What Then Happens When Interaction is Not Possible: The Virtuosic Interpretation of Ergodic Artefacts

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ABSTRACT

Procedural systems allow unique modes of authorship and singular aesthetic experiences. As creators and users of these systems, we need to be aware that their aesthetic potential is not solely defined by interaction but that interpretation, and the capacity to understand and simulate the processes taking place within these artefacts is highly significant. This paper argues that although direct interaction is usually the most discernible component in the relationship between ergodic artefacts and their users, ergodicity does not necessarily imply interaction. Non-interactive procedural artefacts may allow the development of ergodic experiences through interpretation, and the probing of the system by its reader through simulations. We try to set the grounds for designing towards *virtuosic interpretation*, an activity that we may describe as the ergodic experience developed by means of mental simulation through the development of theories of systems.

KEYWORDS

Ergodic; Interaction; Simulation; Aesthetics; Procedural Design; MDA; Vicarious Interaction; Interpretation.

1 | INTERACTING WITH ERGODIC MEDIA

As digital technologies become ubiquitous, they have been replacing previous media as economic and reliable alternatives. These technologies are excellent simulators of other media forms, but perhaps because of this, they often fall short of being developed to their highest potential for the creation of new media forms. The very definition we use for them is based on their digital encoding properties and fundamentally omits the fact that, being processor-based, these media forms are essentially procedural.

These media may be developed in either *data-intensive* or *process-intensive* approaches (Crawford, 1987), the first of these devoting most of the resources to “moving bytes around” in artefacts that “are based primarily on pre-recorded sound and/or image sequences, or on static texts or images that are selected or arranged during the interaction” (Kwastek, 2013, p. 114) and mainly use their procedural capacities to select, rearrange, compose or give access to these assets. Conversely, a process-intensive approach tends to produce artefacts that “will be generated in real time according to algorithms” (Kwastek, 2013, p. 114) and where the

focus on procedurality remains clear, even when data-intensive approaches are also used.

We may therefore emphasize procedurality when designating these media as *procedural* rather than simply as *digital*, following Janet Murray's first essential property (1997, p. 71) and her observation that a computer "is not fundamentally a wire or a pathway but an engine", designed to "embody complex, contingent behaviors" (1997, p. 72).

Authorship in these media is also procedural, a process where one writes "the rules by which the texts appear as well as writing the texts themselves", devising "rules for the interactor's involvement" and "conditions under which things will happen in response to the participant's actions" (Murray, 1997, p. 152). This turns the author into something of "a choreographer who supplies the rhythms, the context, and the set of steps that will be performed" (1997, p. 153), creating not sets, scenes, or objects, but rather potential narratives to be discovered and enacted. Procedural authorship also underlines, and takes advantage of, the "principal value of the computer, which creates meaning through the interaction of algorithms" (Bogost, 2008, p. 122), an ability that radically distinguishes them from other media and that turns them into a significantly different class of artefacts.

In these media the role of the reader is also affected [1]. Murray describes how readers make use of a "repertoire of possible steps and rhythms to improvise a particular dance among the many, many possible dances the author has enabled" (1997, p. 153) and how this leads to the adoption of something of a creative role within the system, a role that is however not equivalent to that of the author, not even close enough to qualify as a co-authorship. Rather, she speaks of agency, the power "over enticing and plastic materials" (1997, p. 153) "to take meaningful action and see the results of our decisions and choices" (1997, p. 112), and distinguishes it from mere activity, seeing how it "goes beyond both participation" (1997, p. 128), and becomes an aesthetic pleasure in itself.

Following Murray, Espen Aarseth (1997) speaks of the ergodic experience developed in artefacts where multiple user functions are possible to develop — an omnipresent *interpretative* function; an *explorative* function, in which decisions are made regarding which spaces of the text's topology to access; a *configurative* function, in which textual contents may be created, selected or rearranged; and a *textonic* function, when contents may be permanently added to the text. He posits that artefacts where "a cybernetic feedback loop, with information flowing from text to user (through the interpretative function) and back again (through one or more of the other functions)" may be described as ergodic, a term "appropriated from physics that derives from the Greek words ergon and hodos, meaning 'work' and 'path'. In ergodic literature, nontrivial effort is required to allow the reader to traverse the text." (Aarseth, 1997, p. 1). From this definition of ergodic texts, we may consider that other media, where some of these user functions can be developed, can likewise be ergodic.

