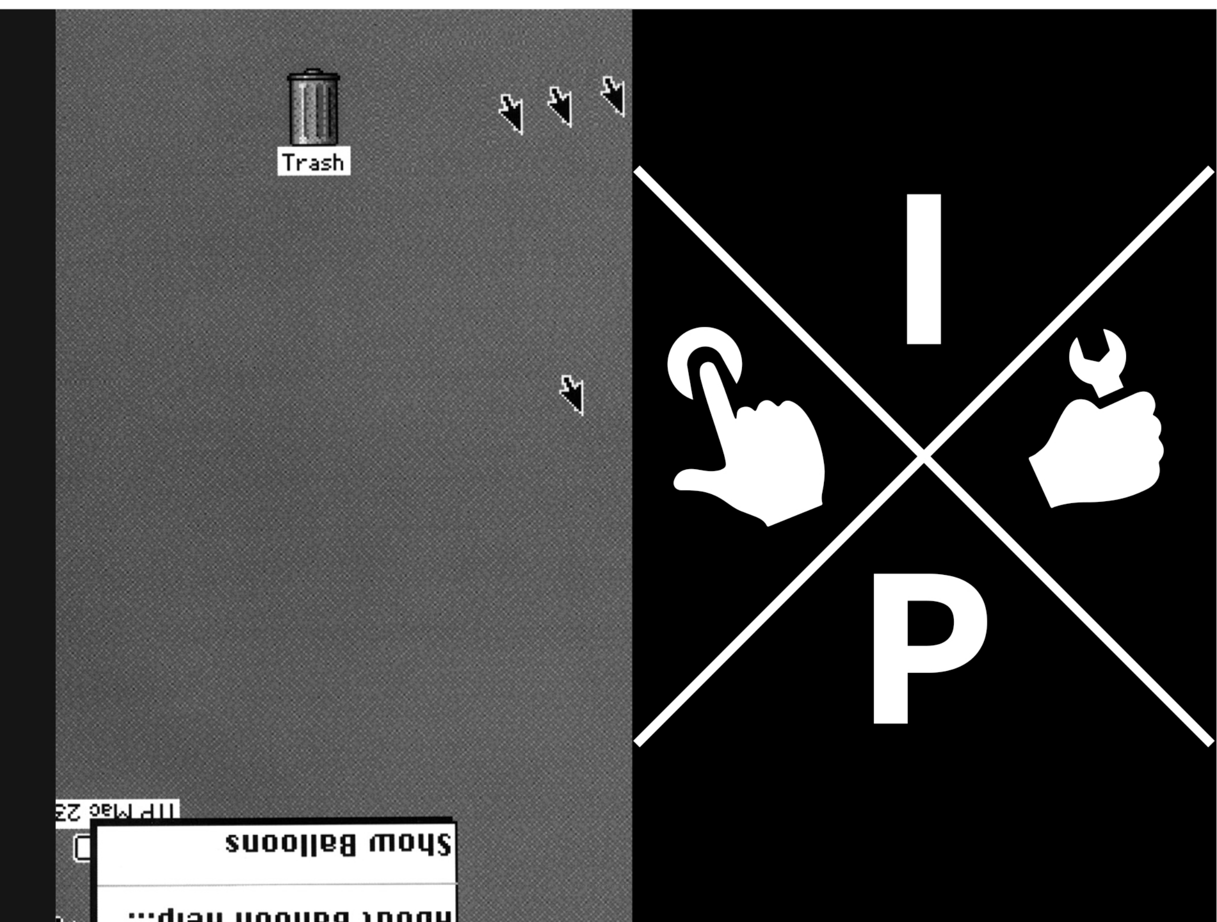
View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Royal Holloway - Pure

Interface Politics

1st International Conference 2016

GREDITS
Grup de Recerca en Disseny i Transformació Social



PUBLICACIONES GREDITS

Bau, Centre Universitari de Disseny de Barcelona

Editores:
Teresa Martínez Figuerola
Jorge Luis Marzo

Comité Científico:

GREDITS
Grup de Recerca en Disseny i Transformació Social

www.gredits.org

1ª Edición.
Cantidad de ejemplares 150
Barcelona, España.
Septiembre 2016

Impresión:
9. disseny
Diseño y maquetación:
Best Boy

ISBN (Ed. Impresa): 978-84-617-5132-7
Depósito Legal: DL B 20848-2016
Copyrights de la publicación:
Bau, Centro Universitario de Diseño
Copyrights de los textos:
Todos los autores

El contenido de los artículos es de absoluta responsabilidad de los autores.

