Video games and Cybernetics

Introduction

Cybernetic studies have influenced a vast array of disciplines and left a significant mark on the previous century. Artificial intelligence, psychology, modern biology, computer science, and communications are just a few striking examples. The origins of cybernetics are attributed to Norbert Weiner (WEINER cybernetics 1948), who developed this approach in collaboration with several specialists of the time to unite different domains of knowledge.

In this essay, we focus on the underlying connections that unite the various approaches to the study and design of video games. Through the different authors that we will discuss, we will attempt to establish the foundations of a cybernetic approach to the study of dynamic systems in games as design patterns and objects of analysis in the gaming experience.

Authors on which we base our research

The authors discussed in this essay are all linked by their use of cybernetic patterns. We will first address Marc Leblanc, who uses the pattern of positive and negative feedback loops to balance the stability, duration, and success of the game. We chose to start with this author for the simplicity of his model, which we believe is a good base for understanding the link between game mechanics and their effects on the experience.

We will then look at the component framework of Bkork and Holopanien and the notion of game patterns, which serves as a basis for cybernetic patterns. This model, combined with Csikszentmihalyi's Flow, will later allow us to approach the design of experience by patterns proposed by Philippe Lemay, who combines the two to propose extending the component framework.

The design-oriented approaches mentioned above are mainly linked to the first level of cybernetics. We will use the second movement of cybernetics to address the notion of meaningful experience. To assist us, we will use the models proposed by Julian Kücklich and Dominic Arsenault. These models, as we will see, have much in common and allow us to consider the experience as a whole, supporting a hermeneutic dimension that is essential for us in the design of a complete experience. But first, let's start with Marc LeBlanc's MDA model.

Marc LeBlanc – Feedback loop in games, MDA

The model proposed by LeBlanc is simple and allows a comprehensive and pragmatic understanding of games as systems. Firstly, he proposes a designer-player oriented structure. This model reads as follows: Mechanics – Dynamics – Aesthetics. For Marc LeBlanc, the game is designed by designers and intended to be consumed by players. Designers can produce effects on the reception of players through aesthetics as a concept encompassing types of experiences lived (Examples: Sensation, Socialization, Fantasy, Discovery, Narrativity, Expression, challenge, pastime, etc.). To do this, they can use game mechanics to create dynamics producing an aesthetic effect. Dynamic systems being the object of study of cybernetics, the relevance of his approach is quickly understood.

Marc LeBlanc proposes a game design approach based on the cybernetic notion of feedback loop. He highlights the functions of negative and positive feedback systems in video games. Negative feedback grants a behavior of adjustment to the system. For

LeBlanc, negative feedback can be used to stabilize a cybernetic system, such as, for example, adjusting the difficulty level of a game. It can thus prolong the duration of the game by pushing back the certainty of success. Positive feedback, on the other hand, allows destabilizing a cybernetic system, thus bringing its end closer, for example, by reinforcing the chances of victories. This can be done by using additive "combos" preventing enemy action and allowing a player to increase his advantage over the other and widen the gap between them. Identifying negative and positive feedback loops allows managing the rhythm of the game.

Marc LeBlanc therefore proposes the use of the notion of positive and negative feedback loop to manage stability, duration, and success in video games. However, he warns about their emergent nature. Indeed, unforeseen feedback loops can appear in the design and cause a loss of control of the designer and the player. For us, the feedback loop illustrated by LeBlanc is a cybernetic pattern that can serve the design of experience.

Bjork and Holopanien – Game patterns and component framework

To be able to organize game mechanics to create interesting dynamics, it is necessary to identify these mechanics. This is what Bjok and Holopanien (BJORK and HOLOPANIEN 2005) propose with the concept of pattern language (CHRISTOPHER ALEXANDER 1977) applied to video games. They propose a structure for evaluating game mechanics and organize them into a relational rhizome based on ascendencies, descendencies, compatibilities, and incompatibilities in a Pattern Template. It is a methodology centered on Gameplay, which they define as "the structure of player interaction with the game system and with the players in the game."

