Playing in 7D: Considerations for a study of a musical instrumentality in the gameplay of video games

Pedro Cardoso, Miguel Carvalhais

ID+, Faculty of Fine Arts, University of Porto, Porto, Portugal
pcardoso@fba.up.pt / miguel@carvalhais.org

Abstract. We believe that it is not at random that the term *play* is used in diverse contexts and across various media. *Playing* a musical or sonic instrument and *playing* a video game are, in principle, different activities. Yet, *play* is somehow involved.

The intersection between music and video games has been of increased interest in academic and in commercial grounds, with many video games classified as 'musical' having been released over the past years. The focus of this paper is not, however, on 'musical' video games themselves, but on exploring some fundamental concerns regarding the instrumentality of video games in the sense that the player plays the game as a musical or sonic instrument, an act in which she becomes a musical performer. And this something that is not necessarily exclusive to those considered to be 'musical' video games.

We define the relationship between the player and the game system to be action-based. We establish a parallel rationale regarding the musician and the musical instrument, focusing on intersections between these two activities. Afterwards, we propose that the seven dimensions we found to govern that action-based relationship to be a source of instrumentality in video games.

With this study we not only aim at raising a deeper understanding of music and sound in video games but also of how the actions of the player are actually embedded in the generation and performance of music and sound. In this paper we aim at setting up the grounds for discussing and further developing our studies of action in video games intersecting those with that of musical performance, an effort that asks for multidisciplinary research in musicology, sound studies and game design.

Keywords: Action, Gameplay, Instrumentality, Music, Sound, Video games.

Introduction

Music and games are not exceptions when it comes to the ubiquity of computational systems in contemporary societies. Studies focused on intersections between the field of video games and that of musical performance seem to be an emerging field of interest. Ours was initially captured by the thoughts of Aaron Olderburg on *Sonic Mechanics: Audio as gameplay* (2013); Julio D'Escriván's thoughts and works regarding performing digital media in opposition to perform with digital media (2011, 2014); Julian Oliver's works relating audio, music and video games; Chris Novello's Illucia: a patchable videogame system[1]; and by *The Adventures of General Midi* (2014) by Will Bedford, a video game that generates parts of the game world based on the content of MIDI files.

[1] Illucia is a patchable video game system developed by Chris Novello, that consists of a patchbay controller that allows the interconnection between video games, music software, text editors, and so on. At the time of writting more info could be consulted at www.illucia.com.

In *Sonic Mechanics: Audio as gameplay* (2013) Aaron Olderburg proposes that "[u]sing game mechanics to expressively proceduralize experiences such as sound and using sound to break apart the visual-centric space of games opens up the potential to create new expressive forms of gameplay." We agree that most mainstream contemporary video games are primarily visual-centric. Nevertheless, our intent is not to follow Olderburg's recommendations in a strict manner, but to complement them proposing that to rethink the visual-centricity that is currently found in video games one needs to first pay close attention to the relationship established between the player and the game system, in order to only then be able to see and be aware of how it affects the entanglement between music/sound and play itself.

Our premise is to explore fundamental concerns regarding the video game player as a musical performer, in a sense that they play a video game as a musical or sonic instrument. This notion of instrumentality not only advocates the need to understand the computational attributes of the system and the ludological traits of the game but mainly the specificities of the relationship that is established between the player and the game system during gameplay.

This relationship has been the core focus of our studies, which we identified as being *action-based*. We studied action as the quintessential component governing the relationship between the player and the game system, having discerned seven dimensions through which it may be deeply analysed: *Traversal, Chronology, Depth, Responsiveness, Transcoding, Thinking & Actuating,* and *Focus*. Each of these dimensions frames very specific perspectives on the relationship player-system, taking into account the process-intensive (Crawford 1987, 2003, Carvalhais 2013) nature of computational systems.

> Process intensity is the degree to which a program emphasizes processes instead of data. All programs use a mix of process and data. Process is reflected in algorithms equations, and branches. Data is reflected in data tables, images, sounds, and text. A process-intensive program spends a lot of time crunching numbers; a data-intensive program spends a lot of time moving bytes around. (Crawford 1987)

And although we have no intention of claiming the non-existence of other dimensions – avoiding the presumptuous and colossal mistake of thinking that we have uncovered them all – we acknowledge that these already grant us a large amount of variables to work with. With this into consideration, we believe that the exploration of these dimensions is of the utmost importance in the analysis of the player-system relationship; a relationship that bears a central role within the poietic and aesthetic dimensions of the musical or sonic compositions that are dynamically performed during gameplay.

1. Instrumentality in Play

From games, music, sports, film and theater to other recreational and entertainment activities, and so forth, *play* is a term that we see used across diverse contexts and across various media. In principle, *playing* is a term that, in all of those contexts, consists of different activities. Yet, if we disregard the differences that emerge from semantics and context, the relationship between the player and the game system and between the musician and the musical instrument are similar, being both governed by a communicational feedback loop seeded in a sort of cybernetic entanglement. In order to play, both the player and the musician act on an artefact – e.g. a video game console controller or the strings on a guitar – obtaining a response. The relationship between the player/musician and the game system/instrument is, from this perspective, grounded on the cycle established by the actions they express towards each other, resulting in a kind of performance: *play*. Play is thus inexistent without *action,* otherwise the cybernetic relationship falls apart. Here, to play is to operate, and whether that is done in a more or less ludic fashion is, to a certain level, a matter of semantics.

