



AUTOPOIESIS AND DANCE

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Creativity in movement and dance

There are many ways to think about systems that choreograph movements that we socially conceive of as dance. This theoretical work¹ is inspired by Alfred North Whitehead's *process view of organisation*² [22], viewed through the transformational conceptual-lens of *autopoietic theory* (Maturana and Varela [15]); according to which we view a creative system as a clearly delineated and identifiable network of *continuously operational* component producing processes and concomitant elements, bounded as an autonomous entity *within its own creative environment*.

So construed, the autopoietic dancer can never be fully satisfied with her work, but continually re-engages a complex process of 'attention' (on *her* current movement context) and 'reconstitution' (of *her* body), as she *creatively* reflects and *enacts* her world.

The autopoietic dancer lives in a universe of *meaning-distinctions* - the totality of which constituting her *dance field* - and her dance begins as creative processes are drawn to, and collectively attend, these distinction(s); from which she chooses one element, the most 'interesting' gesture, to (re)interpret. In this manner the autopoietic dancer continuously reflects and refracts back into the world *she* has just brought forth, reinventing her universe in order that she may subsequently generate further new (re)interpretations.

As interpretations disappear with their appearance, they cannot be altered, but only give cause for the production of new movements, which are subject to the same mechanism. Thus, while there is a stimulating dance-field with which to interact - *and she continues to (re)interpret interesting and meaningful gestures* - this autopoietic unity will continue intact. Conversely, as the dance-field becomes less stimulating, the meaning-distinctions become less interesting and the autopoietic unity more-likely to fade and ultimately dis- solve; in the very moment of such movements coming into being, they already fade away and the dancer returns to reflect stillness again³.

On 'meaning distinctions' and the 'dance field'

Central to the operation of the dancer's autopoietic unity is the identification of inter- esting meaning distinctions in the dance field which, through her dance, she is able to (re)interpret.

Relationship to the Stanislavsky system

The dance field is comprised of 'mean- ing distinctions'; emerging from the dancer's *umwelt*⁴ of elements and gestures - *an open door; a movement of the head; the tension in a finger or arm; an inviting smile; a light; a memory invoked; a shadow etc.* - in this manner 'meaning distinctions' distinct to the dancer, neither fully subjective or objective in character, are brought-forth through her choreographic interaction with the environment.

The totality of such 'atomic' meaning distinctions - delineating her sensorium, *or field*, of movement embedded in sight, sound, touch and personal lived history - comprise the artist's *dance field*. By modulating the distinctions she is drawn to attend, as she cre- atively interacts with and explores her environment, the autopoietic dancer adapts what she construes as [artistically] 'meaningful' in her own historical dialogue.

Furthermore we observe that the 'dance field', so defined, has resonance with core ideas from Stanislavsky through the notion of the *Attention Field* [8]; as Clare (ibid) outlines:

"The arrangement of information in Stanislavskys inner world, then, is orientational, or adpositional, because it is orientated in positional rela- tionships to a source in a no-

tional three-dimensional space. In an adpositional model relationship is key. Therefore, in this perceptual model, the circumstances of a persons life at any given moment (on-line) are located perceptually in space, adpositionally: around the body. At any moment, we are experiencing a particular configuration of available thoughts, memories, and feelings: I have called this an *attention field*. Patterns and consistencies within this field are apparent to the observer as that information is leaked both verbally and non-verbally.”

Relationship to Dynamic Field Theory

In modern cognitive science *Dynamic Field Theory* outlines a important shift towards a new and intentionally integrated theory of cognition. Thus, in their introduction to the work of the DFT Research Group, as they move toward a unified theory of cognitive dynamics, Spencer and Schoner suggest:

“DFT provides an embodied account, that is, neural processes are grounded in sensory and motor processes that are anchored on a body situated in a physical environment .. we are pursuing a general theory that spans perception, action, and cognition .. carrying forward a set of common principles as we move from lower- to higher-level cognition”, [20].