Joan Soler-Adillon

Interfacing with the unexpected: notes towards a design theory for emergent interaction

Abstract

This paper presents a first approach to the design of emergent behaviors and interfaces in the context of interactive arts. The main conceptual issues involved are presented, along with the metadesign challenge implied in designing something that, by definition, cannot be designed per se. Key examples are discussed and used as examples of successful attempts to generate emergence in interactive art. Whilst the issue remains largely unsolved, these examples and the proposed theoretical framework are presented as a starting point towards the design of interactivity that can be regarded as being emergent.

Keywords: *Emergence, interactivity, design, behavior, interface*

1. Introduction: Emergence and Digital Art

Emergence is often referred to as the idea of the whole being more than the sum of its parts, or of being order out of chaos. In this sense, it refers to the idea of complex behaviors arising from an aggregate of relatively simple elements with relatively simple behaviors (Langton, 1988; Holland, 1998; Bedau, 2008). In other accounts, complementary of those in occasions, it is related to fundamental novelty (i.e. the appearance of novel and unexpected behaviors) (Cariani, 1992; 2012; Steels, 1992). It can be argued that emergence refers, in fact, to either (or both) a self-organization process or the appearance of novelty (Nagel, 1961; Soler-Adillon and Penny, 2014; Soler-Adillon, 2015).

The concept found a fertile ground in Complexity Sciences, where it became a central concern, especially in the field of Artificial Life (ALife), a discipline initiated by Christopher Langton in 1987 (Waldrop, 1994). It was through the use of ALife techniques and themes in art –which constituted the discipline known as ALife Art– that emergence permeated digital art mostly as related to the idea of the search for the unexpected result (the surprise).

The early years of interactive and digital art were coincidental in time with the early years of Complexity Sciences. The personal computer facilitated the former while computer simulations enabled the latter. When experimenting with them, computers were capable of producing unexpected results and computational emergence became one of the ways to explain these phenomena. In a nutshell, when a set of relatively simple rules produced complex and varied results, these were interpreted as emergence.

Conway's Game of Life was an iconic example of his. This cellular automaton brilliantly shows how a simple set of rules can generate surprisingly complex dynamic results. Another iconic example is Craig Reynolds' 'boids', a simulation of a flock of birds or school of fish using three very simple and local rules that generate a group behavior strikingly ressemblant of the modeled system. Finally, genetic algorithms, developed by John Holland, constituted a very fertile ground of experimentation.

In any case, in the formation years of interactive art, emergence became an idea linked to the possibility of escaping the pre-specification that computer programming forces the artists into. The idea was that, instead of predefining behaviors, one should be able create agents that would exhibit interactive behavior that was emergent. It was presented in contraposition to the reductionist approach, which implies that the complex can always be accounted for by breaking it apart and analyzing its (simpler) parts:

> *[Reductionism] is premised on the assumption that to understand a complex object, one breaks it into component parts and examines those parts in controlled settings, then adds the results of those examinations together. The basic principle of emergence is that organization (behavior/order/meaning) can arise from the agglo meration of small component units which do not individually exhibit those characteristics. Emergent order implies that the whole is indeed greater than the sum of its parts, that higher level behaviors cannot be disassembled into their component lower level building blocks. (Penny, 1996).*

2. The Design Challenge

Emergent interactive behavior, as formulated by Penny in (1996), becomes in this context a design endeavor, and quite a challenging one. If taken literally, the idea is to be able to create artistic devices that behave emergently. Accordingly to the formulation proposed here, this means either generating a self-organization process or generating novel and unexpected behaviors.