This may seem a somewhat simplistic perspective on the subject. A cybernetic feedback loop is present in various contemporary activities, which are different from playing games or musical instruments, such as driving a motor vehicle, for instance. Nevertheless, it is important to notice that we are not saying that games and musical instruments are equivalent because of that cybernetic feedback loop. We are stating

that, from a strictly operational point of view, the relationship player-system and the one musician-instrument are quite similar: *operator-artefact*.

The question now is: Why would we want to reduce everything to an operational standpoint? The fact is that this is the ground in which video games stand, as seen through the perspective of an action-based computational medium. The game progresses as the player operates its system[2]. It is this operation that is the focus here. And, as previously said, this is a point of convergence between playing video games and playing musical instruments in which we are interested. We are not claiming that this is a great discovery or some grand fact because it is not. We are simply noting that through the perspective of a framework that is action-based – such as the one we propose[3] – this is their common ground. Can this be a common ground for video games and other artefacts? It certainly can. But that kind of study is beyond the scope of this paper, as the contexts and purposes of those other artefacts direct us to other fields of knowledge. In other words, they may have a common ground but that does not imply that they are equivalent, only that that common ground is a good place to start, it is a proper place to ignite our research.

Our goal is thus not to repurpose, reconfigure or even to appropriate particular components of video games in order to create musical instruments; an operation where the original video game would stop being a game to become an instrument or where the newly created instrument would not be a game but a mere sum of game components. In contrast, our study is much more focused on how video games themselves can be used to perform music and sound; to serve as musical or sonic instruments and still continue to be games. In short, how can video games simultaneously be musical instruments and games?

This marks the start of our pursuance of what we are calling *instrumentality* in video games.[4] Instrumentality may be briefly defined as the quality of something to serve as a means to an end. But, from our perspective, an instrument is not just a tool; it consists of an artefact that is used – in this case, that is 'played' – to produce or to perform something, or even that produces and/or performs by itself. With this in mind, we propose that this notion of instrumentality – applied to video games – is rooted in three characteristics: *dialectical ability*, *freedom of expression*, and *actors*.[5]

1.1 Dialectical Ability

Video games are a very specific kind of computational artefact: one that is meant to be *played*. In this context, we use the term *dialectical* to illustrate the ability that allows the game system to act in opposition to the player, consequently challenging them, and vice-versa. The first situation is very evident in older video games where the player is constantly challenged by the presence of enemies that populate the game world and that contribute to a game world topography that could already be challenging to traverse. The win and loose conditions ever present in those games (and in many contemporary ones) acutely illustrate this point.

Notwithstanding, in some contemporary video games this is not so clear. In many there is no win or lose conditions. The focus is on experience, narrative, exploration, and so on. In any way, by providing the player with a plethora of choices, often questioning her moral standpoints or her judgmental capabilities, we may still consider the system as an opposing force to that of the player – even when this kind of situations is pretty implicit. The choices the player makes can dramatically change the unfolding of events and, consequently, the game's narrative. This is a kind of conflict the game system constantly presents to the player, through various means and nuances.

---

[2] We have identified various ways in which the player operates the game system, from moments where this feedback is continuous to those where it is not.
[3] A summary of that framework is described in chapter 2 of this article. However, for a deeper knowledge into these subjects we recommend reading our various publications mentioned in each section.
[4] Studies on instrumentality in video games are actually something that we believe to be applicable beyond the scope of music and sound. But that is outside the scope of this paper.
[5] With further studies we are expecting to uncover more of these characteristics.

On the other side, the player also challenges the game system by not only exploring its capabilities but also its limitations, testing it by forcing or even bending the rules, extracting as much as she can from it in order to understand it – sometimes – to the fullest.

> Conflict can only be avoided by eliminating the active response to the player's actions. Without active response, there can be no interaction. Thus, expunging conflict from a game inevitably destroys the game. (…) Conflict is an intrinsic element to all games. It can be direct or indirect, violent or nonviolent, but it is always present in every game. (Crawford 2011, loc. 285-301)

Musical instruments with computational capabilities have the potential to establish this dialectical relationship with their operators. We are not saying that musical instruments with no computation capabilities don't pose a challenge to their operators, because they do – especially when learning or mastering them (understanding them to the fullest). But that is not the only point. The question is not just on challenge itself, but on the ability to compute those challenges' and their outcomes, in response to the operator's actions, in order to mould the narrative that constitutes her experience. And that requires, as insinuated, computation capabilities.

The relationship that the operator establishes with this type of musical instruments is, such as with video games, action-based. They are seeded on interaction, as the operator's actions are transcoded into the machine that acts based on the algorithms it is governed by and the data it collects. Computational artefacts, as used in *algoraves,* for example*,* explore and harness the process-intensive nature of computational systems (Crawford 1987, 2012, Carvalhais 2013, Kwastek 2013) into the poiesis and aesthetics of musical and sonic compositions. In this context, often during a live-coding session, the operator programs the machine, a performance that cannot be considered analogous to that of playing a musical instrument because it actually is the performance of playing that musical instrument.