Furthermore, in [8] Clare grounds the cognitive dynamics of ‘Dynamic Field theory’ to the actor via the notion of ‘attention field’ as follows:

“The Group outlines different types of ‘attention fields’ - spatial attention fields, scene attention fields, feature attention fields, transformation attention fields, contrast fields retinal fields within which attentional foregrounding, hills and peaks of activation, and sequential transitions occur. Although these are short-term attention fields, they can be related to the constructed attention field of the actor, a long-term, artificially sustained field with a complex contextual function .. Other relevant aspects of DFT include descriptions of working memory fields as feature, spatial, or scene .. In a chapter on Integrating perception-action with cognition (pp. 197-226), Schneegans, Spencer, and Schoner address the attention field and working memory patterns of individuals in relation to objects in the real world - it would be extremely useful to extend this to imagined objects and the conceptual world within which actors function and construct the lives of their parts over time.”

On autopoiesis and allopoiesis

Autopoiesis or self-creation

Maturana and Varela's original definition of autopoiesis is found in [15]:

“An autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network”, (p. 78).

Thus, the boundary of an autopoietic system is determined circularly by the production of its constituent elements; in this way the organisation of, say, a cell is both ‘circular’ and autopoietic because the components that specify the cell are the same components that the organisation of the cell secures and maintains. It is this circularity that maintains the cell as a *living* entity. It is in this sense that an autopoietic system can be considered as a special type of *homeostatic system*, where the variable to be maintained and controlled is the *organisation and behaviour* of the system. For Francisco Varela, autopoiesis is both necessary and sufficient to characterise the organisation of *living, autonomous* systems.

In addition to maintaining the conditions for its own continued existence, an autopoietic system may, in addition, generate *allopoietic system(s)* as output(s).

Allopoiesis

In contrast to autopoiesis, the operation of an allopoietic system is given in terms of the concatenation of processes. Such processes are not the processes that specify the components of the system itself, as a unity; instead the components are produced by other processes that are independent of the organisation of the system. Because the components that make up an allopoietic system's existence are contingent upon other systems, an allopoietic system is never ‘fully autonomous’. Some examples of allopoietic systems are: cars, trains, robots etc.

Furthermore, because an allopoietic system is always contingent on the output of other systems for its existence, its teleology and meaning will always reside in the observers world, never in its own - the systems - world.

On the autopoietic status of systems

To determine whether a system is or is not autopoietic in its organization, Varela et al. [21] have developed six key points or criteria that should be applied to the system; Koskinen [11] restates these criteria as follows:

1. Determine, through interactions, if the unity has identifiable boundaries. If the boundaries can be determined, proceed to 2. If not, the entity is indescribable and we can say nothing.
2. Determine if there are constitutive elements of the unity, that is, components of the unity. If these components can be described, proceed to 3. If not, the unity is an un-analyzable whole and therefore not an autopoietic system.
3. Determine if the unity is a mechanistic system, that is, if the component properties are capable of satisfying certain relations that determine the unity, the interactions, and transformations of these components. If this is the case, proceed to 4. If not, the unity is not an autopoietic system.
4. Determine if the components that constitute the boundaries of the unity constitute these boundaries through preferential neighbourhood relations and interactions between themselves, as determined by their properties in the space of their interactions. If this is not the case, you do not have an autopoietic unity because you are determining its boundaries, not the unity itself. If 4 is the case, however, proceed to 5.
5. Determine if the components of the boundaries of the unity are produced by the interactions of the components of the unity, either by transformation of previously produced components, or by transformations and/ or coupling of non-component elements that enter the unity through its boundaries. If not, you do not have an autopoietic unity; if yes, proceed to 6.
6. If all the other components of the unity are also produced by the interactions of its components as in 5, and if those which are not produced by the interactions of other components participate as necessary permanent constitutive components in the production of other components, you have an autopoietic unity *in the space in which its components exist*. If this is not the case and there are components in the unity not produced by components of the unity as in 5, or if there are components of the unity which do not participate in the production of other components, you do not have an autopoietic unity.

Thus, the successful application of the above six-point taxonomy is sufficient to determine if a system is autopoietically organized (or not).

Luhmann: autopoiesis and social systems

In formulating his *law of requisite variety* William Ross Ashby [3] observed that to survive in a complex environment while maintaining internal stability and structure, a system must be able to generate an appropriate gamut of responses to an ever changing environment. In contrast, General Systems Theory, as formulated by Ludwig von Bertalanffy [5], assumes an *open systems model*⁵, viewing complex systems in terms of the difference between ‘the system and its environment’; contra a *closed system model*⁶ and mereological distinctions between, say, the physical instantiation of ‘whole and parts’.

