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Gesture-based cognitive enhancements by random walks and human digital body doubles

Alexander Matthias Gerner¹

Abstract

We will follow an embodied gesture-based example of randomizing reasoning: the importance of chance for the evolution of movement habits enhanced by body gestures as strictly experimentation on stage. This will show us how a technique of automatization and the application of randomness can be mediated specifically by the reasoning technique of >random walks< and enhanced by gesture and body movements and interactions with digital doubles. After introducing random walks and random driven behaviour derived from chance in roulettes, logical and economic theory as well as cybernetics, this paper will show the random walk method in the transdisciplinary dance piece STOCOS.

Keywords

Cognitive enhancement, random walks, gesture-based performance, digital doubles, Peirce

1 - algorizmi dixit: RANDOM WALKS

How to unite choice with ubiquitous randomness of chance? How can we draw randomly, if

our choices of action are caught by an algorithm – a set of rules allowing to perform numerical computation– in a finite number of trials would be always mediated or premeditated by will or “programmed” to find a correct path/decision? Wouldn’t the random or even the randomly absurd be a stronger vector for human action in which the reality conceived as a pure game of hazard or randomness and a primal accidentally of pure chance of life following random paths based on contingency acting locally, could be seen as an automaton. An idea of pure randomness or pure chance (randomness, noise) without final causality as strictly opposed –and not entangled in various notions of (classical physical, quantum –physical, computational and biological randomness)– by pure necessity (order) as proposed by MONOD (1970) as complementary dual aspects of life and a specific “living state of matter” (BUIATTI et al 2004; BUIATTI & BUIATTI 2001), seems today scientifically overcome (cf. BUIATTI & BUIATTI 2008; cf. BUIATTI & LONGO 2013).

Nevertheless, the fictitious automaton of action expressed by the murderer in Camus’s novel “The Stranger” in his negative response

¹ Dr. Alexander Matthias Gerner (PhD in History and Philosophy of Science), Head: Philosophy of Human Technology at the CFCUL, amgerner@fc.ul.pt. This paper was made possible by a FCT post-doc grant SFRH/BPD/90360/2012 on “Philosophy of Cognitive Enhancement” <http://cognitiveenhancement.weebly.com/>

to the persecutors question, if he had intended to kill the (nameless¹) man on a hot sunny afternoon at the beach: "(...) it was a matter of pure chance". The questions of randomness or purposelessness develop into dynamic uncertainties on a more abstract level, specifically in cases of complexity sciences such as cybernetics (WIENER² 1948; critical TAYLOR 1950a,1950b; cf. HGENER 2008) and its disciplinary influences derived and deviated from mathematical logic: Leibniz universal symbolism and calculus ratiocinator and Pascal's arithmetic machine³. These were aimed at the mechanization, exporting, externalization and delegation of human thought processes (machina ratiomatrix) into inert matter away from any idea of a pure science of mind (BOOLE 1854) and towards an experimental epistemology of cybernetics by putting human bodies into perspectives of either a) "purposeful" or b) random –e.g. (non)-feedback driven- behaviour as indicated in the second order of distinction in the diagram below:

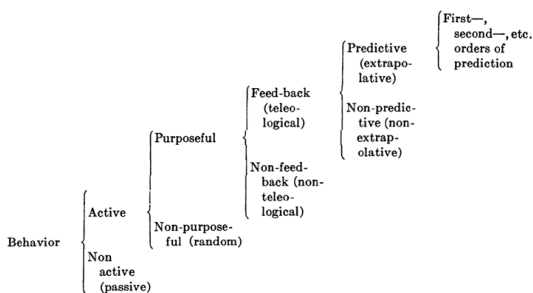


Diagram 1- taken from: ROSENBLUTH, WIENER & BIGELOW 1943, 21

PEIRCE in his "Theory of probable inference"(1883) notes that the abstention of self-controlled logical notations is not easy to be achieved, and thus should be tried out by

using random trials and bets, as in the case of "random drawings" of hand gestures with the technical help of mechanical randomizing tools such using the function of such a betting machine, "designed precisely for purposelessness" (ROSENBLUETH, WIENER & BIEGELOW, 19): a roulette⁴:

(...) this abstention from a further determination of our choice often demands an effort of the will that is beyond our strength; and in that case a mechanical contrivance may be called to our aid. We may, for example, number all the objects of the lot, and we may even go so far as to say that this method is the type of all random drawing; for when we abstract our attention from the peculiarities of objects, the psychologists tell us that what we do is to substitute for the images of sense certain mental signs, and when we proceed to a random and arbitrary choice among these abstract objects we are governed by fortuitous determinations of the nervous system, which in this case serves the purpose of a roulette. PEIRCE, CP 2.727

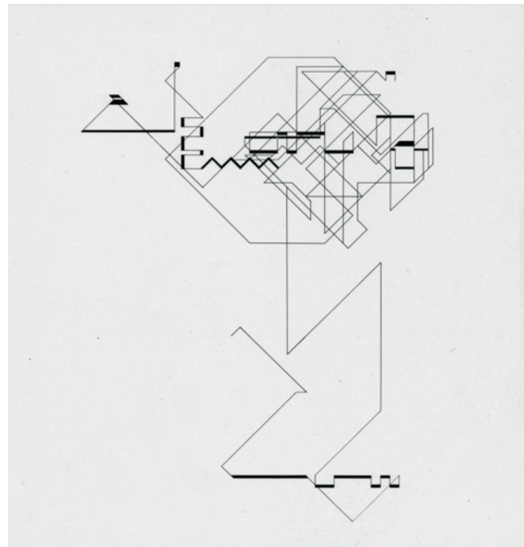
Let us follow Charles Saunders Peirce's thought on techniques of abstention of purposeful choice aiming at randomizing reasoning: the importance of chance for the evolution of habits of reasoning enhanced by body movements as >strictly experimentation< with the help of specific art works show us how a technique of automatization and the application of ran-

domness can be mediated specifically by the reasoning technique of >random walks<.

The terminology goes back to Karl PEARSON's 1905 essay "The problem of the random walk"⁵. A random walk is hereby defined as a mathematical model for a movement in which the individual steps are carried out at random. These stochastic processes in discrete time are suitable for non-deterministic time series as they are for example used in financial mathematics for modeling stock prices (proposing a random walk hypothesis⁶). With their help, the probability distributions of measured values of physical quantities can be understood. The contemporary importance of handling dynamic or even "predatory" (Johnson et al 2013) algorithms in the stock markets is nowadays due to the subhuman experiential threshold level events at the millisecond-scale in which data of the global financial market in a new all-machine phase characterized by large numbers of sub-second extreme events automatize the stock market below human decision-making capacities "as humans lose the ability to intervene in real time."(Ibid.) These sub-second extreme algorithmic events are causally linked to the system-wide financial collapse in 2008.

The application in contemporary art of the usage of for instance Venn's random visualization of the decimal digits of p as VENN in 1866 proposes in his "The Logic of Chance", suggesting that the digits 0 to 7 represent eight compass directions, and can be followed as a movement path tracked by these digits in p - even though Venn had left out the initial number "3", and started from 1 4 1 5 9 9 - in the contemporary computer-assisted artist Manfred Mohr in his "Random Walks" series

from the late 1960's produced for instance at Brookhaven National Laboratory in 1969.



Manfred Mohr P-18 Random Walk plotter drawing ink on paper 50cm x 50cm 1969
Image 3 of 5

Diagram 2 - early digital plotter print of Manfred Mohr "P-18 Random Walk" plotter drawing; ink on paper 50cm x 50cm (1969) screenshot taken from: <http://dam.org/artists/phase-one/manfred-mohr/artworks-bodies-of-work/early-algorithmic-works>

Today, this double concept of movement and randomness in random walks are frequently used in formalized methods of probability and statistics, static uncertainties in forecasting and predictions, but are also re-embodied in performative settings such as created by Live Coding (Toplap) often linking performance art and contemporary choreography dance with the generation of spatial-temporal structures on spot, without backup or pre-recorded actions, visualizations or automata and playback systems.