Dependent on the traits of the software and the capabilities of the hardware, the computer, consequently and without a doubt, performs in a very different fashion than a traditional acoustic instrument. Usually, the audience is unable to perceive what is going on, to understand how the operator (musician) is playing, and how sound/music are generated. There is no direct correlation between the sonic output and the gesture of the musician. "Regardless of whether any sensors can capture the resilient nuances of physical gesture, software is necessarily symbolic, and physical action will always be mediated through code." (Sa 2014) In fact, in many occasions the performance doesn't even contribute to the music itself, but solely to a visual spectacle that keeps the audience entertained.

> [A]re we in presence of a phenomenon of conformity in which audience tends to replicate what is the average tendency of preferring a certain degree of visual entertainment (served mostly by the gestural information) in detriment to the *absolute* value of the aural performance? (Joaquim and Barbosa 2013).

In essence, computational artefacts are *played* differently from traditional instruments because their very natures diverge. The foundational difference – which is of most interest to us – is that traditional acoustic instruments are not capable of establishing this dialectical relationship with their operator. Conversely, computational musical instruments can, as this capability is intrinsic to computational artefacts.

And video games, due to their computational traits stand closer to the latter than to the former. Video games are bound to their intrinsic computational genesis, with *action* at their core. And by being computational artefacts, they express a wide range of variance within this dialectical relationship; a relationship that sometimes is not clearly perceived in the ways the player and the game system challenge each other.

1.2 Freedom of Expression

In *Levels of Sound: On the Principles of Interactivity in Music Video Games,* Pichlmair and Fares Kayali (2007) discern between two major types of audio games: *rhythm games* and *electronic instrument games*.

In the first category, the player tries to follow very specific instructions, such as following a given musical score, a particular rhythm or aiming at the correct pitch when singing to the microphone; a performance that is monitored, measured and evaluated by comparison to one considered the standard of excellence. Here, we can find video games that became famous and that have mainstreamed musical game genres, such as *PaRappa the Rapper* (1996), *Guitar Hero* (2005), *Rock Band* (2007), *Singstar* (2007), or even *Rocksmith* (2011) – that uses a real guitar as a controller instead of a toy guitar –, or even yet *Patapon* (2007) – as a somewhat less known title.

Regarding the other category, the authors call *electronic instrument games* to those where the player "plays the game as an instrument. The game provides – or at least pretends to provide – all the freedom of expression that a musical instrument calls for." (Pichlmair and Kayali 2007) *Sim Tunes* (1996), *Small Fish* (1998), *Electroplankton* (2005), and *Fijuu2* (2006) are identified as examples.

Although the authors present seminal concepts to this ongoing study, we are not in full agreement with the terminology employed in their taxonomy – *rhythm* and *instrument* –, as at a first glance we may feel tempted to state that games in the first category don't possess instrumentality, opposing to the games included in the second. But a deeper inspection will show that that is not such a clearly defined issue.

We may then briefly state that a game that acts as a musical instrument is a game that is played in order to produce and/or to perform sound and/or music. So, we may say that, according to this concise definition, games in the first category also possess instrumentality, as they produce sound that derives and/or is moulded by gameplay, and which result may be seen as musical and/or sonic compositions. From this perspective, the difference between both categories doesn't seem to rely now on whether they possess instrumentality or not. We believe that that potential is already there. In our view, and as the authors insinuate, that difference depends on *freedom of expression*:

> Rhythm games offer little freedom of expression apart from the prerogative to perform while playing. They strictly force rules on the player on how she has to react to a specific stimulus displayed on screen or communicated by sound. (…) [P]layers are not building their own environment of sound. (Pichlmair and Kayali 2007)

It is thus this freedom of expression that marks the difference, setting games like *Guitar Hero* and *Electroplankton* apart. Games in their first category – rhythm – force the player to perform in a every specific and contained way, while in their second category – instrument – the player is granted more freedom, aiming for more diverse types or arrangements of formal expression and performance. With this in mind, we conclude that the difference between these two categories is not a matter of having or not having *instrumentality* (or the potential for it), but a question of *expressiveness* within their own instrumentality. This is a perspective that entails that both these categories already possess instrumentality, or at least instrumentality in potential. This freedom of expression is what distinguishes games where the player is obligated to follow a very strict path in which any diversion results in failure from those where the player is liberated and able to choose from multiple to an indefinite number of paths – whether by manipulating general game elements or going all the way inducing deep reconfigurations within the game world and its inhabitants.

1.3 Actors

As previously stated, the player-system relationship is nurtured by *action*. With this in mind, we propose a framework grounded on the existence of game elements that we define as *actors*. Actors are entities that have the ability to act in, on or within the game world. They are entities with the ability to influence the course of events and to alter game states, making it progress. In sum, everything able to act in the game is considered an actor, whether it is a playable character, an enemy, a power-up, the cursor pointer, an item, the camera, etc.. As long as they act, producing an effect on the game world and on each other, they are actors. In fact, through this perspective the game system and the player are also actors – albeit high level and complex.

