Summarising the 7 Dimensions of an Action-Oriented Framework for Video Games

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ABSTRACT

This article summarises our Ph.D. thesis – an analytical view on the player-game relationship through the lens of an action-oriented framework, centred on fundamental entities defined as actors, entities through which action is enacted in the game and of which the player and the game system are a part of. With this in mind, the grounding principles of this framework are seeded in a transition of action into experience, based on communicational systems that structure the dynamic formation of networks of actors from which distinct behaviours emerge, which, in turn, promote the enactment of diverse sequences of events establishing narrative, which is a source of experience of the player. Chronology, responsiveness, thinking and actuation, transcoding, focus, depth, and traversal are the 7 dimensions we unveiled through the lens of this action-oriented framework. This work proposes that video games can be regarded as action-based artefacts and a call to awareness for game designers that when designing for action they are working with the foundations on which video games are built upon.

KEYWORDS

Action; Chronology; Depth; Design; Focus; Framework; Responsiveness; Thinking and Actuation; Transcoding; Traversal; Video Games.

1 | INTRODUCTION

Since our very first contact, video games always amazed us by the fact that they were able to respond to our input and challenge us. Our amazement came not from their audiovisual capabilities, but from their ability to act. Today, along with other authors, we believe action is at the core of video games, and it is with this in mind that this work's starting point is set on exploring the dynamics of action through a perspective deeply focused on the relationship established between the player and the game system. We find this perspective to be important because video games have been frequently seen at the light of other media, such as cinema, television, literature, etc. Despite the fact that they have appropriated much of what is found in those media, they are not a part of them. They are a different kind of media, with singular characteristics. Therefore, by focusing on an analysis of the player-system action-based relationship we were able not only to question the consistency of popular categories found in video game genres – many of which are used in the practice of game design –, but also to promote a more consistent and focused perspective on the subject.

With this in mind, the action-oriented framework presented in this work attributes equal importance to the player and to the game system, even taking into

consideration that the entity assuming the role of operator of the game system may not even be human. This is a framework that can be used as a model for analysing or conceiving action in video games, and that is primarily focused on the transition that occurs between the mechanics of the system and the experience of the player. Through it we unraveled seven dimensions of action that we believe contribute to a better design of communication, meaning, rhetoric, and experience in video games.

2 | AN ACTION-ORIENTED FRAMEWORK

2.1 TO ACT IN VIDEO GAMES

Computers that processed early video games were unable to display complex graphics along with the interactive features expected from a game, and, consequently, gameplay was prioritised (Rollings & Adams, 2003, p. 292). Even now, this is a pretty valid statement. A game's primary prerogative is to be playable, as without action it becomes passive entertainment. The player is an active participant in the game world, influencing it in the most various ways and taking part in the "central conflict of the game's narrative" (Wolf, 2001, p. 114).

With this in mind, we may say that *action* is the means by which the player is able to alter or maintain game states influencing the game system (Björk & Holopainen, 2005), which reacts back at the player, in a cybernetic feedback loop (Wiener, 1948, 1954), and that, therefore, games only occur when they are actually enacted, since "[w]ithout action, games remain only in the pages of an abstract rule book" (Galloway, 2006, p. 2).

As Laurel states: "action is indeed the primary component of human-computer activity" (1991, p. 135). That is why, according to her, *Spacewar!* (1962) [1] was the natural thing to build with computers (Laurel, 2014).

With this in mind and in order to characterise action, we undertook an analysis of:

1) Wolf's thoughts on why video game genres should be focused on interactivity, as well as his perspective that the player is sometimes forced "to momentarily take on the author's way of thinking" (2001, 4) in order to succeed in the game, something that is clearly depicted in the MDA framework (Hunicke, LeBlanc, & Zubek, 2004);

2) Bartle's (1996, 2004) player taxonomy in which he differentiates action from interaction;

3) Björk and Holopainen's (2003, 2005) implicit distinction between action and actuation in their activity-based framework for video games;

4) Galloway's (2006) gamic action, characterised by means of a model that encompasses the actions of the player and those of the game system within the diegetic and non-diegetic realms, and that validates action and inaction as equally important phenomena in the player-game system relationship;

5) the capabilities of modularity and recursion found in the gameplay-based classification model of video games proposed by Alvarez (2004, 2006) and Djaouti et al. (2007a, b, 2008a, b);

6) the properties of emergence present in Schell's definition of operative and resultant actions (2008, p. 140);

7) Adams's perspective that a "player experiences a video game through its input and output devices" [2] (2014, p. 255);

8) Crawford's perspective on interactivity as a conversation, "a cyclic process in which two actors alternately listen, think, and speak" (2003, p. 5), evidencing a communicational structure composed by input, processing, and output, along with Zimmerman and Salen's (2004) similar view on Sutton-Smith's model focused on the psychological processes by which digital games are experienced (1986), and the also concurrent perspective of Djaouti et al. (2008) on the structural parts of a video game; and

9) Crawford's position about conflict in video games (2011), along with the idea that for LeBlanc "[a]ll drama originates from conflict" (2005, p. 444).