Influenced by General Systems Theory, the core element of Niklas Luhmann’s ‘system theoretic’ view of social systems is communication: social systems *are* systems of communication and society *is* the most encompassing social system. In Luhmann’s view [13] a social system is defined by the boundary between itself and its environment, which is considered an infinitely complex (‘chaotic’) exterior. Thus, relative to the exterior, the interior of the social system is a space of reduced complexity: communication within a social system operates by selecting only a limited element of all the information available outside the system. In this way Luhmann’s concept of communication inherently entails a “reduction of complexity”, whereby the criteria according to which information is selected and processed is *meaning*. Thus social systems are *operationally closed* because, while they use and rely on resources from their environment, those resources do not become an integral part of the systems’ operation.

Thus for Luhmann, social systems operate by processing meaning and furthermore, each system has a distinctive identity; a unity, that is constantly reproduced in its communication and depends on what is considered meaningful (and what is not) for that system. If the system fails to maintain this identity, it dies, it ceases to exist and it dissolves back into the wider environmental ether whence it came.

Luhmann conceived this process of continuous reproduction from elements previously filtered from an over-complex environment as *autopoiesis*⁷.

‘Creativity’ as an autopoietic process

Historical

The resonance of art with autopoiesis has been explored by several thinkers, most notably Luhmann who in his theory of social systems [14] famously put forward a ‘theory of art’ as “*a particular system of communication*”, i.e. “*.. the function of art can be traced to problems of meaningful communication*” [12]. For Luhmann, the domain of art is to

be viewed as an operationally closed and self-referential communicative system, an autopoietic system; radically suggesting that it is “.. *from the autopoiesis of art which works of art will be created*”. This led Rampley, in his review [19], to suggest that the “.. *key question Luhmann addresses [in his conception of art and autopoiesis] is how art differentiates itself from other systems*”.

A traditional, representation-heavy, view of the artist as an open-system, fundamentally posits the artist's activities as contingent on external influences; the artist responds creatively to demands from a pre-given, objective environment by building and creatively processing appropriate internal representations. In this view, through his art, the artist builds representations of a pre-given reality - universal, objective, and transferable - and it is his role, as artist, to transform these representations in novel, interesting and creative ways.

The contrary, autopoietic perspective reflects that creativity is autonomous and operationally closed⁸. In addition, autopoietic creative systems stand ‘structurally coupled’ with their medium; fundamentally embedded in a dynamic of changes, exercised via appropriate sense-action coupling. This continuous dynamic can be considered a rudimentary form of *creative knowledge*.

Emerging from a *General System Theory* perspective, the exploration of autopoiesis in the context of ‘creativity studies’ was first outlined by Gornev in 1997 [9] who first set out to construct a theory of human creativity on the foundation of autopoietic systems theory (AST), whereby:

“creativity is seen as an activity recurrently reproduced by couplings of specific states of moderate emotional arousal with transitional environments, i.e. soft social structures in which the world is permitted to be both subjective and objective; the archetype of these creative couplings can be found in the earliest perfect environment formed by the symbiotic infant/mother relationship”.

In contrast in 2010 Takashi Iba [10] defined “Creative Systems Theory” in order to view *creative processes*⁹ in an alternative way, “.. *focusing the process itself without the reference to psychic or social aspects*”. In his work Iba postulated *creative processes* to be “autopoietic systems whose elements are ‘discoveries’ emerged by a synthesis of three selections: *idea, association, and consequence*”.

However, by merely defining that “creativity is an autopoietic system whose element is *discovery*”, Iba's work, like Gornev's first tentative explorations thirteen years earlier, remains floating very much at a conceptual level; it offers little insight into how ‘creative process’ at the personal, ‘psychic’, *artistic* level could ever actually be cashed out; indeed, as he stated in the paper (ibid), this was never his project.