But actors are different between themselves. Although from this perspective, a power-up and the player are both actors, they don't have much in common. The difference resides in their composition, which is based on an encapsulated and recursive formative structure. Meaning that a network of actors is able to constitute a more complex actor, and that a network of those more complex actors is also able to constitute an even more complex actor, and so on. With this in mind, an actor's composition may incorporate more or less complex networking and still be able to act as a single actor.[6]

The game system is an actor because its diverse components act in a network that contributes to the enactment of the game. A human player may also be seen as a collection of simpler actors that act articulately, allowing the player to receive and process information and to actuate based on that – e.g. just think of human sensory organs such as eyes, ears, the skin, as input devices; think of the brain as a processing unit; and all the sets of muscles, tendons and bones that allow the player to physically express herself as output actuators – not to mention all those that keep her alive, having the ability to influence her affective state.

So, this encapsulated and recursive formative structure allows the existence of actors with various degrees of complexity. The deeper we go into that structure the more specialised the actors are, focused on performing very specific actions. On the other hand, the higher we go into that structure, the more dynamic the actors' behaviours are, making them more versatile. A common power-up as the flower in *Super Mario Bros.* (1985) can be considered an actor that is set at a lower level than the player in this structure. While the flower has a very limited set of behaviours and actions at its disposal[7], the player is much more versatile.

The actors' diversity is thus expressed by variations in the complexity of their formative structure, and depending on that several kinds of actors may emerge. Eventually, actors in higher levels may even be able to experience agency, as defined by Murray (1997), thus being able acknowledge the effects of their actions and those of other actors in the game.

2. Playing in 7D

Considering what was previously enunciated, we propose a framework centred on the action-based relationship between the player and the game system. We propose seven dimensions that emerge from the behaviour of these actors:

1. *Traversal* is related to the journey of player in the game through the hardcoded narrative – the narrative that is fixed and scripted directly into the game – and the emergent narrative – the narrative that is expressed through occurrences derived by the behaviours of the player, of the game system and of other actors;

2. *Chronology* is a dimension focused on the ability of the player and of the game system to manipulate the relationship between objective time – the time the player takes to play – and play time or event time – and the time that flows in the diegesis of the game world –, which consequently affects the sequences of events in the game;

3. *Depth* is a dimension concerned with the influence of the player's actions in given layers of the game system's structure, from its surface to its core, from its aesthetics to its mechanics, thus proposing diverse player functions that occur during gameplay;

---

[6] This is actually something similar to what can be seen in actor-network theory (Latour 2005), in object-oriented programming, and even more similarly in Ian Bogost's unit operations and tiny ontology (2012).
[7] The flower power-up in *Super Mario Bros.* (1985), once touched by the playable character, allows it to shoot fireballs. The playable character looses that ability if touched by an enemy.

4. *Responsiveness* is a dimension that looks at the fundamental input and output structure of the actors (sensors, processing core, and actuators) to discern its diverse basic states drawing the possible combinations of communication in the relationship player-game system;

5. *Transcoding* is a dimension that studies the relationship between the performance of the player and its proxy in the game word considering the player space – the space where the player is actually situated – and the game space – the space where the game actually occurs, where the game world resides;

6. *Thinking & Actuating* is a dimension focused on the player as a collective actor of biological origins in order to discern between diverse types of actions that are expressed by means of varying intensities in the processes of conceptualisation (thinking) and of enaction (actuating) of an action;

7. And *Focus* is concerned with the player's attention span – input of information, the actor's sensors –, and how the game system challenges her, sometimes by overload and other times by deprival.

For a deeper discussion on the matters described in the following sections we suggest reading the works where we explore to a greater extent each of these phenomena.

2.1 Traversal

Traversal (Cardoso and Carvalhais 2013d, b, 2014b, Carvalhais 2013) can be defined as a journey, featured within the dialectical relationship between the player and the game system. Traversal regards the experience of the player when crossing the ergodic[8] landscape of the video game, focused on the diverse expressions that emerge from the relationship between the hardcoded and the emergent narratives.

The *hardcoded narrative* is static, fixed. It is a narrative "framed" (Bissel 2011) in the script of what usually is the story of the game. The *emergent narrative* (Salen and Zimmerman 2004, Carvalhais 2011a, b) is dynamic, fluid. It emanates from the relationship between the player and the game system. It transpires from the rules of the game that are put into motion, and it is solely experienced during play. And therefore it is difficult to be re-enacted with exactness, as a given event only occurs due to a very specific alignment of other previous events, many of which may be the result of chance.

The different types of traversal we propose are summarily described as follows:

1. *Branching* is a type of traversal that occurs when the player is asked to choose between mutually exclusive paths or events;

2. *Bending* occurs when the player is able to access optional non-mutually exclusive paths or events;

3. *Modulating* happens when the player is able to make adjustments to the social network of the actor's within the game, regulating the disposition or affinity of those actors towards her and each other, in a system in which events emerge from these relationships;

4. *Profiling* is a kind of traversal that is focused on the analysis of the player's behaviour, on understanding how she plays and acts within the game, in order to determine how events will unfold, either by proposing challenges of increasing or decreasing difficulty, or simply to personalise the narrative and the overall experience;

5. Contrarily to the types of traversal previously enunciated, *exploiting* is a kind of traversal that does not operate in a designed part of the algorithm. Exploiting happens when the player explores errors and malfunctions within the game.

---

[8] See Aarseth (1997).