Interrelating these ideas, thoughts and concepts allowed us to find that to act in the context of video games is an activity that can be summarily characterised as follows:

- *To act is to engage on a cybernetic relationship* that can be characterised as *dialogical* — because it establishes a communicational feedback loop between player and system — and as *dialectical* — because they act as opposing forces.

- *To act is to actuate in order to alter or maintain game states or player states,* in the sense that, in order to be realised, the actions of both the player and the game system require some kind of operation, regardless of whether they are successful or not in accomplishing their goals.

- *To act is to emit signals,* since the player and the game system *communicate* with each other, interpreting each other's actuations.

- *To act is also not to act*, because the player-game's communicational system is not always on continuous feedback.

- *To act also means to influence behaviour,* because behaviours are complex actions that emerge from simpler actions.

Overall, *to act is to shape the experience of play,* in the sense that it is the player's and game's actions that determine the course of events.

2.2 FROM ACTION TO EXPERIENCE

The framework we propose follows a line of thought that can be described as a multistage transition that goes *from action to experience:* from action stems communication, communication originates networking, networking creates emergence, emergence gives rise to narrative, and narrative constitutes experience.

From action stems communication in the sense that the relationship between the player and the game-system is based on a communicational feedback loop rooted on a cybernetic relationship "involving both organic and nonorganic actors." (Galloway, 2006, p. 5). These communicate through actions, which are interpreted as signals, in a similar fashion as what we find in Shannon's (1948) and Weaver's (1949) models for communicational systems. Hence, in this framework the player and game system emit signals that traverse an environment, reaching their ultimate destination.

Communication originates networking since actors [3] constantly establish links with each other that are frequently interrupted as well, severed by their own will or by decision of others, constituting dynamic networks, a perspective influenced by Latour's actor-network theory (1987, 1988, 1993, 1999), Harman's object-oriented philosophy — mainly his perspective on Latour's work as a contribution to metaphysics (2009) —, Bogost's *unit operations* and *tiny ontology* (2006, 2012) [4].

Networking creates emergence because it is from the fluidity of these networks, from their ever-changing nature that behaviour emerges. And it is this behaviour that the player mainly witnesses as the rules of the game in motion. Even unanticipated behaviours on behalf of human players — such as cheating, hacking, modding, etc. —, caused by other software — viruses included —, or even by means of the hardware itself give rise to alternative behaviours.

Emergence gives rise to narrative in the sense that the sequence of events generated by these behaviours is what constitutes narrative. Bear in mind that we are not necessarily talking about the storyline of the game but about all the events that result from internal procedures of the game system and from the player's interactions with it that are expressed in runtime during a game. That is what LeBlanc calls the emergent narrative (cited in Salen & Zimmerman, 2004, p. 383) and what Bissel names the ludonarrative (2011).

And finally, *narrative constitutes experience* because it is these sequences of events that emerge from these behaviours promoted by these networks of actors — that unfold while playing the game — that constitute the action-based experience of the player. An experience is dependent on processes, on procedures, on action, and that is not related with iconography or theme.

This perspective — grounded on action — is then able to look at the specificities of video games as ergodic media as defined by Aarseth (1997), and this chain of procedures seems to be in tune with the MDA framework (Hunicke et al., 2004), depicting how the dynamics level links the mechanics and the aesthetics levels.

2.3 ACTORS

This framework is grounded on elements we define as actors, and through which actions in the game are enacted. In sum, everything that is able to act in the game is considered to be an actor, whether that is the player, the game system, a playable or non-playable character, a power-up, the arrow cursor, an item, the camera, etc.

Actors act by emitting *signals* that may be sensed by other actors and/or by its originator [5]. In order for a given signal to travel between the emitter and the receiver it must traverse the *environment*, which is what allows the creation of links of communication between them, but at the cost of altering the signal, a phenomenon that can be classified as *noise* [6].

By further inspecting actors, we found the following traits:

- *Topology:* is based on a recursive structure, in which actors are constituted by networks of other actors, which in their turn are also constituted by networks of other actors, and so on [7].

- *Mereology:* considering the previous point, actors either have an open topology — in which their components are accessible to others — or a closed topology — in which their components are inaccessible to others, appearing to them as black boxes.

- *Milieu:* an actor's connections with other actors, its social grounds, which plays an essential role in determining its influence and function in the network.

- *I/O structure:* an actor is constituted by sensors — enabling it to inspect the environment — processing core — allowing it to process signals and to make decisions — and actuators — that permit it to actuate and be able to emit signals (see Figure 1).

- *Behaviour [8]:* Actors exhibiting *class 1* behaviours express a uniform, deterministic and predictable behaviour. Actors within *class 2* act according to nested patterns of behaviour. The output of actors with *class 3* behaviour may present random or pseudo-random results. Actors exhibiting *class 4* behaviour are those that have a complex, structured but not necessarily deterministic behaviour, being able to plan various strategies to accomplish their goals.

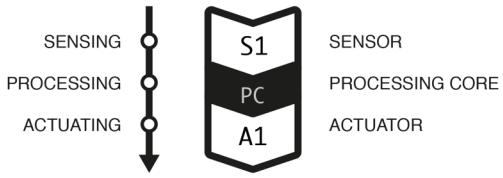

Figure 1 | Actor's I/O structure.