But emergence, by definition, cannot be designed per se. Thus, from the design point of view, designing emergent behavior is a paradox, at least up to some degree. If we focus on emergence as self-organization, we cannot design the emergent behavior but only the agents and their local behaviors and interactions. It is through these local interactions that something emergent might appear. Similarly, emergence as novelty cannot be designed: if we design a behavior, it will not be unpredictable in the sense that emergent novelty is. Of course here the 'novel to whom' question arises. Cariani's emergence-relative-to-a-model is aimed at answering this and also the 'novel in respect to what exactly' question (Cariani, 1992; 2011; 2012).

The task of designing emergent interactive behavior, therefore, becomes a metadesign effort. That is, we can only design the conditions for emergence to appear, but not the emergent phenomena itself. When aiming to create self-organizing phenomena, as said, this means creating agents that have local rules and interact locally. No central control or collective goal can exist in order for it to be a genuine example of self-organization. The above mentioned boids, or the robotic installation Sympathetic Sentience (see below) are successful examples of this, although the first is not interactive in the sense that it doesn't respond to an interactor in any way. On the other hand, in order to generate novelty, the interactive systems and devices have to be open in a way that can facilitate this change at one point or another. Cariani's emergence-relative-to-a-model is a theoretical framework that thoroughly explains how this can be described and what types of emergent novelty can be assessed. Elaborating on it, the SOE/GNO Framework (Soler-Adillon, 2015) is an attempt to put this framework in practice in terms of analyzing particular systems, under the umbrella of the dual understanding of emergence mentioned above. Arguably, this latter framework can, in turn, serve as the basis for the elaboration of the guidelines for designing interactive behavior that is emergent.

3. Emergent Interactivity

When designing interactive artistic artifacts, the approach to interactivity is not that of functional interaction, but what can be labeled as poetic interaction (Penny, 2011). Within this paradigm, the fundamentals of traditional Human-Computer Interaction, Design and Digital Creativity conflate in an effort to create communicational interactive experiences that go beyond the instrumental (Soler-Adillon et al., 2016).

In this context, there are two main aspects in which the designer needs to focus, above anything else: behavior and interface. The first refers to how the artifact responds to its environment and to the interactor, and the second is the means of establishing such relationship. Elaborating on this idea, this section looks at examples of emergence in both.

3.1 Emergent behavior

Sympathetic Sentience in an interactive sound installation by Simon Penny first presented in 1995. It consists of a group of twelve robots that communicate to one another sequentially. Each of the robots is a relatively simple electronic device, capable of producing one chirp each minute with a particular rhythm and to pass along to the next an infrared signal indicating it. Then, this receiving unit combines its own rhythm with the received information, and passes the new rhythmic pattern along. As the process advances, the complexity of the rhythms increases as they cycle around the group. The system is self-organizing or, in Penny's words, self-governing (Penny, 2000). The sound pattern that the visitors to the installation perceive is neither predesigned, nor directed by any one of the robots or an external entity. As the robots communicate locally –each one to the next in circle– the overall process is formed. In this respect, it is an example of emergence as self-organization.

Interactivity is implemented in the piece in an unconventional way. After an initial build-up period, the system works on its own as rhythmic patterns continually evolve. It never becomes fully saturated, nor does it become fully silent if it is not interfered with. However, this equilibrium can be disrupted, often unintentionally, by the presence of the installation visitors whom, by moving around the space, interrupt the infrared transmissions of the units. If these interruptions are short in time, lapses of silence will infiltrate the rhythm patterns of Sympathetic Sentience. If long, the whole system can be forced into complete silence. When this happens, once the interruption of transmissions ends, the build-up process will have to start all over again (Penny, 2008).

However, a point can be made here to whether or not in this piece we have an actual example of emergent interactive behavior or, rather, the juxtaposition of an interactive behavior (the group symphony) with the interactivity towards the visitor (his or her ability to interrupt the symphony). Two more examples should be of use here in making this point: Ruairi Glynn's Performative Ecologies (2008) and my own Digital Babylon (2005). Since in terms of analyzing emergent interactive behavior they both use the same technique and offer comparable results, these two pieces are analyzed here together. Details on the pieces can be found in (Glynn 2008) and in (Soler-Adillon, 2011) respectively.