2.2 Chronology

Chronology (Cardoso and Carvalhais 2012c) focuses on the exploration of the sequences of events as the game is played. It is about inspecting the actions that are used to manipulate or influence the sequence of events. The relationship between the hardcoded and the emergent narratives in video games provides an experience that emerges from the relationship between predetermined and non-predetermined sequences of events, respectively. While the hardcoded narrative on its own can be navigated out of the intended order, the emergent narrative cannot. This renders video games dependent on the experience of the player, and on the chronology of that same experience. When the player manipulates the relationship between these two kinds of narrative, she is also manipulating the relationship between two distinct types of time: event time – the time that flows in the diegesis of the game world – and objective time – the time the player actually takes to play.

In this dimension, the player's actions are thus constrained to the following: 1) By altering already experienced events the player propels the due consequences to the future – what would otherwise mean that her actions wouldn't have consequences, and thus that play wouldn't be meaningful; 2) The player cannot alter events that haven't happened, simply because she cannot access them; 3) The player only acts in the present time. Even if she is able to travel to the past and change it, that moment (past) is then her present time. And if she travels back to the future, that will become her present time as well. With these considerations in mind, we propose three main groups of actions focused on chronology.

Preterite actions are focused on accessing past events. We have discerned two disparate sub-groups here: 1) *Replay actions* allow the player to return and resume play from a particular moment in the past, usually in order to change its outcome; 2) *Review actions* also allow the player to return to a given moment in the chronology, but they do not permit her to change its outcome, only allowing the player to re-experience them, to inspect the past – sometimes from other perspectives – or to evaluate what happened.

Despite all actions being enacted in the present time, *present actions* are the actions that are solely focused on the really short time span that is the immediate present time. As a result they are usually fast actions, or even reactions.

And lastly, *preemptive actions* work towards forestallment. They are taken to prevent an anticipated event, or at least in preparation for it. This is an ability that not only depends on the experience and perspicacity or astuteness of the player, but also on the predictability and determinability of the game system and other relevant actors in play.

2.3 Depth

Depth (Cardoso and Carvalhais 2012a) is a dimension that is focused on discerning how the player's actions influence the game depending on where in its structure they are enacted. There are actions aimed at the surface of that structure, influencing the game only at its aesthetics level. And there are actions that are enact all the way into its more mechanical depths, influencing its rules and behaviours, reconfiguring them and even being able to generating new ones, in some cases. We explore these actions relating our work with that of Marie-Laure Ryan's "layers of interactivity" (Ryan 2011b, a), the MDA framework (Hunicke, LeBlanc, and Zubek 2004, LeBlanc 2005), and cybertext (Aarseth 1997), uncovering several player functions.

1. *Function 1* occurs when the player is focused on interpreting rules, on observing or perceiving the expressed behaviours within the game world.

2. *Function 2* is enacted when the player is concerned with following rules, on exploring and testing the behaviours of the actors found in the game world.

3. *Function 3* takes place when the player is involved in moulding rules, configuring and reconfiguring the behaviours of the actors present in the game world.

4. *Function 4* is developed when the player is embroiled in changing rules, adding new actors and behaviours to the game world.

2.4 Responsiveness

Responsiveness (Cardoso and Carvalhais 2012b, 2014a) is a dimension that probes the dialectical balance of action and inaction between the player and the game system, revealing a dynamic array of methods that have their foundations in functionality and dysfunctionality.

Functional methods are those where at least one of the actors is receptive to the other's output, when their behaviours are intertwined, featuring interactive, semi-interactive, and unidirectional methods.

Dysfunctional methods are unable to establish a direct pathway of communication between both actors, that are consequently unable to be directly responsive to each other's actions.

2.5 Transcoding

Transcoding (Cardoso and Carvalhais 2013c, 2014c) aims at an understanding of the translation between the player's and the game system's actions that occur during gameplay, taking into account the relationship between game space and player space.

In some games, the player acts within the game world by means of a surrogate: the player's *proxy*. The player's proxy is an actor that is directly controlled by the player. It may be her playable character, but it may also consist of other elements such the cursor she manipulates by pointing and clicking, for example.

Player space is the physical space where the player is situated, enveloping the necessary hardware to play the game. It is a space that the player's physical body can never leave, as it is intrinsic to its very own existence.

Game space is the space where the game actually happens, it is where the player plays the game, it is the space she inspects while playing. The game space is usually seen as the space where the game world resides.

Table 1. Variations in Transcoding.

Intangible	Tangible
Arbitrary articulation	Game space < Player space
Symbolic articulation	Game space = Player space
Mimetic articulation	Game space > Player space

Intangible transcoding occurs when the game space and the player space are apart. In this case the player needs a proxy in the game space in order to be able to act within the game world. It is under this context that the transcoding between the player's actions and those of her proxy becomes relevant.