2.4 METHODS OF OPERATION

By further inspecting the methods of operation of this framework, we encountered three distinct types:

- *Mediated operations* are those in which the signals that emanate from the player and/or the system are processed by another actor that stands between them, such as in the practice of tool-assisted speedruns [9].

- *Direct operations* are those where the effects of mediation (noise) are considered to be irrelevant, despite the fact that every operation in this framework is considered to be mediated.

- *Delegated operations* occur when an actor acts in representation of another, such as when the player delegates her role as operator of the game system to a bot, to an artificial intelligence agent, or even to another organism.

3 | 7 DIMENSIONS OF ACTION

From this perspective and focusing on the relationship between the player and the game system, we were able to find 7 distinct dimensions of action (see Figure 2).

3.1 CHRONOLOGY

By establishing a reasoning that video games are fundamentally chronological, we may classify *chronology* (Cardoso, 2015, p. 141-157) as a dimension that is focused on understanding variations in the sequences of events, attentive to the manipulation of objective time — the time the player

takes to play — and event time — the time related with the diegesis of the game world (Juul, 2004).

Preterite actions are those that are focused on past events, accessing the memory of the computational system in order to invoke stored data. Here, we found two subtypes:

1) *Replay actions* allow the player to return to a certain moment in the chronology in order to change its outcome. We find this in trial-and-error based videogames, such as *Lunar Lander* (1973), *Pac-Man* (1980), *Manic Miner* (1983), *Ghost 'n' Goblins* (1985), *Super Mario Bros.* (1985), *Contra III: The Alien Wars* (1992), *The Unfair Platformer* (2008), *Braid* (2008), *Super Meat Boy* (2010), *VVVVVV* (2010), *Blades of Time* (2012), *Donkey Kong Country: Tropical Freeze* (2014), *Plants vs. Zombies* (2009), *Angry Birds* (2009), *Flappy Bird* (2013). We also find them in more cinematographic or narrative-based games such as *Life is Strange* (2015).

2) *Review actions* allow the player to access past events without being able to influence their outcome, useful for evaluating one's performance. The ghost ship feature in *Wipeout Pulse* (2007), the ghost Mii feature in *Super Mario 3D World* (2013), and the blood stains in *Demon's Souls* (2009) are examples.

Despite all actions being enacted in the present time, *present actions* are those that are solely focused on the really short time span that is the immediate present time. These are usually fast actions and are often not consciously enacted. Therefore, although sometimes they are not executed taking into account one's best interest, they are essential since conscious thought takes time. *Robotron: 2084* (1982), *Unreal Tournament* (1999), *Geometry Wars: Galaxies* (2007), *Bayonetta* (2009), *Vanquish* (2010), *Sonic Lost World* (2013) are examples due to their fast-paced nature that promotes quick decision-making.

Preemptive actions are those that work towards the preparation for a determined foreseen situation. This is an ability that not only depends on the experience and astuteness of the player but also on the predictability and determinability of the game system. The 'zapping system' in *Resident Evil 2* (1998) that allows the player to sequentially play two complementary scenarios within the game, and the case of the sniper 'The End' that can be killed at an earlier stage of the game in *Metal Gear Solid 3: Snake Eater* (2004) in order to bypass it later as a boss are examples.

3.2 RESPONSIVENESS

Responsiveness (Cardoso, 2015, p. 159-181) is a dimension that looks at the fundamental input and