Manfred Mohr P-10-2 Random Walk
plotter drawing ink on paper 50cm x
35cm 1969
Image 2 of 5



Diagram 3 - design generated by an algorithm in Manfred Mohr P-10-2 Random Walk plotter drawing ink on paper 50cm x 35cm 1969 screenshot taken from: <http://dam.org/artists/phase-one/manfred-mohr/artworks-bodies-of-work/early-algorithmic-works>

2 - Gesture-based cognitive enhancements by algorithmic human body doubles on stage

The double notion of transformation of alterity experience in staging algorithmic gesture-controlled AI-human interaction on a performance stage inside the cultural change of the digitalisation of culture (Vinck 2016) such as theatre/performative arts, including the appearance of robots and avatars, the expansion of the theatre-stage and the establishment of an 'augmented space' by mixing real and virtual aspects and the use of new media, non-human

actors –such as AI algorithms or game tools. In a contemporary dance piece that uses live coding - controlled by performer's gestures- and random walks such as Muriel Romero's, Daniel Biesig and Pablo Palacio's reference art work "Stocos" (2011) based on random walks structure different random walks methods are used for experimentation of each dancer, creating a gesture-based virtual reverberation feedback of the original physical movement of the dancers bodies in topological space, a variation by algorithmic AI mediated visual and acoustic swarm interaction. Thus, another question of interest is related to a) the initiation of b) doubling of and c) interaction with non-identical arithmetic body doubles, and how these influence (performative) art praxis and our embodied participation with others inside social cognitive interaction.

Of course, an uncanny effect can be part of the performance when digital body doubles of the performers are introduced. For example, technologically mediated Full-body illusions among other forms of illusion of embodiment- e.g. autoscopic experiences (Blanke, Slater & Serino 2015; Brugger 2002; 2006) can have uncanny lasting effects- e.g. derealization or feeling of detachment/substitution and disembodiment: sharing the stage with ghosts.

However this paper hinges not on abstract and disembodied logical notations of infinity and uncertainty and the non-predictable but on the technological double that can be described as pre-intentional or simply put: the materially "disembodied gestures, reduced to their referential system of transformations" (MAZZOLA 2011,9) in relation to living organisms, that besides their morphological, functional machinic⁷ bodies, seem to have the need

to create arithmetic and virtual doubles besides (or because of?) their (metabolic) needs. As JONAS (2001) perfectly explained:

“Living things are creatures of need. Only living things have needs and act of needs. Need is based both on the necessity of continuous self-renewal of the organism by the metabolic process, and by the organism’s elemental urge thus precariously continue itself” (JONAS, 2001,126)

But may there be as well a human need (MASLOW 1943) not only to reproduce or provide self-conservation, but even a need to double him/herself in artistic processes and create arithmetic, virtual or secondary body doubles, doppelgänger or shadows of him/herself? Hereby also the question arises if there are different instances of randomness that have to be differentiated and related such as mathematical, computational-logical, physical (classical and quantum) and biological (including behavioural and symbolic) randomness - in far from equilibrium (BUIATTI & LONGO 2013) systems- mediated through ontogenesis and phylogenesis in their multi-level interactions (cf. BUIATTI & BUIATTI 2008) also on the behavioral and symbolic level.



Diagram 4 & Diagram 5 - from Videostills taken from the dance project “Stocos” (2011-2012; 50min)taken from the documentary at the Auditorium of Tenerife with Pablo Palacio <https://vimeo.com/64567060> The swarm intelligent visuals create doubles of the performers bodily gestures and movements in order to enhance their interaction

The transdisciplinary dance project Stocos (2011-2012) works on the algorithmic double as interaction and transpositions of dynamic algorithmic mechanisms onto the choreographic field of bodily gestures, generating variations with stochastic and random walk schema in choreography and by that generates variations on two places on stage by the two performers and their social interplay in movement and changing multimodal planes (topological, sound-time, gesture-movement) in which stochastic processes in AI based visual simulations create behavioural dependencies and interactions with an extended algorithmically swarm-generated double or secondary self of the gesture-based performers.

“Stocos is the third part of a trilogy focused on the analysis and development of the interaction between sonic gesture and dance gesture inside three-dimensional sound spaces. (...) As a result, the stage becomes a

responsive environment whose visual and acoustic properties emerge from the mutual interactions between the dancers, stochastic sound synthesis and swarm simulations." (PALACIO⁸).