1. An *arbitrary articulation* occurs when there is no direct correlation between the actions of the player and her proxy. It is an articulation that the player usually apprehends by instruction or by trail and error, even for trivial routines such as pressing a button to make a given character jump in the game;

2. A *symbolic articulation* occurs when there is a partial correlation between the actions of the player and those of her proxy. In this articulation, their actions bear some similarity, they bear some

resemblance, but they are not the same. An example of this can be found when pressing a combination of keys on the gamepad or joystick that resembles the movement of the player's character, such as when executing the *hadouken* combo in *Super Street Fighter 2* (1992);[9]

3. A *mimetic articulation* happens when the actions of the player and those of her proxy are homologous. Here the proxy imitates the player's actuations to the best of the system's capabilities, where more concrete examples are present in motion-based or partially motion-based video games, such as *Kinect Star Wars* (2012) or *The Legend of Zelda: Skyward Sword* (2011) – where the player swings her arm holding the game controller in order for the game character to swing its sword.

Tangible transcoding happens when the player's body is embedded in the space of the game, meaning that game space and player space are the same, or at least in the same dimension, which in turn implies that the player's proxy is dismissed. A tangible transcoding allows players to actually touch each other as a significant component of gameplay.

1. *Game space is smaller than player space* when the actuations related with the actions of the player only involve a part of her body, something that usually happens when playing *Fingle* (2012) on a phone or tablet;

2. *Game space is equivalent to player space* when the totality of the player's body is involved in game space, and consequently the immediate space that surrounds her becomes a space of play, of the game. This occurs when playing *Dance Dance Revolution* (1998), for example;

3. *Game space is bigger than player space* when the player is forced to travel in order to play, meaning that the game space now incorporates a scale of actual geographic proportions, something very evident in location-based games such as *Ingress* (2013).

2.6 Thinking & Actuating

Thinking & Actuating (Cardoso and Carvalhais 2013a) explores the interdependencies in player action that can be found between the player's stage of thinking and conceptualisation and the stage of actual actuation or enactment. We have identified three types of action in this context.

Premeditated actions are those in which the player is required to invest conscious mental effort in their planning. The player takes the time to deliberate how to put things in motion. These are actions that require the player to deal with heavy loads of information.

Trained actions are those that the player executes rather unconsciously, that are learned and mastered by rote, becoming automated and choreographed. These actions are voluntarily initiated and terminated by the player, but their performance is not under her conscious control, as they are conditioned and dependent on the training the player has undergone.

Finally, *autonomic actions* consist of automatic, mechanic, organic responses of the player's body. They are actions that, although may be influenced, are not directly controlled, initiated or terminated by her, as they depend on the physiologic operations of her body.

---

[9] The *hadouken* (a surge of energy that is shot towards the direction the game character is facing) is a combo that can only be executed when playing with *Ryu* or *Ken* and by pressing the following combination of keys in one swift move: move the joystick or the d-pad a quarter of a circle, starting from down and then hit the 'punch' key (↓, ↘, →, punch).

2.7 Focus

Focus (Cardoso and Carvalhais 2014d) is concerned with how the system challenges the attention span of the player. We identified four dimensions: time span, sensorial scope, frame, and actuation automation. In all of these the player is able to express three alternative states: focused, defocused, and unfocused.

Table 2. Variations in Focus.

Dimensions / States of Focus	Time Span	Sensorial Scope	Frame	Actuation Automation
Focused	Short	Narrow	Single	Automated
Defocused	Long	Wide	Non-simultaneous	Mixed
Unfocused	None	Total	Simultaneous	Non-automated

Time span is focused on the exploration of the temporal durations that the player is granted to act on the game, limits that stress the player enforcing gameplay pace and speed:

1. A *short time span* (focused) promotes fast-paced action and quick decision-making;

2. A *long time span* (defocused) grants the player time to plan her actions, to ponder, to act with care, but it is nevertheless a limited time;

3. *No time span* (unfocused) allows the player to relaxedly act and explore the game world.

Sensorial scope is related to how much of the game world the player is able to simultaneously perceive:

1. A *narrow sensorial scope* (focused) forces the player to be attentive to the immediate, to her surroundings, or to the vicinity of her proxy in the game world, coercing her to act quickly, on impulsion;

2. A *wide sensorial scope* (defocused) permits the player to perceive beyond those immediate surroundings, granting her time to anticipate behaviours that unfold all around the game world;

3. A *total sensorial scope* (unfocused) allows the player to perceive the entirety of the game world, straining her attention span with the simultaneous occurrences of various, and sometimes, unrelated events and actions.

Frame refers to the 'windows' through which the player witnesses the game world and its events:

1. A *single frame* (focused) promotes the player's undivided attention to it;

2. A game with *non-simultaneous frames* (defocused) permits the player to explore the game world through multiple frames sequentially;

3. A game with *simultaneous frames* (unfocused) allows the player to witness diverse parts of the game world or from diverse perspectives, at the same time.

Actuation automation relates to the variations found between automated and non-automated actuations, when the player simultaneously realises two or more actions:

1. An *automated actuation* (focused) involves the player in actions that are repeated in short-term cycles, capable of being patterned through training and thus incorporated into somewhat self-executing processes;

2. A *mixed actuation* (defocused) involves the player into actions that require her to execute both automated and non-automated actuations. This is something that divides the focus of the player, and which success is attained due to the her capability of keeping automated actions ongoing without monitoring;

3. A *non-automated actuation* (unfocused) involves the player in improvisation, forcing her to be attentive in order to adapt to the events that are in development. Managing two different actions that use this type of actuation may become a daunting task, as the player's focus is seriously divided, constantly alternating between them.

