to dance either focus on the creative thinking skills of the choreographer alone (e.g. Merce Cunningham) or the integrative experience of 'play' out of which dancers create novel forms of movement. They do not discuss how a fuller range of personal creative skills (such as imaging, abstracting, analogizing, dimensional thinking, etc.) can be developed and uniquely expressed through body movement and sensation by the individual dancer.
[10] There are a wide range of named techniques associated with somatic practice such as the Feldenkrais method, Ideokinesis, Skinner Releasing Technique and Body-Mind Centering®. In part these techniques variously associate the concept or theory of a more integrated functioning of mind and body with its attainment through a practice-based heightening of the awareness of sensations. This general theory often foregrounds an interior landscape engaging different forms of imagery and related sensing. Somatic practices seek to discover 'a more functional understanding of the body's various sub-systems (such as skeletal structure, muscular system, fluid systems), with the goal of finding a more integrative approach to sourcing movement material' (Clarke et al. 2010: 208).
[11] From a selection of dancer biographies the kinds of training cited include: Central School of Ballet, London; Ecole Supérieure de Danse de Cannes Rosella Hightower; School of Art, Milan, training in classical ballet, Cunningham technique and improvisational dance theatre; National Ballet School in Lodz; etc.