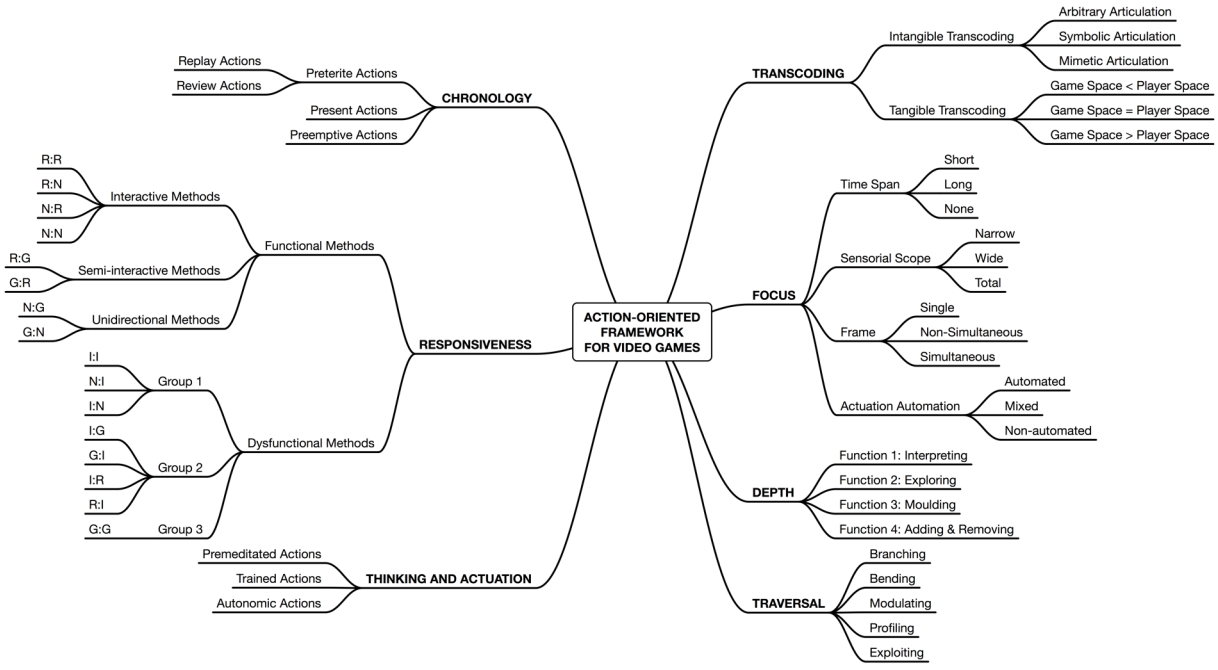

Figure 2 | Overview of the seven dimensions featuring all the variables.

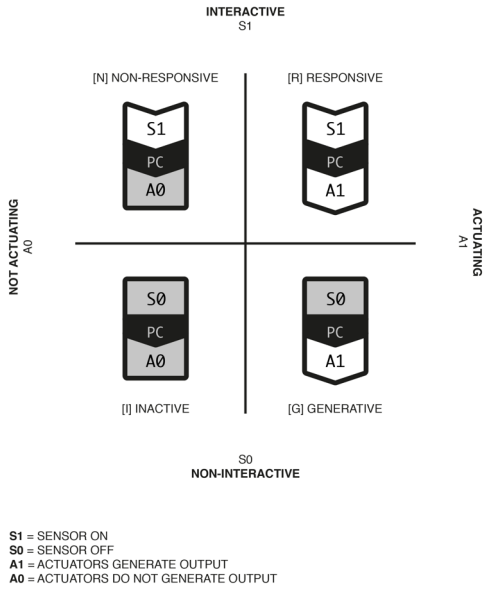

Figure 3 | Actor's I/O states.

output structure of the player and of the game system (sensors, processing core, and actuators), discerning their basic input and output states, having determined four I/O states (Figure 3): *non-responsive* (N), *responsive* (R), *generative* (G) and *inactive* (I).

We then calculated all possible permutations between these states in systems featuring two actors (player and game system), uncovering *functional methods* — those where at least one of the actors is receptive to the other's output — and *dysfunctional methods* — those that are unable to establish a direct pathway of communication between both actors (Figure 4).

Overall, in this dimension we have asserted that variations in responsiveness promote the emergence of different play experiences, confirming that the relationship between the player and the game system is not always in constant flux, valuing inaction as much as action itself, therefore corroborating that dysfunction is not exclusively a synonym of uselessness or error, but that it plays a major role in the action-oriented nature of video games instead.

3.3 THINKING AND ACTUATION

This is a dimension that is observant of the player as an entity of biological origins and is focused on discerning diverse types of player action found between conceptualising and enacting an action (Cardoso, 2015, p. 183-195).

Premeditated actions are those in which the player is required to invest conscious mental effort in their planning, taking time to deliberate. *Populous* (1989), *Warcraft: Orcs & Humans* (1994), *Age of Empires* (1997), *Black & White* (2001), *Supreme Commander* (2007) and *Starcraft II: Wings of Liberty* (2010) are examples since these games enforce the player to