Summary and Future Work

> Games are less of something created than something explored, manipulated, or inhabited. They are less musical composition and more musical instrument – to be played, by players. (Zimmerman 2014)

We have suggested that playing a video game and playing a computational musical instrument are activities that, from an operational point of view, may be considered similar. But even so, the instrumentality of video games is still different and, up to a point, rather unique. We have demonstrated that *freedom of expression* has a wide variance across the spectrum of contemporary musical video games, from lower – in *Guitar Hero* – to higher – in *Electroplankton* or in *Fijuu2*. And that instrumentality in video games is a phenomenon that requires *dialectical ability,* a relationship of frequent opposing forces, something that is at the core of the cybernetic relationship established between the player and the game system. Finally, we proposed that video games are dynamic systems in which *action* is at their core, and defined *actors* as the elements that act within the game, changing its state and evolving its narrative.

Ultimately, we presented a framework that explores seven dimensions of action. One of our goals is to use it as a methodological tool to analyse the instrumentality of video games. For example and at the moment, we are considering if the demonstration of *Super Mario Spacetime Organ* (2012)[10] performed by Chris Novello to promote the *Illucia* can be considered a demonstration of the potential of instrumentality of video games within the dimension of *chronology*. We are also pondering if *The Adventures of General Midi* (2014) is a game (or a prototype of a game) focused on a particular manifestion of instrumentality within the dimension of *depth*. With this in mind, our most immediate goal is to collect sufficient case studies aimed at each of the seven dimensions and their respective sub-dimensions. In parallel, we are also working towards the development of prototypes in order to test the boundaries of each dimension.

We aim at an understanding of how instrumentality related to sound and music in video games can be achieved and moulded by these dimensions; a task that asks for multidisciplinary studies in game design, sound studies and musicology, working towards the production of experimental artefacts with potential for concerts, performances and installations, and with great prospects for applied research in the development of both innovative video games and musical instruments.

Beyond this context, this study on instrumentality in video games is actually something that we believe that may be applicable beyond the scope of music and sound. We are confident that they may also play a role in serious games and similar pedagogic activities.

---

[10] At the time of writing, a video and more information about this subject could be consulted at http://vimeo.com/49142543.

Acknowledgements. This work is funded by FEDER through the Operational Competitiveness Programme – COMPETE – and by national funds through the Foundation for Science and Technology – FCT – in the scope of project PEst-C/EAT/UI4057/2011 (FCOMP-Ol-0124-FEDER-D22700).

Bibliography

Aarseth, Espen. 1997. *Cybertext: Perspectives on Ergodic Literature*. Baltimore: The Johns Hopkins University Press.

Bissel, Tom. 2011. "Extra Lives: Why Video Games Matter." In. New York: Pantheon Books.

Bogost, Ian. 2012. "Alien Phenomenology, or What's Like to Be a Thing". Kindle ed. Minneapolis: University of Minnesota Press.

Cardoso, Pedro, and Miguel Carvalhais. 2012a. "Explorations on Action Depth in Video Games." Videogames 2012: Annual Conference in Science and Art of Videogames, Lisboa, Portugal.

Cardoso, Pedro, and Miguel Carvalhais. 2012b. "In/action: an exploratory approach to responsiveness in interactive narratives and videogames." Avanca | Cinema: International Conference Cinema - Art, Technology, Communication, Avanca, Portugal.

Cardoso, Pedro, and Miguel Carvalhais. 2012c. "A perspective on action and chronology on interactive narratives and videogames." Avanca | Cinema: International Conference Cinema - Art, Technology, Communication, Avanca, Portugal.

Cardoso, Pedro, and Miguel Carvalhais. 2013a. "Between Thinking and Actuation in Video Games." xCoAx: Computation Communication Aesthetics and X, Bergamo, Italy.

Cardoso, Pedro, and Miguel Carvalhais. 2013b. "Breaking the Game: The traversal of the emergent narrative in video games." *CITAR Journal: Journal of Science and Technology of the Arts* 5 (1). doi: 10.7559/citarj.v5i1.87.

Cardoso, Pedro, and Miguel Carvalhais. 2013c. "Transcoding Action: A perspective on the articulation between the player's and system's actions in video games." Videojogos 2013: Conferência de Ciências e Artes dos Videojogos, Coimbra.

Cardoso, Pedro, and Miguel Carvalhais. 2013d. "Traversing the emerging narrative in interactive narratives and video games." Avanca | Cinema: International Conference Cinema - Art, Technology, Communication, Avanca, Portugal.

Cardoso, Pedro, and Miguel Carvalhais. 2014a. "In/action: An exploratory approach to dysfunctional responsiveness in interactive narratives and video games." Avanca | Cinema 2014: International Conference Cinema - Art, Technology, Communication, Avanca.

Cardoso, Pedro, and Miguel Carvalhais. 2014b. "Profiling: A traversal between the player and the game system." Videojogos 2014: Conferência de Ciências e Artes dos Videojogos, Barcelos, Portugal.

Cardoso, Pedro, and Miguel Carvalhais. 2014c. "Transcoding Action: Embodying the game." ISEA 2014: The 20th International Symposium on Electronic Art, Dubai, United Arab Emirates.