Allowing for interaction and agency, these media forms will be characterized by a relatively unpredictable usage, with the number of user functions involved, and their relative weight in the experience of the media forms varying. Hunicke, LeBlanc and Zubek (2004) describe artefacts such as these in terms of three stages they call *Mechanics, Dynamics and Aesthetics*, developed consecutively during the artefact's design and discovered in reverse order by their readers [2]. The perspectives of reader and author are therefore opposite in ergodic artefacts. The author deals primarily with mechanics, the code and data, and consequently with dynamics, the runtime behaviour of the mechanics previously developed, which will ultimately result, at the aesthetics level, and twice removed from the author, in "the desirable emotional responses evoked in the player, when she interacts with the game system." (2004). Through user functions, the reader interacts at the aesthetics level, discovers the dynamics but is normally not able to burrow into the level of mechanics.

With dynamic and varying outputs that are largely unknown both to the author and the reader, we may consider the aesthetic value of interaction. Katja Kwastek notes how in data-intensive artefacts, readers may "seek to activate all the available assets" (2013, p. 114) in order to achieve a sense of completeness, used as they are to linearity and

completion in other media, and wanting to "experience the 'whole' of a work" (2013, p. 114). In process-intensive artefacts, completeness may be found in exhausting the algorithmic possibilities for interaction, with the focus shifting from traditional aesthetics to one of interaction and performance (Ribas, 2014a), from an Aristotelian to a rhizomatic idea of perfection.

This is particularly noticeable when readers are not engaged directly with the artefact but rather observe others during their interactions, in a situation of "vicarious interaction" (Levin, 2010). In these cases "sensual or cognitive comprehension can still take place", and the observer may discover "relations between action and effect, even if he is not actively involved" (Kwastek, 2013, p. 94). A vicarious interactor does not develop the same experience as an active interactor, but is "able to observe and understand interaction processes that he would not have carried out" (Kwastek, 2013, p. 94), and even to aesthetically consider the performance of the interactor (Zielinski, 2006, p. 138).

The three positions identified by Aarseth (1997, p. 135) for human-machine collaboration – pre-, co-, and post-processing – require direct human-computer interaction. Likewise, his definition of ergodic text (and any definition of ergodic artefact based in it) also requires interaction. Given this, any non-interactive media, even if processor-based, may be difficult to classify as ergodic. In non-interactive artefacts – or non-interactive states of otherwise interactive systems – the reader may apparently be limited to the interpretative function and barred from developing any of the other functions that are necessary to the definition. We however propose that a broader, procedural understanding of the nature of the interpretative function, can allow us to consider the experience of these systems as ergodic.

2 | WHAT THEN HAPPENS WHEN INTERACTION IS NOT POSSIBLE?

While interacting vicariously, one may be able to intuit the mechanical principles of a system, and thus start inferring causal relations. By observing both the system's and the interactant's behaviours, one may identify regularities and patterns that lead us to expect specific reactions from both parties. We may question whether a full understanding of the artefact's mechanics may be attained through this or any other means, including direct interaction, as long as direct access to the code is not allowed, but we may expect that if the outputs of the artefact exhibit any regularity and if their behaviour is somewhat determinable (Carvalhais, 2010, p. 363), the reader may be able to develop a working model of the system that is capable of producing useful predictions regarding its behaviours or those of the interactant-system pair. This model may of course be based on false assumptions, or on the adaptation of familiar behaviours from other systems, but if it is demonstrably effective, it will be useful to the reader, and will allow her to approach completeness in the experience of the system. Therefore, as a result of vicarious interaction, the reader may be able to peer through a system's aesthetics level, developing hypotheses about dynamics and ultimately about mechanics. What then happens when interaction is not possible?

When reading a system with which one is unable to interact with, in order to achieve a comprehension of its procedural level and behaviour, one needs to surpass the traditional scope of the interpretative function. Besides the interpretation of text, images, sounds and other signs, procedural systems offer the possibility of developing a *procedural interpretation*. When interpreting texts, readers form and develop hypothesis, confirm, modify or abandon predictions (Douglas, 1994, p. 175). A similar process may be developed at the procedural level.

When perceiving a system and following its outputs, a reader is not capable of directly accessing the prescriptive rules at the level of mechanics, but she is able to make use of descriptive rules to create models that intend to explain or understand the phenomenological levels of the experience. While registering affordances on the artefact's outputs, the reader gradually identifies patterns of behaviour and relations between the perceived system and other systems or artefacts in the world. Using the data thus gathered the reader is then able to develop mental simulations of the processes behind the surface units found in the artefact's outputs. The reader probes the level of mechanics, constructing hypotheses that are verifiable at the level of dynamics and allow the fine-tuning of the mental models.

These models do not need to be based on complete sets of data, and they do not even need to generate precise predictions of the system's behaviours. They need to pose testable hypothesis that can be verified by the system's behaviours, being eventually replaced by hypothesis that ultimately may contribute to a better working model of the system. And while the system continues under observation, this trial and error process will be continuously developed.