Patterns are conceptual objects referring to the idea of a certain organization of basic elements of a given domain. These objects can be seen as "building blocks" that can be arranged like words to design "sentences". These objects can manifest in various ways such as sequences, cycles, processes, trends, forms, probabilities, etc. According to Christopher Alexander, patterns can be used as generic design models.

"patterns describe a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over without ever doing it the same way twice."

The concept of pattern has also been used in cybernetic studies. (COUFFIGNAL 1963). Couffignal identifies patterns as effects perceived in a set: "The psychic effect produced by an external physical action is generally perceived globally. We will adopt, for this global psychic effect, the English term pattern." Couffignal defines the term as "the semantics of descriptive information". Still in cybernetic studies, the psychologist Andrew Gordon Speedie Pask refers to it as a form of system: "Any arranged form (Pattern) of activities in a network considered coherent by some observer is a system" (G.Pask, in Cameron-Yovit, 1960, p. 233)

Patterns can be thought of as persistent objects serving as guides or common references for communication in a given domain. In our case, the mechanics of the game in video games.

Game patterns are therefore a set of game mechanics gathered in a taxonomic system that Bjork and Holopanien call the component framework. They divide their structure into four domains: Boundary – Holistic – Temporal – Structural, each divided into subsections on two levels.

The Boundary class contains the patterns limiting the player's activity. Holistic concerns aspects of the game that allow considering the game as an inseparable whole. Temporal contains the elements describing the evolution and causality in the game. Finally, Structural encompasses the components of the game that can be manipulated by the player and the system.

The model of Game Pattern and the Game component framework seem to us to be good bases for designing game dynamics. As we saw with LeBlanc's MDA, game mechanics are ingredients that can lead to an interesting aesthetic experience if they are well arranged. This arrangement produces dynamic systems. These dynamic systems can also be designed as patterns. This is what we call cybernetic patterns. Cybernetic patterns make the link between the games patterns and the resulting experience.

Mihaly Csikszentmihalyi - Flow and emotions

Csikszentmihalyi is an essential author when studying the notion of experience. His Flow theory offers a most interesting basis for better understanding and developing the experience. The notion of Flow or "optimal experience" is defined by Csikszentmihalyi as "the holistic sensation that people feel when they act with total involvement" (Csikszentmihalyi 1975b, p. 36): the holistic sensation that people feel when they act totally engaged. Flow can therefore be seen as an immersive experience produced during an action accomplished for itself (autotelic experience). For the achievement of this state, the experience must meet the following conditions:

- Clear target
- Immediate feedback
- Balanced Demand-Skill dynamic

Already we are dealing with two cybernetic concepts: feedback and dynamics. The combination of these conditions in an autotelic activity should allow the achievement of the Flow state, which is characterized by:

- Intense concentration
- Immersion in the activity
- Feeling of control
- Loss of self-consciousness
- Altered perception of time

Flow is an experience model that works dynamically. As Penelope Sweetser and Peta Wyeth (SWEETSER and WYETH 2005) have pointed out, this model has a lot in common with the experience that a person can feel when playing a video game.

As we have seen, Csikszentmihalyi uses several concepts borrowed from cybernetics. Among other things, in his descriptions of the mechanics of Flow, he regularly uses the notions of feedback and dynamics. The Demand-Skill dynamic is a very good example. In this system, the level of challenge offered by an activity interacts with the individual's skill level. This dynamic takes the individual through different states that move him away from or closer to Flow. During the optimal experience, the individual is led to experience different emotions that Csikszentmihalyi distributes in a circular model following the Demand-Skill dimensions. The feedback cycle takes place here at the interpretive level and results from the judgments that the individual makes of the situation. This relationship between perception and the individual's self-evaluation is, as we will see later, part of the second movement of cybernetics. For now, it is enough to mention here that as in the model of

LeBlanc discussed earlier, there is a negative feedback loop that oscillates between two axes to stabilize the system and that it evolves over a timeline.