Stocos uses an embodied approach to gesture⁹ - based Artificial Intelligence – in a collaboration of Muriel Romero, Pablo Palacio and the AI researcher Daniel BIESIG (2012) in the sense of a holistic view combining mental and bodily capabilities situated in the environment - and interactive dance with intelligent visuals, interacting with gestures, body-postures and socially related body movement of the dancers and the sonic landscapes: Besides the enhancement of stochastic sound synthesis, the interaction of the performers with their stochastic or algorithmic selves and shadows presented in the visuals is generated by gesture-controlled AI swarm behaviour that is itself inspired by the "free stochastic music" based on random walks and sonic art of Iannis XENAKIS¹⁰:

"Sound in Stocos is generated using a software implementation of dynamic stochastic synthesis, a rigorous algorithmic composition procedure conceived by Iannis Xenakis. It uses mathematical concept of random walks to produce both duration structure and timbral fluctuations in computer-generated sound, resulting in a huge gamut of sonic entities. An original version of the algorithm was written in Supercollider language. Stocos proposes an extension of the Xenakian algorithm using swarm simu-

lations to modulate the parameters that define the dynamic stochastic algorithm. These parameters are, at some moments of the piece, controlled by the activity of the dancers." (PALACIO, *Ibid*)

The gestures of the performers effectuate –at certain moments of the performance piece– not only technological music soundscapes, but as well the light design, in which the visual and the acoustic environments become enhanced in their responsiveness to the environment. The responsiveness of the environment is lined up to feedback mechanisms triggered by the gestures of the performers that overcome certain sensory-thresholds of stillness and movement in their body gestures and random walk structures of movement. Herby their bodies are inscribed inside an arithmetic control feedback loop given within a numerical topologic grid, that systematizes the performers original 6 degrees of freedom in movement.

Notes

- ¹ cf. the literary response on the nameless murdered "Arab" in: DAOUD, K. (2014). *The Mersault Investigations*. Translated from the French by John Cullen, Other Press
- ² WIENER, N (1985[1948]). *Cybernetics. Or Control and Communication in the Animal and Machine*. Second edition. Cambridge Mass: MIT, p.12
- ³ As Pascals sister announces it: "... cette machine d'arithmétique par laquelle on fait non seulement tout sortes de supputations sans

plume es sans jeton, mais on les fait meme sans savoir aucune règle d'arothmétique, et avec une sûreté infallible. Cet ouvrage a été considéré comme une chose nouvelle dans la nature, d'avoire réduit en machine une science que reside tout entière dans lésprit, et d' avoir trouvé le moyen d'en faire toute les operations avec un entière certitude, sans avoir besoin de raisonnement." Gilbert Périer, in: E. Havet (ed.). Vie de Blaise Pascal. Cit. in: BLUMENBERG 2015, p. 229, n.27)

- ⁴ Critical against the position of a *roulette being intrinsically a purposeless tool* cf. TAYLOR 1950, 314-5 and not being as well *used by a being with a purpose* (in order to achieve a random number). This critique encounters in LONGO et al 2011 an approach that tries to develop not only different concepts and relations of randomness and order but also to distinguish different levels of randomness related to different disciplines such as (1) physical randomness a) classic b) quantum -and their still outstanding unification- (2) algorithmic randomness (3) computer science randomness (4) biological randomness
- ⁵ "The Problem of the Random Walk (...) Can any of your readers refer me to a walk wherein I should find a solution of the following problem, or failing the knowledge of any existing solution provide me an original one? (...) A man starts from a point *O* and walks *l* yards in a straight line; he then turns through any angle whatever and walks another *l* yards in a second straight line. He repeats this process *n* times. I require the probability that after these *n* stretches he is at a distance between *r* and *r+dr* from his starting point, *O*." PEARSON, 1905, p.294.
- ⁶ cf: BACHLIER (1900) and COWLES (1933)

⁷ Even in regard to organisms Maturana and Varela see living organisms as non-purposeful machines or systems:" Living systems, as physical autopoietic machines, are purposeless systems" MATURANA & VARELA 1980 [1973], 86. Here they inscribe themselves in the physiological stance based entirely on physics and chemistry from von Helmholtz, Du Bois-Raymond, Brücke tradition of the principle of substantial equivalence of living and non-living systems.

- ⁸ PALACIO, P. retrieved from: <http://www.palopalacio.com/STOCOS.html>
- ⁹ BIESIG, B, PALACIO, P. (2012). "STOCOS Dance in a Synergistic Environment" Conference paper at the 15h Generative Art Conference GA2012; cf. SMALLY (1997).
- ¹⁰ An attempt at musical synthesis according to this orientation is to begin from a probabilistic wave form (random walk or Brownian movement) constructed from varied distributions in the two dimensions, amplitude and time (*a*, *t*), all while injecting periodicities in *t* and symmetries in *a*." XENAKIS, 1992, p.289; cf. Xenakis random walk based sonic art piece: *N'Shirna (1975)* online: <https://www.youtube.com/watch?v=dNd81WWYgYE>

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