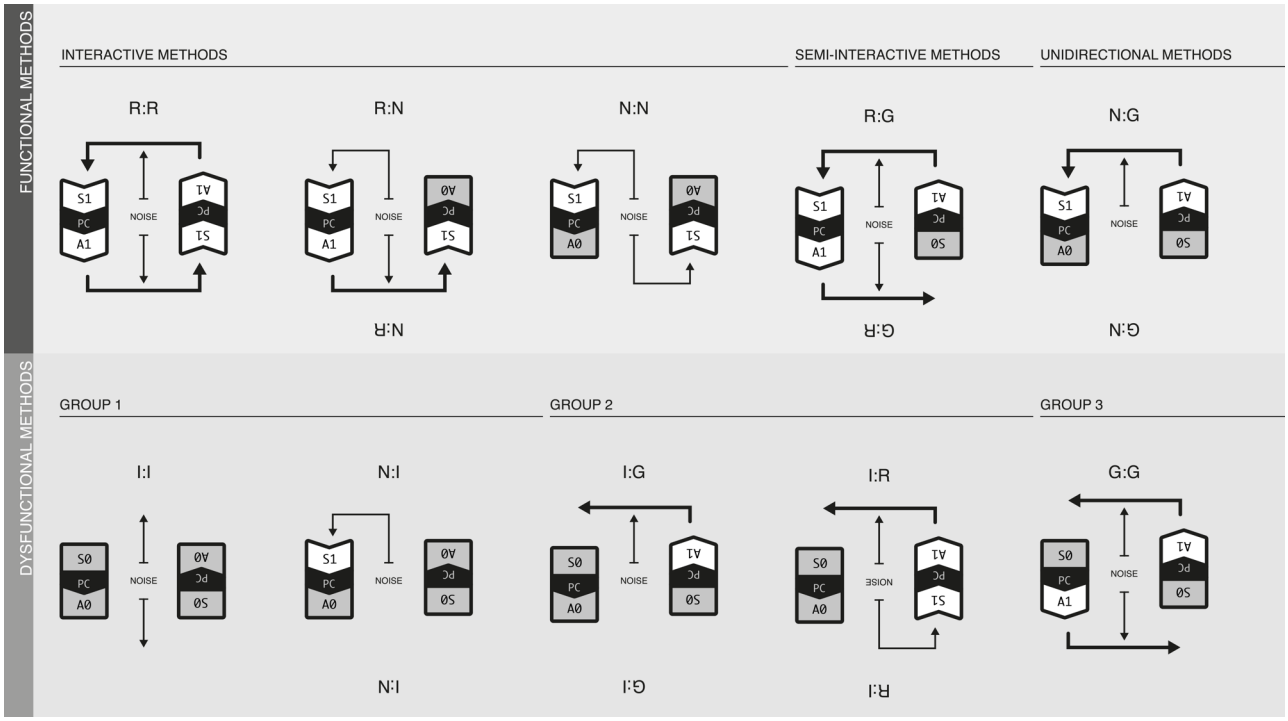

Figure 4 | I/O methods.

make plans in order to achieve long-term goals.

Trained actions are those that, although voluntarily initiated and terminated by the player, are executed unconsciously, and learned and mastered by rote, becoming automated and choreographed. *Super Mario Bros.* (1985), *Sonic the Hedgehog* (1991), *Super Street Fighter II* (1993), *Tekken* (1994) and *Wipeout* (1995) are some examples of games that resort to this kind of actions.

Autonomic actions are those that are dependent on the physiologic operations of the player's body, and that occur without her direct control, will, or even consciousness. *PainStation* (2001), *Tekken Torture Tournament* (2001), *Nevermind* (Early Access 2015) and *Brainball* (2001) are examples of games that resort to this kind of action in order to be played.

3.4 TRANSCODING

Transcoding (Cardoso, 2015, p. 197-217) is a dimension focused on the relationship between the performance of the player and of her proxy in the game world, and by considering the corresponding events in *player space* — the physical space where the player's body is actually situated — and in *game space* — the space where the game world resides. With this in mind, we uncovered two major types of transcoding: intangible and tangible.

Intangible transcoding occurs when player space and game space are different, a case in which the player needs a proxy in game space in order to act within the game world. And it's their articulation that is relevant here:

- An *arbitrary articulation* occurs when there is no direct correlation between the actions of the player and those of her proxy. It is an articulation that is subjected to instruction due to its arbitrariness. Jumping and firing in *Super Mario Bros.* (1985), the 'fatality' combos in *Mortal Kombat* (1992), or even punching and kicking in *Tekken 3* (1997) are good examples here.

- A *symbolic articulation* occurs when there is a partial correlation between the actions of the player and those of her proxy. In other words, their actions bear some similarity but they are not the same. Executing the 'hadouken' in *Super Street Fighter II* (1993), shifting between first-person and third-person side view in *Metroid: Other M* (2010), or executing many of the on-screen prompts in *Fahrenheit* (2005), *Heavy Rain* (2010), *Beyond: Two Souls* (2013) and *Asura's Wrath* (2012) are good examples here.

- A *mimetic articulation* happens when the actions of the player and of her proxy are homologous, where the proxy imitates the player's actuations to the best of the system's capabilities, or vice-versa. Attacking or raising the sword in *The Legend of Zelda: Skyward Sword* (2011) is an example, similar to that in *Dragon Quest Swords: The Masked Queen and the Tower of Mirrors* (2007), *Red Steel 2* (2010), *Kinect Star Wars* (2012) or even in *Wii Sports* (2006), as well as particular moments in *Heavy Rain: Move Edition* (2010) where the player has to execute very specific movements indicated by the game which are replicated to a certain degree of fidelity by her avatar.

On the other hand, *tangible transcoding* happens when player space and game space are the same, which implies that the player's proxy is dismissed:

- *Game space is smaller than player space* when the actuations related with the actions of the player only involve part of her body. *Angry Birds* (2009), *Fruit Ninja* (2010), *Fingle* (2012) and *Finger Tied* (2012) are some examples since the player mainly uses her fingers directly on the game world, which is featured on a small touch-sensitive screen (the size of a tablet or smartphone, for example).

- *Game space is equivalent to player space* when the totality of the player's body is involved in game space. *Dance Dance Revolution* (1998) or *Johann Sebastian Joust* (2010) are good examples of games where the player needs to make use of her whole body to be able to play.

- *Game space is bigger than player space* when the player is forced to travel in order to play, something that is evident in *Coderunner* (2012), *Ingress* (2013) and *Pokémon Go* (2016), games that track players' location through Global Positioning System equipped devices.

3.5 FOCUS

Focus (Cardoso, 2015, p. 219-243) is concerned with the player's attention span and how the game system

challenges her by overload or deprival. We emphasise three states — *focused, defocused,* and *unfocused* — that are transversal to the four uncovered sub-dimensions.