In the example above (Illustration 7), it is a negative feedback loop that tends towards Flow. It retroacts by maintaining the level of challenge and skill in an equilibrium oscillating in the Flow zone without ever fully stabilizing. Indeed, as soon as the balance is reached, the increase in skills generated by the activity will produce a disequilibrium compared to the challenge, and the individual will have to seek a greater challenge to get closer to Flow again. In the opposite case where we would have positive feedback, the Flow would quickly be broken and would lead to anxiety or boredom. It is also to be noted that in this case, it is the individual who readjusts his level of challenge. In the case of game design, the objective is to bring the player into the same loop but to complete it with its computer counterpart. That is, the game will follow a feedback loop that will always aim to adjust the level of challenge provided to the player based on his skills. This is what LeBlanc suggests when he suggests using the feedback loop to adjust the difficulty level of a game, and this is a good example of a cybernetic pattern allowing to make the link between the design and the analysis of the game.

It seems obvious to us that the concept of Flow is perfectly adapted for the study of video games and their design. Moreover, as LeBlanc pointed out, it is very useful to be able to identify cybernetic systems as we have done with Flow in order to better understand the dynamics that come into play in their functioning.

Phillipe Lemay – Pattern Language for Flow Experience in Video Games

Phillipe Lemay positions himself at the exact intersection between Bjork and Hollopanien's theoretical framework and Csikszentmihalyi's concept of optimal experience (Flow). In his article "Developing a Pattern Language for Flow Experiences in Video Games," he proposes to combine the two theories by adding a fifth branch to the Game Component Framework focused on experience design. He adds to these two approaches the research of Sweetser and Wyeth, who attempt to evaluate the gaming experience based on Flow. They divide the experience into different subcategories: Psychological, Emotional, Cognitive, Social, and Behavioral. These categories would be branches of the Experience category added to the component framework. Still aiming to develop a game design methodology focused on experience, Philippe Lemay points out that there is a fundamental difference between experience patterns and patterns for experience. This distinction, as far as we are concerned, touches on different branches of cybernetics. Patterns are objects that can be organized in dynamic systems that can be associated with the first movement of cybernetics. The second movement of cybernetics or "second-order cybernetics" is interested in the place of the observer of the system. As we will see later, it is by integrating the observer into the dynamic system that we can construct an analysis model of concepts like gameplay.

Regardless, for Lemay, patterns can serve to create Flow and maintain it: "what elements may help generate or maintain Flow experiences? That is, what patterns would be useful in creating the conditions of Flow and then maintain the characteristics associated with it." As we have seen earlier, the notion of patterns and Flow are both related to concepts used in cybernetics.

Lemay proposes to use the taxonomic model inspired by Christopher Alexander's pattern language to build a bank of experience design patterns.

Julian Kücklich – Computer Games as a Second-Order Cybernetic System

We now move on to the second movement of cybernetics. Julian Kücklich is interested in the semiotic process that, for him, constitutes the act of playing a video game. He approaches video games from an angle based on media and literary studies, which he links to structuralist narratology. However, the model he proposes is based on the constructivist concept of viability, which presupposes a shift in perspective from what he calls "naive objectivity" to "informed subjectivity". This notion of subjectivity comes from second-order cybernetics, which implies the inevitably influential presence of the observer in any process he perceives.

In his article "The Study of Computer Games as a Second-Order Cybernetic System", he addresses the question of "playability" inherent in games by focusing on the interaction between the player and the game and, more specifically, on the player's experience. The model proposed aims to develop and better understand the aesthetic and hermeneutic dimensions of video games.

Based on the concept of interactive storytelling developed by Marie-Laure Ryan, Kücklich proposes a definition of the notion of openness focused on a computer game's ability to create possible worlds: "openness now refers to the ability of a computer game to create possible worlds". This conception of the notion of openness corresponds to the desire to integrate narration as a cybernetic process in a video game. Julian Kücklich points out that the question here is not whether games are "in themselves" or are "in" cybernetic systems but rather that they are only observable when played. When a game is played, it is not only observable, but it forms a cybernetic system with the observer.