Cardoso, Pedro, and Miguel Carvalhais. 2014d. "Un-De-Focused: Variations of attention in player action in video games." xCoAx 2014: Second Conference on Computation, Communication, Aesthetics and X, Porto, Portugal.

Carvalhais, Miguel. 2011a. "The Emergence of Narrative: Procedural Creation of Narrative in Artificial Aesthetic Artifacts." Avanca Cinema, Avanca.

Carvalhais, Miguel. 2011b. "A Perspective on Perspective and on the Genesis of Generative Narrative." GA-Generative Art Conference.

Carvalhais, Miguel. 2013. "Traversal Hermeneutics: The Emergence of Narrative in Ergodic Media." xCoAx 2013, Bergamo, Italy.

Crawford, Chris. 1987. "Process Intensity." *The Journal of Computer Game Design* 1 (5).

Crawford, Chris. 2003. *The Art of Interactive Design: A Euphonious and Illuminating Guide to Building Successful Software*: No Starch Press.

Crawford, Chris. 2011. *The Art of Computer Game Design*. Kindle ed. Original edition, 1984.

Crawford, Chris. 2012. *Chris Crawford on Interactive Storytelling*. 2 ed: New Riders. Original edition, 2004.

D'Escriván, Julio. 2014. "Video Games as Digital Audiovisual Performance." xCoAx 2014: Second conference on computation, communication, aesthetics and X, Porto, Portugal.

D'Escriván, Julio, and Nick Collins. 2011. "Musical Goals, Graphical Lure and Narrative Drive: VisualAudio in Games." *Journal of Visual Culture* 10 (2). doi: 10.1177/1470412911402896.

Hunicke, Robin, Marc LeBlanc, and Robert Zubek. 2004. "MDA: A Formal Approach to Game Design and Game Research." AAAI-04 Workshop on Challenges in Game AI.

Joaquim, Vitor, and Álvaro Barbosa. 2013. "Are Luminous Devices Helping Musicians to Produce Better Aural Results, or Just Helping Audiences Not To Get Bored?" xCoAx 2013: First Conference on Computation Communication Aesthetics and X, Bergamo, Italy.

Kwastek, Katja. 2013. *Aesthetics of Interaction in Digital Art*: The MIT Press.

Latour, Bruno. 2005. *Reassembling the Social: An Introduction to Actor-Network Theory*. New York: Oxford University Press.

LeBlanc, Marc. 2005. "Tools for Creating Dramatic Game Dynamics." In *The Game Design Reader—A Rules of Play Anthology*, edited by Eric Zimmerman Katie Salen, 438-459. The MIT Press.

Murray, Janet H. 1997. *Hamlet on the Holodeck: The future of narrative in cyberspace*: MIT Press.

Olderburg, Aaron. 2013. "Sonic Mechanics: Audio as gameplay." *Game Studies: the international journal of computer game research* 13 (1).

Pichlmair, Martin, and Fares Kayali. 2007. "Levels of Sound: On the Principles of Interactivity in Music Video Games." DIGRA.

Ryan, Marie-Laure. 2011a. "The Interactive Onion: Layers of user participation in digital narrative texts." In *New Narratives: Stories and Storytelling in the Digital Age*, edited by Ruth Page and Bronwen Thomas. Lincoln and London: University of Nebraska Press.

Ryan, Marie-Laure. 2011b. Peeling the Onion: Layers of User Participation in Digital Narrative Texts. Accessed 2012/08/26.

Sa, Adriana. 2014. "Repurposing Video Game Software for Musical Expression: A Perceptual Approach." NIME: International Conference on New Interfaces for Musical Expression.

Salen, Katie, and Eric Zimmerman. 2004. *Rules of Play: Game Design Fundamentals*: MIT—Massachussetts Institute of Technology.

Zimmerman, Eric. 2014. "Games, stay away from art. Please." Polygon. http://www.polygon.com/2014/9/10/6101639/games-art.

Cited works

Dance Dance Revolution. 1998. Konami.

Electroplankton. 2005 (JP), 2006. Indieszero. Toshio Iwai.

Fijuu2. 2006. Julian Oliver.

Fingle. 2012. Game Oven.

Guitar Hero. 2005 (NA), 2006. Harmonix.

Illucia: a patchable videogame system. Chris Novello. At www.illucia.com.

Ingress. 2013. Niantic Labs.

Kinect Star Wars. 2012. Terminal Reality. Lucas Arts.

PaRappa the Rapper. 1996. NanaOn-Sha.

Patapon. 2007 (JP), 2008. Pyramid, SCE Japan Studio.

REZ. 2002. United Game Artists.

Rock Band. 2007 (NA), 2008. Harmonix.

Rocksmith. 2011 (NA), 2012. Ubisoft San Francisco.

Sim Tunes. 1996. Maxis.

Singstar. 2007. SCE London Studio.

Small Fish. 1998-1999. Kiyoshi Furukawa, Masaki Fujihata, Wolfgang Münch.

Super Mario Bros.. 1985. Nintendo Creative Department.

Super Mario Spacetime Organ. 2012. Chris Novello. At https://vimeo.com/49142543.

Super Street Fighter II. 1992. Capcom. Capcom.

The Adventures of General Midi. 2014. Will Bedford.

The Legend of Zelda: Skyward Sword. 2011. Nintendo EAD, Monolith Soft. Nintendo.