In short, Digital Babylon presents the user with a virtual ecosystem in which he or she can interact with one of the species. This species evolves through genetic algorithms, and one of the characteristics that change over time is the likelihood that its individuals will pay attention to the interactor or not. As a result, if the interactor helps the friendly individuals survive, the species as a whole becomes friendlier. If he or she harms them, they will be less friendly for future interactions. In Performative Ecologies, a series of robots dance in front of the users and check, through the visitor's gaze, what dance moves are capable of maintaining the attention. Then, the successful moves are recombined trough genetic algorithms to create new dances.

Thus, in both cases what changes is actually the way in which the piece interacts with the visitor. That is, the piece modifies itself over time and will not respond the same way to interactors at different moments of its existence. In this respect, the door is open for emergent interactive novelty to appear in their behavior, since the conditions for emergence are set. If unanticipated behaviors appear after the system has been initially defined (according to emergence-relative-to-a-model or the SOE/GNE Framework), then the new behavior is emergent (for an example, see (Soler-Adillon, 2015: 324)).

3.2 Emergent interfaces

If creating emergent behavior is a difficult task, emergent interfaces are to be found one step closer to impossibility. For an interface to be emergent, it has to be spontaneously formed. That is, it cannot be previously designed. As Cariani indicates when discussing creative emergence, this is feasible in natural system (through the course of evolution), but extremely rare in artificial systems. In fact, he identifies only one single example in the literature: Gordon Pask's electrochemical 'ear'. This somewhat obscure device, developed in the 1950s, was capable of evolving its own sensors in order to choose those aspects of its external environment to which it would react, and it would to so independently of its designer (Cariani, 1993). As Pask presented it in 1958, it could either be trained to recognize magnetic fields or sound. In about half a day, it was capable of adaptively grow its own connections in order to do so. In the case of sound, once this was done it could also rapidly gain the ability to distinguish between two different frequencies (Pask, 1959).

A similar example, presented fifty years after Pask's, is the evolved radio developed at the University of Sussex by Jon Bird and colleagues (Bird et al., 2003). This group of researchers, inspired by Cariani's taxonomy of robotic devices, pursued the creation of epistemically autonomous hardware, in what they called the 'unconstrained intrinsic hardware evolution,' a design method with which they evaluated hardware by instantiating it. With this approach, they were able to create and evolved radio. After some experimentation with oscillators, they found that some circuits, which had achieved good fitness according to the predefined criteria, were however not oscillating in a stable manner. Upon further examination, they found that these circuits had evolved to pick up radio frequencies that were present in the physical environment were the prototypes were being tested. To do so, the circuits had evolved to use some of its components as antennas. In this particular instance, besides the transistors of the evolvable motherboard on which the circuits were constructed, the circuits also utilized the analog switches and the printed circuit boards (Bird et al., 2003).

The authors claim that this is "the second experimental system ever to construct novel sensors through a process of creative emergence"–the first being Pask's device. However, such systems have a fundamental problem, they argue: since these circuits sometimes utilize environmental conditions and component properties that are very particular of a given implementation, they do not always generalize well. But if, to avoid this issue, the evolutionary process is constraint, so that the circuits are more robust, then the possible advantages of unconventional design, in terms of flexibility, are lost.

4. Conclusions

Twenty years after its conceptualization, emergent interactive behavior is still a challenging goal in terms of design. Self-organization can be sought by setting up a series of agents that interact with one another locally, and techniques such as genetic algorithms can facilitate the recombination of computations in order to achieve results that were unexpected (or at least no specifically pre-programmed). But translating that into the interactive behavior, in the sense of affecting how the artifact relates to its environment and visitors, remains a difficult task. In terms of physical interface design, the complexity of the challenge escalates, since achieving interfaces as the result of emergence implies enormous difficulties as seen in the last section (provided that the approach to emergence proposed here is accepted). The presented examples shade some light into this issue. The clear separation, in the design process, of behavior and interface, and a thorough understanding of emergence, along with the further development of theoretical tools such as the SOE/GNE Framework, might become key elements in resolving this.

Bibliography

Bedau, M. A. (2008). Downward Causation and Autonomy in Weak Emergence. In M. A. Bedau & P. Humphreys (Eds.), *Emergence. Contemporary Readings in Philosophy and Science* (pp. 155–188). Cambridge, Massachussetts: MIT Press.