As we mentioned earlier, the dynamics between game patterns are possible due to the active presence of the player. This is what constitutes the cybernetic patterns leading to the experience.

Julian Kücklich explains that in the process of interaction between the game as a "written text" and the player, one can assume that there is a mental reconstruction ("read text") of the "text-to-see" by the player. Kücklich mentions two levels of interaction: Aesthetic Interaction and Hermeneutic Interaction. He refers to aesthetic interaction as a first-level perceptual process (seen text). Hermeneutic interaction, on the other hand, refers to the process of constructing meaning (read text).

This distinction requires a deconstruction of the "player" agent into two parts: the player and the observer. Kücklich is not referring here to two individuals but rather to a single one playing two roles in the system. The player interacts at the aesthetic level, while the observer interacts at the hermeneutic level. One perceives and experiences, while the other observes and interprets. From the player's point of view, his actions have meaning at the level of the game world. From the observer's point of view, the player's actions only make sense as a textual strategy, in relation and confrontation with the game's textual strategy as an agent. The aesthetic interaction is related to the player's immersion, while the hermeneutic interaction involves the process of demystification: "process of demystification". This latter denotes the observer's desire to attribute meaning to the game. Kücklich names this desire: player's intention and integrates it into his model. He bases this on two concepts borrowed from semiotics: "possible worlds" and the concept of abduction. (PIERCE – 1934 - 1948)

A possible world can contain an unlimited number of sub-worlds. This notion is very obviously related to the notion of system and subsystems. The notion of abduction, on the other hand, is a form of conclusion that distinguishes itself from deduction and inference. It allows for the construction of hypotheses without direct evidence from coherence clues. In

the context of possible worlds applied to video games, the player is constantly making abductions to construct his vision of the game world. For Kücklich, there are different types of abductions: Trivial (insignificant), context-dependent (contextual), and creative (creative).

The creative abduction is the one that interests us here. It comes into play as a textual strategy resulting from the player's intention (intentio lectoris) and is in opposition to the game's intention (intentio operis). The interaction between the two textual strategies produces a creative conflict that creates the game world.

This model, therefore, proposes to approach the game process as a second-order cybernetic system. The creation of the game world by creative abduction is part of a level of the process belonging to the hermeneutic dimension. To be able to construct itself, this dimension is based on the aesthetic dimension, which results from the direct interaction between the player and the game.

This distinction between two levels of interactivity is made by several authors. Marie-Laure Ryan notes a level related to the medium and another related to the work itself: "Interactivity appears on two levels: one constituted by the medium, or technical support, the other intrinsic to the work itself." Alain Mongeau also attributes two main dimensions to it, similar to Ryan's vision. Mongeau points out the dual essence of interactivity, "The essence of practice, then the underlying human essence." One is rather instrumental and linked to the form or support that we can associate with Kücklich's aesthetic dimension, and the other is more symbolic, more intrinsic to the work itself, which is similar to the hermeneutic dimension.

In summary, Kücklich proposes to conceive the game process as a second-order cybernetic system involving two levels of interactivity that he calls aesthetic and hermeneutic. The importance of the second-order cybernetic approach is that it allows us to analyze the process by taking into account these two levels of interactivity. This brings us to the notion of gameplay used in video game studies. For us, the game process described by Kücklich is similar to the notion of gameplay and is a dynamic system that can be studied thanks to cybernetics.

Dominic Arsenault – Magic Cycle

Dominic Arsenault proposes a hermeneutic approach that we believe has several points in common with Kücklich's approach. He is based on Bernard Perron's Heuristic Circle of Gameplay model and proposes a model he calls the "magic cycle" in reference to Huizinga's magic circle (HUIZINGA 1955).