This process of gradually understating a system from which the reader only has inferred clues is analogous to the process of developing theories of mind of other humans or of human-like entities [3]. A theory of mind allows one to simulate the mental states and processes of others, and to picture "the world from another person's vantage point", constructing "a mental model of another person's complex thoughts and intentions in order to predict and manipulate [their] behavior." (Ramachandran, 2011, loc. 2281) Based on known humans, familiar systems or mechanics, but also on other artefacts, and phenomena from the physical world, etc., humans speculate regarding mental processes, developing hypotheses that are confirmed or falsified based on the witnessed actions.

Through the developed simulations, and still from the stance of the reader, one tries to see the system from the designer's point of view, embracing its wholeness and fully understanding it. Interactive systems are plastic and need to be interacted with in order to be experienced and understood. Non-interactive systems, or systems in non-interactive states, do not allow the user to investigate them through interaction, but mental simulations developed by the user are far more plastic, versatile, and accessible. They allow for transformations or variations, and for a larger space of possibilities to be explored as the reader develops a *theory of the system*, a process during which, they are not engaged with the artefact's diegesis or with a fiction, but rather try "to master its routines" (Kirkpatrick, 2011, p. 8).

The process of validating the model can then be seen as leading the reader through an experience of traversal punctuated by epiphanies and aporias — when hypotheses are confirmed or disconfirmed — which may lead to the development of narrative (Aarseth, 1997, p. 92) and even of drama in artefacts that wouldn't otherwise be experienced as narrative (Carvalhais, 2012a, 2013). Furthermore, epiphanies will activate the reward centres of the reader's brain, resulting in pleasurable experiences that will drive the enjoyment of the artefact and of its simulation.

3 | ERGODIC CONTEMPLATION

We may thus propose that non-interactive systems, or systems in non-interactive states, in spite of being limited to the interpretative user function, may also be ergodic. The mental exploration and reconfiguration of analogues — or simulations — of the systems can be a de facto ergodic experience, therefore procedural works are not limited to a classic interpretation, as their procedural nature allows for a new level of virtuosic interpretation that while seemingly contemplative is actually very active. As with other ergodic forms, procedural artefacts require the development of a nontrivial effort from the reader in order to find not one but many paths along the traversal of the procedural space of possibilities.

In the ergodic forms studied by Aarseth the reader is "constantly reminded of inaccessible strategies and paths not taken" (1997, p. 3), with each decision making parts of the content more or less accessible and building up uncertainty regarding the result of one's choices and to what may or may not be missed along the traversal. In procedural artefacts the questions posed by the reader point towards how many and how diverse those paths may be, and to a discovery of how the system tends to follow them. As a result of ergodic contemplation one is then led not to build up uncertainty but rather to increase information and knowledge regarding the artefacts mechanics and to regard the possibilities to be discovered at the dynamics and aesthetics levels.

If in ergodic forms the reader already faces a risk of rejection (Aarseth, 1997, p. 4), in procedural artefacts they also face the added risk of incomprehension, of being unable to develop a working theory of the system that may lead to useful predictions. Naturally, with the exception of the very simplest of systems, a total understanding of the processes is not only unattainable as it is utopian, and the reader should be reconciled with that.

4 | DESIGNING FOR VIRTUOSIC INTERPRETATION

While developing procedural systems, artists and designers need to be aware that much of this process of building models and testing hypotheses is developed unconsciously. A conscious procedural close reading is certainly possible but in most cases — with perhaps the exception of game forms — should not be expected. We are therefore faced with the difficulty of communicating processes, or of designing processes that may be discovered by readers.

Code descriptions, procedural descriptions or even explicit code may be presented either at or with the system. These may duly inform the reader and allow for the easier elaboration of models and predictions. An example of this approach may be found in John F. Simon Jr.'s *Every Icon*, a work presented with the following text:

> *Given: A 32 X 32 Grid*
> *Allowed: Any element of the grid to be black or white*
> *Shown: Every Icon*
> (Simon, 1997)

More recently, C.E.B. Reas has developed several works in his *Process* series that are presented with textual descriptions of the elements in the pieces from which dynamic compositions emerge. Elements are "machines" composed by forms (as e.g. "Circle", "Line") and one or more behaviours (such as "Move in a straight line", "Constrain to surface", "Change direction while touching another Element", etc.). Each piece in the series is a process that "defines an environment for Elements and determines how the relationships between the Elements are visualized" and that is presented as "a short text that defines a space to explore through multiple interpretations." (Reas, 2008). As an example, we may present:

> *Process 18*
> *A rectangular surface filled with instances of Element 5, each with a different size and gray value. Draw a quadrilateral connecting the endpoints of each pair of Elements that are touching. Increase the opacity of the quadrilateral while the Elements are touching and decrease while they are not.*
> (Reas, 2008)

Finally, explicit code may be found in "program code poetry" (Cramer, 2001), of which the works in Pall Thayer's *Microcodes* (2009-2014) series are good examples:

> *Sleep*
> *31. March 2009*
> *#!/usr/bin/perl*
> *sleep((8*60)*60);*
> (Thayer, 2009)

If code or procedural descriptions are not presented, processes may be designed with repetition and (some amount) of regularity in mind. As an example, algorithmic processes that largely depend on pseudo-randomness may dissimulate their structure and processes under extremes of disorder that are far off from a readable and understandable level of effective complexity (Galanter, 2003, p. 8; 2008; Lloyd, 2006). A balance of repetition and novelty — to which randomness can certainly contribute (Leong et al., 2008) — can ease deduction, comprehension, and the following of processes, as well as (to a certain extent) the participation of the reader in the processes.

Finally, and as Steve Reich notes in *Music as a Gradual Process* (1968), *perceptible* and gradual processes facilitate the closely detailed reading of a piece, helping to connect compositional processes and sounding music. The pacing of the processes may be instrumental in facilitating ergodic interpretation, or allowing it altogether, and we should bear in mind that the timescales of modern computational devices and of human psychology and perception are very different.

But processes should also be developed taking into account a series of perils or difficulties related to human interpretation of procedural systems — both natural and artificial — as e.g. being aware of psychological and perceptual illusions such as the Eliza effect [4] (Hofstadter, 1995, p. 158) and the Tale-Spin effect [5]. The mental processes supporting some of these illusions should also be taken into account during development: *patternicity* [6], "the tendency to find meaningful patterns in both meaningful and meaningless data" and *agenticity*, "the tendency to infuse patterns with meaning, intention, and agency" (Shermer, 2011, p. 5).

5 | CONCLUSIONS AND FUTURE WORK

We should regard the interpretative user function as broader and more relevant to the aesthetic experience than what one may be led to believe from its usual association with non-ergodic forms. Procedural interpretation may allow the development of rough analogues of the explorative and configurative functions, when these are not present or are not possible in a given context, and lead to the transfer of algorithmic processes between the artefact and the reader and to the development of a virtuosic interpretation.

An awareness of these processes may thus lead creators to develop artefacts that may rely on them or at least aesthetically negotiate with them, so if from traditional aesthetics we move to an aesthetics of interaction, agency and performance, we now find these also coupled with a very relevant aesthetics of process and procedurality. This paper establishes the need for this awareness, enumerating some recommendations for the design of the ergodic experience of *virtuosic interpretation*, while in the future we aim to expand and uncover new considerations, and to develop them into a formal set of principles and guidelines.

ACKOWLEDGEMENTS

This project was partially funded by FEDER through the Operational Competitiveness Program – COMPETE – and by national funds through the Foundation for Science and Technology – FCT – in the scope of project PEst- C/EAT/UI4057/2011 (FCOMP-01-0124-FEDER-D22700).

ENDNOTES

[1] Among the possible and often confusing designations — user, reader, spectator, player, interactor, etc. — we will use reader, albeit recognizing that this also describes a particular mode of engagement with a medium or artefact.

[2] Hunicke, LeBlanc and Zubek's MDA framework was developed as a formal approach for studying videogames, an undoubtedly ergodic form. MDA has been previously used by ourselves (Carvalhais, 2012b) and other authors (Ribas, 2014b; 2012) to study interactive and ergodic media forms.

[3] The capacity to develop theories of mind is not exclusive to humans and not only developed towards humans but also towards entities or systems that may exhibit behaviours, emotions or "mental states" comparable to those witnessed in humans (Zunshine, 2006; Ramachandran, 2011), with "many of us even project[ing] this onto objects." (Gazzaniga, 2011, p. 158).

[4] The Eliza effect is "…defined as the susceptibility of people to read far more understanding than is warranted into strings of symbols – especially words – strung together by computers. (…) We don't confuse what electric eyes do with genuine vision. But when things get only slightly more complicated, people get far more confused – and very rapidly, too." (Hofstadter, 1995, p. 158).

[5] "A very complex programming process is reproduced in such a simplified form that the complexity remains concealed from the recipient. Wardrip-Fruin's name for this effect refers to a 1970s story-generating computer program whose highly complex algorithms could not be discerned by the users." (Kwastek, 2013, p. 135).

[6] This phenomenon is also known as apophenia.

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