Time span is focused on the exploration of the temporal durations that the player is granted to act, enforcing pace and speed.

- A *short time span* promotes fast-paced action and quick decision-making. Examples are found in quicktime events in games such as *Shenmue* (1999), *God of War* (2005), *Metal Gear Rising: Revengeance* (2013), *Resident Evil 4* (2005), or in particular moments of decision in *The Walking Dead* (2012) or in *Octagon: A Minimal Arcade Game with Maximum Challenge* (2013), *Super Hexagon* (2012), or even in *Tetris* (1984) to mention an entirely different genre.

- A *long time span* grants the player a limited time to plan her actions. *Worms* (1995) is a good example because each player turn is due in a particular amount time, as well as in *Pikmin 3* (2013). *Max Payne* (2001) even transforms the previous type of actions into these longer time span actions in what became known as 'bullet time', as well as *Super Mario Bros.* (1985) when the 'hurry-up' theme plays.

- When a given *time span is not enforced on the player,* she is able to act relaxedly on the game world. Exploring the world in *The Elder Scrolls V: Skyrim* (2011), in the *Grand Theft Auto* series, or in more experimental games such as *The Endless Forest* (2005) is an example. As is the temporal experience in dialogues in *Mass Effect* (2007), *Fallout 3* (2008) and *Deus Ex: Human Revolution* (2011). *Superhot* (2013) is even more interesting since in it, game time only advances when the player's avatar moves.

Frame refers to the 'windows' through which the player witnesses the game world and its events. Although it is easier to describe it in visual terms, this dimension may also regard non-visual phenomena. Frames can be fixed — increasing a sense of entrapment or confinement — or scrollable — allowing the player to travel to a currently hidden part of the world, consequently hiding another.

- A *single frame* promotes the player's undivided attention to it. Some of the many examples are *Pong* (1972), *Asteroids* (1979), and *Super Mario Bros.* (1985).

- *Non-simultaneous frames* permit the player to sequentially witness diverse parts of the game world or the same part from diverse perspectives. Examples are found when alternating between Aiden and Jodie (two playable characters) in *Beyond: Two Souls* (2013), when using a 'Hyoi Pear' in *The Legend of Zelda: The Wind Waker* (2002) in order to control a seagull, or when exchanging control between teams in *Pikmin 3* (2013) or characters in *Thomas Was Alone* (2012).

- When *simultaneous frames* are displayed the player is able to witness diverse events occurring on the game world at the same time, or the same events from alternative perspectives. For example, games like *The Legend of Zelda: Phantom Hourglass* (2007) for Nintendo DS, and *Assassin's Creed III* (2012) for Wii U take advantage of systems that use two screens. *Fahrenheit* (2005) and *Siren: Blood Curse* (2008) frequently divide the screen in various frames, simultaneously presenting different events in the game world. *Screencheat* (2014) is a game based on screencheating, something that happens in competitive games when players peek at the opposing players' frame, usually to determine their location. Elements featured in the heads-up display such as maps — as the one in *Metal Gear Solid* (1998) — or the health bar in *Street Fighter* (1987) or *Tekken* (1994) are also examples.

Sensorial scope is related to how much of the game world the player is able to simultaneous perceive. In some video games this scope changes along the traversal, and may be controlled by the player or automatically managed by the system.

- A *narrow sensorial scope* forces the player to be attentive to her immediate surroundings, promoting quick reaction since it conditions the amount of time available between the perception of a particular event and the time that the event actually gets concretised. Horror games like *Dead Space* (2008), *Resident Evil* (1996), or *Silent Hill* (1999) are excellent examples here since those usually entrap the player in small and/or dark spaces.

- A *wide sensorial scope* permits the player to perceive beyond her immediate surroundings, granting her some leeway between planning and actuating. Games like *The Sims* (2000) and *Starcraft II: Wings of Liberty* (2010) are good examples because they provide a partial overview of the game world.

- A *total sensorial scope* allows the player to perceive the entirety of the game world. *Pong* (1972), *Asteroids* (1979) and *Tetris* (1984) are a few examples.

Actuation automation regards the variations that occur between automation and non-automation of certain actuations when the player has to realize two or more operations simultaneously. This is the case of *Brothers: A Tale of Two Sons* (2013), in which the player simultaneously controls two characters, one with each hand, with a single game controller.

- When the *actuation is automated* the player is involved in repetitive actions, whose actuations can be trained, patterned and transformed into automated processes.

- A *mixed actuation* consists of the execution of both automated and non-automated actuations, something that is rendered possible because automated actuations can be kept ongoing without being constantly monitored.

- *Non-automated actuations*, on the other hand, involve the player in constant improvisation and adaptation to the events in progress, requiring their attentive monitoring.

3.6 DEPTH

Depth (Cardoso, 2015, pp. 245-259) is a dimension that is attentive to the influence of the player on the game system's behavioural structure. Here we uncovered four player functions that describe how deep that influence is.