Our view

Conversely, and in an analogous manner to Luhmann's conception of *information processing*, we view *creativity* as entailing a reduction in complexity of meaning in the environment; with the system operationally closed because, while its creativity uses and relies upon resources from its environment, these resources do not become part of the underlying systems' operation.

Viewed under this conception, a creative system (a) processes *meaning* and (b) maintains a distinctive identity; a unity that is repeatedly reproduced in its operation, contingent upon what is considered meaningful (or not) for the system. If the environmental conditions are such that, over time, the creative system can no longer maintain this identity, then its investigations will simply *dissolve away* to void.

In this way creativity is a *constructive process*; it inherently reflects an *individually constructed artistic reality*. Furthermore, because autopoietic creativity emerges from the observation of *distinctions* and not of *things*, its operation is fundamentally contingent on its own history, and in this way is ever-sensitive to its own historical context.

In summary, and in contrast to the classical view of creative processes building (reflecting on and transforming) representations of a pre-given, out-there, world, an autopoietic view of creativity is based on the simultaneous knowledge processes of *sensing* and *memory*. In this context memory¹⁰ entails that:

- the unity has access to its existing knowledge;
- previous, accumulated, knowledge modulates the the unity's ongoing structures and operations;
- the unity's cognitive structures and operation affect its acquisition of new data from the environment and its creation of new internal knowledge structures.

Furthermore, we observe that by conceptualising creative processes within an autopoietic framework, we must conclude that *creativity* is never a directly transferable skill or knowledge¹¹.

Autopoiesis, creativity and dance

In our work we examine a dancer, typically working with a rehearsal director, a choreographer, who guides the dancer's movements. We consider the *space* defined by the dancer's state-of-mind, the dancer's movements and teacher's movements as the *dance-field*¹². The continual *creative processes* of attention and reconstitution (movement) mechanisms that act in this field are detailed in the accompanying paper (in the context of 'the Autopoietic Artist' - a 'weakly creative' computational drawing system) [2].

In summary, we view the creative, guided-improvisations of the ‘autopoietic’ dancer as being primarily directed by two functionally distinct processes: (i) a process of attention whereby the dancers ‘cognitive resources’ are drawn to (potentially multiple) elements of meaning-distinction in the dance-field that are *in some sense* important to the dancer (in [2] we suggest this could be computationally realised by stochastic diffusion processes [6]) and (ii) a process of *interpretation* whereby a movement is (re) interpreted by the dancer in her performance (a process which in [2] we suggest could be computationally realised by a ‘particle swarm’). Elements of the dance-field that are most meaningful/important to the dancer (at this particular instant in time) will attract the most cognitive resources, resulting in these elements to be attended to next by the (re)interpretation processes controlling the dancer’s movement(s).

NB. It is a natural consequence of considering the dancer’s control of her creative movements as an autopoietic process defined in this way, that a skilled dancer/performer will find some aspects of movement relatively simple (less interesting/meaningful) and hence not deploy so much cognitive resources to their (re)interpretation as a dancer relatively new to the movement; in this way the skilled dancer is thus free to redeploy resources in more meaningful areas of performance, perhaps focussing on perfecting the technicalities of a particularly difficult movement, or perhaps focussing on synthesising her movements *as a whole* etc.

In this manner the ‘autopoietic’ dancer is thus continually engaged in a process of sensing her environment (the dance-field) and reconstituting it (by iteratively first choosing a gesture of meaning and (re)interpreting it); hence Varela et al’s criteria [21] for an autopoietic entity are appropriately instantiated in the cognitive processes of the ‘autopoietic’ dancer acting *in the space in which her creative unity exists*.

Over time, with her ‘interest’ drawn to areas rich in meaning (peculiar to her), the autopoietic dancer, so construed, iteratively reinterprets meaningful-distinctions (gestures) in her current dance-field, so offering a very personal reinterpretation of the structure of the work. Over time though, inevitably less of the dance-field will continue to offer up meaningful-distinctions, at which point the dancer’s attention becomes gradually less focussed as her creative process stultify and eventually cease; reifying the movements’ ‘death’ and returning the dancer to silence. Thus, following Luhmann’s conception of *information processing*, we view the working autopoietic dancer as inevitably entailing a reduction in complexity, ravenously consuming ‘meaning-distinctions’ within her environment (the dance-field) until none remain and movement ends ..