Bird, J., Layzell, P., Webster, A., & Husbands, P. (2003). Towards Epistemically Autonomous Robots: Exploiting the Potential of Physical Systems. *Leonardo*, 36(2), 109–114.

Cariani, P. (1992). Emergence and artificial life. In C. G. Langton, C. Taylor, J. D. Farmer, & S. Rasmussen (Eds.), *Artificial Life II* (pp. 775–797). Reading, Massachussetts: Addison-Wesley Publishing Company.

Cariani, P. (1993). To evolve an ear: epistemological implications of Gordon Pask's electrochemical devices. *Systems Research, 10* (3), 19–33.

Cariani, P. (2011). The Semiotics of Percept-Action Systems. *International Journal of Signs and Semiotic Systems*, 1(1), 1–17.

Cariani, P. (2012). Creating New Informational Primitives in Minds and Machines. In J. McCormack & M. D'Inverno (Eds.), *Computers and Creativity* (pp. 395–430). New York: Springer.

Glynn, R. (2008). Conversational Environments Revisted. In *19th European Meeting of Cybernetics & Systems Research*. Viena.

Holland, J. (1998). *Emergence. From Chaos to Order*. New York: Basic Books.

Langton, C. G. (1988). Artificial life. In C. G. Langton (Ed.), *Artificial Life: Proceedings of an Interdisciplinary Workshop on the Synthesis and Simulation of Living Systems* (pp. 1–47). Boston: Addison-Wesley Publishing Company.
Retrieved from http://library.iscpif.fr/files/CSSS2010-20100805-Beslon-lecture4.pdf

Nagel, E. (1961). *The Structure of Science: Problems in the Logic of Scientific Explanation*. New York: Harcourt, Brace & World, Inc.

Pask, G. (1959). Physical Analogues to the Growth of a Concept. In A. Uttley (Ed.), *Mechanisation of Thought Processes* (pp. 877–922). London: HMSO.

Penny, S. (1996). The Darwin Machine: Artificial Life and Interactive Art. *New Formations UK*, 29, 59–68.

Penny, S. (2000). Agents as Artworks: and Agent Design as Artistic Practice. In K. Dauthenhahn (Ed.), *Human Cognition and Social Agent Technology* (pp. 395–414). Amsterdam, Netherlands: John Benjamins Publishing Company.

Penny, S. (2008). Robotic art and interactive installation 1988-1997. DVD documentation.

Penny, S. (2011). Towards a Performative Aesthetics of Interactivity. *Fiberculture, 19*, 72–108.

Soler-Adillon, J. (2011). Playing with Pixels. In E. Puig, A. Vela, & A. Vilà (Eds.), *Impresión Expandida / Expanded Print* (pp. 161–198). Barcelona: Universitat de Barcelona.

Soler-Adillon, J. (2015). *Emergence as Self-Organization and as Generation of Novelty. A Framework for Understanding Emergence in the Context of Interactive Art*. Universitat Pompeu Fabra.

Soler-Adillon, J., & Penny, S. (2014). Self-organization and novelty: pre-configurations of emergence in early British Cybernetics. In *Norbert Wiener in the 21st Century (21CW), 2014 IEEE Conference on* (pp. 1–8). Boston, MA: IEEE. http://doi.org/10.1109/NORBERT.2014.6893946

Soler-Adillon, J., Sora, C., Freixa, P., & Ribas, J. I. (2016). El perfil del profesional de la comunicación interactiva: fundamentos, actualidad y perspectivas. *El Profesional de La Información, 25*(2).

Steels, L. (1995). The Artificial Life Roots of Artificial Intelligence. In C. G. Langton (Ed.), *Artificial life. An Overview1* (pp. 75–110). Cambridge, Massachussetts: MIT Press.

Waldrop, M. M. (1992). *Complexity. The Emerging Science at the Edge of Order and Chaos*. New York: Simon and Shuster.

Related links

Digital Babylon
http://joan.cat/en/dbn/

Performative Ecologies
http://www.ruairiglynn.co.uk/portfolio/performative-ecologies/

Sympathetic Sentience
http://simonpenny.net/works/sympathetic.html