Function 1 is in constant development and it is only concerned with the interpretation of the network of actors that constitutes the game, which is essential for the player to understand the system's behaviour, which, in its turn, will be the fundaments for her subsequent actions [10].

A player developing *function 2* explores the network of actors, by interacting with the game system within the boundaries of fixed and unmodifiable rules, exploring it as by choosing from a predetermined list of options. *Super Mario Bros.* (1985) or *The Last of Us* (2013) are two examples of the many games that resort to this very contained form of interaction.

A player developing *function 3* is able to rearrange the network of actors, being granted the possibility to reconfigure the game system's behaviour but always within the boundaries of predetermined parameters and values [15]. The player develops this function either by reconfiguring the arrangement of the game world — such as in *Lemmings* (1991) or in *From Dust* (2011) — or by generating actors from a predetermined set of constitutive elements — such as in *Spore* (2008), in *Scribblenauts Remix* (2011) or in *Besiege* (Alpha 2015). *Super Mario Maker* (2015) is an even more distinct example since the player is able to create entirely new game levels from a set of particular game elements.

A player developing *function 4* is not constrained by the original set of rules, being able to expand or break them by adding new actors to the game and/or permanently removing existing ones [11]. *Hack 'n' Slash* (2014) is an example here, since it is a game in which the player plays by hacking the actual code in which it runs.

3.7 TRAVERSAL

Finally, *traversal* (Cardoso, 2015, p. 261-297) is a dimension related with how the player journeys through the game, by considering diverse intertwinements between the hardcoded narrative — the narrative that is fixed and predetermined — and the emergent narrative — the one that is fluid and dynamic, arising from the behaviours of the player and of the game system.

Branching is enacted when the player is asked to choose between mutually exclusive paths, of which *Super Mario Bros.* (1985), *Bioshock* (2007), *Infamous* (2009) and *Silent Hill* (1999) are some examples.

Bending occurs when the player accesses optional non-mutually exclusive events, to become more knowledgeable about the game world or to experience parallel narratives. *Super Mario World*

(1990), *The Legend of Zelda: A Link to the Past* (1991), *Final Fantasy VII* (1997), *Mass Effect* (2007), *Grand Theft Auto IV* (2008), *Borderlands* (2009), *Heavy Rain* (2010) and *The Elder Scrolls V: Skyrim* (2011) are all examples of games that invite the player to engage in optional activities.

A *modulating* traversal consists of shaping and crafting relationships between actors, and by regulating their disposition towards the player and each other. Examples are *The Sims* (2000), *Façade* (2005), *The Elder Scrolls IV: Oblivion* (2006), *Fallout 3* (2008), *Prom Week* (2012) and *Middle Earth: Shadow of Mordor* (2014).

In a *profiling* traversal the game analyses the player's behavioural patterns and establishes courses of action. *Silent Hill 2* (2001) system for selecting the ending, the acrobatics skill system in *The Elder Scrolls IV: Oblivion* (2006), the system that dynamically adjusts the location and number of adversaries the player faces in *Left 4 Dead* (2008), or the dynamic game difficulty balancing in e.g. *Super Mario 3D World* (2013) and *Metal Gear Solid V: The Phantom Pain* (2015) are good examples here.

An *exploiting* traversal occurs when the player takes advantage of errors, glitches and malfunctions of the system while playing, with examples being found in all sorts of computer games.

4 | CONCLUSIONS

4.1 ANALYSIS

After defining these dimensions, we proceeded towards establishing various methods of analysis that at the moment are constrained within a scope that encompasses core actions (those that emerge from the core mechanics of the game) and local actions (those that derive from local, particular mechanics of the game). With this in mind, we determined three different approaches, consisting of the method of analysis per se, and that can be divided into descriptive, comparative, and relational — which can be focused on an inter-dimensional or on an intra-dimensional analysis.

A *descriptive analysis* consists in listing the variables for each of the 7 dimensions, giving us a general perspective on the action-based composition of a given game.

A *comparative analysis* is focused on comparing the different core actions, pinpointing their differences and commonalities, operating on the results of a descriptive analysis. This analysis evidences which variables are constant and transient between core actions, giving us a perspective of the field of possibilities to which the player is constrained to in the game.

A *relational analysis* is focused on the relationships between the variables on an inter-dimensional or intra-dimensional level, also operating on the results of a descriptive analysis. An *inter-dimensional relational analysis* is focused on the relationships that exist between the variables in each dimension, which can be characterised as conflictual or as non-conflictual. An *intra-dimensional relational analysis* is focused on pinpointing eventual changes in the variables of a given dimension, therefore presenting the transiency of behaviour within the same dimension.

Considering these types of analysis, due to their focus on action, and despite the fact that they still require further study, this model already showed us that it allows us to peek into a game's procedural rhetoric [12] — something that greatly contributes to the relationship between the game designer and the player.

4.2 LIMITATIONS

We may say that although our primary goal was to uncover and thoroughly inspect these dimensions, each requires further exploration, a pursuit that has the potential to result in various complementary and more in-depth research studies.

There is an interesting asymmetry in the relationships between variables within each dimension. For example, the variables in the first level of *focus* are not mutually exclusive, working towards a particular combination to originate a given state in *focus,* while that does not happen in *chronology* [13].