The autopoietic dancer as a 'strongly' creative system

In summary, in the context of Al-Rifaie and Bishop's 'weak' and 'strong' taxonomy of [computational] creativity [1], we suggest autopoiesis offers a new conception of 'strong' creativity' in movement. Furthermore, and in contrast to the computational autopoietic artist [2], because the dancer's cognitive processes select areas of *meaning distinction* that are, in her current context, paradigmatically meaningful *to her*, the autopoietic dancer - richly embodied in her environment, the dance-field - constitutes a fully autonomous *strongly creative* system.

Endnotes

- 1 This paper merely presents the first *philosophical exegesis* by the author of the core generic concepts relating autopoiesis and creativity discussed at AISB2016, Sheffield UK; cf. Bishop & Al-Rifaie, *Autopoiesis, creativity and Dance* [7] and Al-Rifaie, Leymarie, Latham & Bishop et al *Swarmic Autopoiesis: Decoding de Kooning* [2]. The original conceptual driver - relating swarm intelligence and autopoiesis - first emerged in work by Al-Rifaie and Bishop [on swarmic sketching] and subsequent discussions on computational art with Leymarie and Latham. It is noted that the 'autopoietic artist' has been already been successfully simulated [2]. Deploying choreographic conceptions outlined herein, ongoing research moves to extend these notions to implement an 'autopoietic dancer'.
- 2 For Whitehead, all real objects may be better understood as a constructed series of events and processes. It is this core idea that Whitehead explains the seminal 'Process and Reality' [22], concluding that it is process, rather than substance, that should be taken as the most fundamental metaphysical constituent of the world, "*That 'all things flow' is the first vague generalization which the unsystematized, barely analysed, intuition of men has produced. Without doubt, if we are to go back to that ultimate, integral experience, unwarped by the sophistications of theory, that experience whose elucidation is the final aim of philosophy, the flux of things is one ultimate generalization around which we must weave our philosophical system*", (ibid. pp. 317).
- 3 .. in much the same way as Koskinen identifies that all business organisations eventually wither, dissolve away and ultimately die "*.. decisions have to be imagined as events. In the very moment of their coming into being, they already fade away. Therefore, only little can be changed in business organizations. As decisions disappear with their appearance, they cannot be altered, but only give cause for the production of new decisions, which are subject to the same mechanism. And this is the reason why business organizations step by step wither and die*", (K.U. Koskinen, 'Why do Business Organizations die? Social Autopoietic Perspective').
- 4 As Clare[8] observes, "Jacob von Uexkull labelled perception of the world, experienced by and through the capacity of species-specific bodies, the *umwelt*: literally surround-world. That is to say it is inherently embodied because it is biologically limited by the sensory apparatus of the physical body. Stanislavskys training is, I believe, unique, in that it implicitly addresses this very subject, teaching the student to contextualize their individual *umwelt* within a wider framework of the human *umwelt*: the spatial adpositional *umwelt*. This both frames the acting process and opens the students awareness to what is humanly possible."
- 5 An open system exchanges material, energy, people, capital, information etc. with its environment.

- 6 A closed system does not allow transfers in or out of the system.
- 7 NB. Both Varela and Maturana have forcefully argued against this appropriation of the term autopoiesis; in Maturana and Varela's conception, people cannot be proper elements of a social system's renewal because (a) in describing social systems as operationally closed networks of communications, Luhmann ignores the fact that communications presuppose *human* communicators [17] and (b) people are not (*re*) *produced* as an integral and core part of a social system's renewal processes [18].
- 8 It is operationally close in the sense that there are sufficient processes within it to maintain the unity of creation and that, while they use (and rely upon) resources from their environment, those resources do not themselves become an integral core element of the creative systems' operation.
- 9 Iba defines that a creative process consists of "a sequence of discoveries, which include problem finding, problem solving, observation, hypothesis formation, method selection, practice, and interpretation", (ibid).
- 10 A *self-referential* process which facilitates access to, and learning from, previous experiences and knowledge [11].
- 11 Cf. Koskinen on 'autopoietic knowledge systems in project-based companies' [ibid]
- 12 Mathematically imagined represented as a complex manifold.

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