This model is inspired by another model proposed by Tom Heaton (A circular model of gameplay - HEATON 2006), which is itself inspired by a cognitivist model (perceptual cycle - ULRIC NEISSER 1967) but as Delorme and Flückiger point out:

"From a historical point of view, often neglected, the kinship and interactions between constructive theories of development such as Piagetian genetic psychology, cybernetics, and the cognitive approach from which, for example, work on artificial intelligence is derived, are to be highlighted."

Perron's model is therefore very similar to the cybernetic approach. Moreover, Arsenault's magic cycle reveals a certain similarity with Kücklich's model and refers to the concept of "psychological frame" by Gregory Bateson, who is one of the key authors of second-order cybernetics. In fact, it is the magic circle that reflects the concept of cognitive frame: "In fact, it is the magic circle that reflects the concept of cognitive frame." We will therefore try to

determine to what extent Dominic Arsenault's magic cycle can be analyzed as a second-order cybernetic system.

Firstly, we believe it is relevant to mention that in a cybernetic system, the dynamic aspect related to temporality is implicit and inseparable. For practical reasons, cybernetic models are represented as cycles closed on themselves. The intention being to present an idea as simply as possible, we will stick to this trend. However, dynamic processes that can constitute "open" and evolving systems, the depiction of these in a diagram could just as well be in the form of a spiral as is the case in Dominic Arsenault's model.

Secondly, in Perron's model, some attention is paid to the direction of cognitive processing (TOP-DOWN and BOTTOM-UP). Although it is useful to mention this distinction to better understand the processes of information processing, we have chosen not to dwell on this distinction because "The usefulness of this distinction is questioned by theorists, who consider that the two processes can intervene at the same time (Kossly and Rosenberg, 2001)".

Dominic Arsenault's magic cycle consists of three spirals: Heuristic spiral of gameplay, Heuristic spiral of narrative, and hermeneutic spiral. The first and second refer to the game cycle and narration, while the third is interested in interpretation. In this model, each spiral is based on the previous one. The second and third can only develop if the first is present. The concept of Flow as a negative feedback loop that we proposed earlier corresponds quite well to the first spiral. It therefore constitutes a second-order cybernetic pattern. The second spiral seems to follow the same logic as the first. The narrative is constructed by the player as he discovers new information and correlates them. Here a dynamic is created by the interaction of the player and the narrative as a mental reconstruction. This dynamic also constitutes a second-order cybernetic pattern. The third spiral, on the other hand, allows the game to be given meaning thanks to the circularity between the whole and the parts:

"The circularity between the whole and the parts brings here the question of interpretation and deals with different meanings."

This spiral seems to us to be comparable to the cycle of creative abduction used by Kücklich in that it results in a hermeneutic understanding in the player.

Arsenault points out that although the gaming experience begins with the launch of a game, the hermeneutic and heuristic narrative spirals are already present before the launch. This refers to past experience and modulates new gaming experiences. This is what the presence of the two inverted spirals preceding the game launch expresses.

Throughout the gaming process, the player builds a mental image of the game (what Arsenault calls Game '). This mental image merges with the player (with everything he knows, expects, hopes, etc.) and the gameplay (including the entire spectrum of possible actions and reactions).

Arsenault points out that the gaming process evolves as a constant tension between a search for mastery of the game "playing-for-mastery" and a search for development of the game's content "playing-for-progress". Each player is situated between these two poles. Thus it is with players seeking a more narrative than ludic experience or vice versa. The gameplay is built by the game process involving the player and the game and allows the development of the experience. These two poles, which evolve in Perron's heuristic domain, seem to us to be very similar to the aesthetic dimension described by LeBlanc and Kücklich. The search for mastery and content can also be reduced to autotelic activities as proposed by Csikszentmihalyi. It therefore seems to us that we are dealing here with a cybernetic pattern. This pattern, describing a cyclical dynamic tending towards experience, is described

by several authors. This is the usefulness of the concept of pattern. Because of its dynamic nature, we attribute to it the name of cybernetic pattern, and it refers to all the dynamics linking the agents of a game process as a system.