There is much to be done regarding a study focused on the articulations between these dimensions, as well. They were scrutinised as independent phenomena, however that also didn't leave enough space and resources for a more detailed inspection in their articulation, something that we only became aware of during the final stages of the research.

Another issue is that although this framework is simple in its essence, the model needs a certain level of synthesis in order to increase the likelihood of being used. However, this fact is compensated by the model's versatility, as it allows one to focus on the whole or on the constitutive parts.

Through this framework, the complexity of the actions being analysed dictate the complexity of their own analysis. Therefore, if an action is too complex, its analysis will follow. The model seems to work well when analysing simple games and actions by means of descriptive analysis. However, in more complex situations or to have a deeper insight, the assessment also becomes more elaborated, resorting not only to descriptive but also to comparative and relational analyses. This may eventually hamper the model's use.

Finally, a real world use of this model within the context of game design and development is yet to be done. We don't see this as a problem to the theoretical establishment of the model itself, but a rather welcome subsequent study.

4.3 FUTURE WORK

We do not believe we have uncovered all dimensions and all respective variables, suspecting that there may be larger groups embracing various dimensions. We believe that the dimensions of *focus* and *transcoding* are more related with matters regarding the interface between the player and the system than any of the others. *Focus* and *thinking and actuation* also seem to be dimensions very attentive to processes enacted on the side of the player. This can be indicative of an organisational system that may become more and more evident as other dimensions are unveiled.

A study on the conceptual proximity and farness between variables in disparate dimensions now seems necessary in order to pinpoint eventual redundancies and levels of compatibility between dimensions.

In the same way, a study focused on how the articulations between these dimensions may lead the player towards distinct emotional states also seems relevant now. Therefore, designing for emotion is also a natural course for future developments.

Furthermore, this is also a study we consider to be moving towards an understanding of aesthetics, something that was expected and that we see as a natural and progressive development of this work.

On another subject, a statistical analysis on the player-system relationship through the course of time and across diverse genres may pinpoint to how that relationship evolved, as well as to what shapes it may assume in the future.

The emergence-based structure of action found in this framework also lead us to ponder on the possibility of the procedural generation of actions, of systems able to provide either distinct variations of pre-programmed actions and/or those that may not even have been initially considered or thought-out by the designer or developer of the game. Here, we are talking about actions that are dynamically and contextually generated by a system able to analyse the unique context of each session, of each situation, of each player, and to respond in a diverse, directed and customised way.

Finally, focusing on a more practice-based research we intend to use this model to study the video game player as a performer, intending to explore diverse behaviours promoted by distinct combinations of the dimensions in this framework but also to see what kinds of games and performative expressions emerge, in hopes of contributing to further widen the notions of performance and, most of all, to expand the gameplay of video games.

ENDNOTES

[1] Some consider *Spacewar!* (1962) to be the first video game in history.

[2] "[A]s well as (possibly) through interactions with other players in the same room." (Adams, 2014, p. 255) Also, it is an experience that is regulated by the user interface, which, contrarily to that in utilitarian software, is not supposed to promote the efficiency of the player's actions but the challenges in which the game is based on (38).

[3] Actors are the elemental unit of this framework and can be briefly defined as the elements through which actions in the game are enacted — the player and the game system are both actors. We expand this definition in the next section of the text.

[4] For example, both the player and the game system are composed of networks of actors.

[5] The form and modality of the signal are dependent on the capabilities of the actor that emits it. The capability to perceive the signal is also dependent on the modality of the receiving actor's sensors.

[6] However, since the environment is nothing more than a network of other actors that stand between the original emitter and the receiver, we may say that noise is nothing more than the effect of translation or mediation that a given signal suffers when going from one actor to another.

[7] Considering this, the nature of the actions within a given actor's micro levels may be different from the ones it enacts, but they utterly affect its behaviour, in the same way that its actions will affect the behaviour of an actor from which it is a part of.

[8] The four classes of behaviour we propose are adapted from Wolfram's (2002) classes of computational procedures by taking into account the ontological diversity of actors and considering deliberations articulated by Rucker (2005) and Carvalhais (2010, 2016) on the subject.

[9] A speedrun is a play-through in which the player tries to achieve the game's closure or particular objectives in the speediest way possible, in which some are performed with the use of tools beyond the original setup of the game. At the time of writing http://tasvideos.org is a good resource.

[10] It is also developed when vicariously learning about the game world. See (Carvalhais & Cardoso, 2015).

[11] It is here that questions of co-authorship start to arise, but novelty is only achievable through the reconfiguration of what already exists within the game world.

[12] For more information on procedural rhetorics see Bogost (2007). For video game rhetorics see Frasca (2007).

[13] Maybe that happens because in *focus* we were able to find the underlying characteristics that lead to particular states in that dimension. Perhaps we were aware — even if unconsciously — that there are too many states of *focus* to enumerate within the scope of this work. However, this leads us to an even more pertinent question: Can we do the same for *chronology* and for all the other dimensions? And by doing that will we be able to uncover even more variables/ states? And is this a good way to expand our knowledge on them?

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