Cybernetic Patterns

As we have seen by surveying these authors, there are clear links between design, video game analysis, and cybernetics. LeBlanc has demonstrated with positive and negative feedback loops that cybernetic patterns can be used to create better games. Bjork and Holopanien use patterns as basic objects for game mechanics design, which are at the heart of the dynamics that interest us. Csikszentmihalyi's Flow is a cybernetic pattern that also uses feedback to build the experience. Kücklich and Arsenault approach video game analysis with a second-order cybernetic approach that allows for a better understanding of the process of reception and construction of meaning.

Following this line of thought, we believe it would be interesting to develop a cybernetic approach using the notion of pattern for game design and analysis. As proposed by Lemay, this approach should be oriented towards the player's experience. For us, this experience carries meaning. It is therefore essential to conceive of it as a whole, from micro to macro. From the interactions between mechanics to interpretation. Moreover, as implied by the inverted spirals in Dominic Arsenault's magic cycle model, the experience is always preceded by other experiences. These experiences follow each other in a logical sequence from which we can also extract meaning. These sequences involve a host of other experiences outside our field of research. However, it seems to us that the importance of gaming experiences in these life sequences is often underestimated. Video games are often wrongly considered as "a reserved universe, closed, protected: a pure space". We therefore believe that the first and second order cybernetic approaches can complement each other and "break the magic circle".

In this essay, we have highlighted several cybernetic patterns already used in video game design and analysis. However, these patterns are very limited in the use they make of cybernetic concepts. Cybernetics offers us a host of other models that can be used in the design and understanding of dynamics in video games. In particular, the notion of feedback cannot be sufficient in a complex system. In this respect, the concepts of "anteroaction" and "buffer" are notions that we have not addressed and which could be the basis for new cybernetic patterns in video games. Cybernetics is rich in these models and can be used to design more complex and efficient dynamic systems. That is its raison d'être.

BIBLIOGRAPHY

- Alexander, Christopher, S. Ishikawa, and M. Silverstein. “A Pattern Language, volume 2 of Center for Environmental Structure Series.” Oxford University Press, New York, NY, 1977.
- Bjork, Staffan, and Jussi Holopainen. “Patterns in Game Design.” Charles River Media, Hingham, Mass, 2005.
- Csikszentmihalyi, Mihaly. “Vivre: la psychologie du bonheur.” Paris: Robert Laffont, 2004.
- Csikszentmihalyi, Mihaly, and Isabella Selega Csikszentmihalyi. “Optimal Experience: Psychological Studies of Flow in Consciousness.” Cambridge: Cambridge University Press, 1988.
- Heaton, Tom. “A Circular Model of Gameplay.” Gamasutra.com, February 23, 2006.
- Hunicke, R., LeBlanc, M., & Zubek, R. “MDA: A formal approach to game design and game research.” Proceedings of the AAAI Workshop on Challenges in Game AI, Tech Report WW-04-04. Menlo Park, CA: AAAI Press, 2004.

- Kücklich, J. “The Study of Computer Games as a Second-Order Cybernetic System.” In F. Mäyrä (ed), Computer Games and Digital Cultures. Tampere University Press, p.101-111, 2002.
- Lemay, Philippe. “Developing a pattern language for flow experiences in video games.” Tokyo: The University of Tokyo, September 2007.
- Ryan, Marie-Laure. “Narrative as Virtual Reality: Immersion and Interactivity in Literature and Electronic Media.” Johns Hopkins University Press, Baltimore and London, 2001.
- Salen, Katie and Eric Zimmerman. “Rules of Play: Game Design Fundamentals.” Cambridge, Mass: MIT Press, 2003.
- Salen, Katie and Eric Zimmerman. “The Game Design Reader: A Rules of Play Anthology.” Cambridge Mass: MIT Press, 2006.