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Introduction

There are few concepts that seem as integral to the formal structure of computer games as mechanics (Church, 1999; Lundgren & Björk, 2003; Adams & Rollings, 2003; 2007; Rollings & Morris, 2004; Hunicke et al, 2004; Bateman & Boon, 2006; Cook, 2006; Rollings & Adams, 2007; Järvinen, 2008; Sicart, 2008). Much like rules, all games have mechanics, and these are often used both colloquially, to describe what happens in a game, and technically, as the elements that, implemented, engage users in satisfactory gameplay. In fact, the relation between mechanics and gameplay seems to be so close that works like *Dear Esther* (The Chines Room, 2012) or *The Graveyard* (Tale of Tales, 2009) challenge what games are and can express by challenging the very relation between mechanics and games.

Both these works provide users with a limited set of actions to be performed in an interactive environment. Few of those actions have direct impact on the environment, and none of them have a direct relation with "goals", "achievements", or "victory". *Dear Esther* and *The Graveyard* appropriate the rhetorics of games to explore their expressive potential when they cease to be conventional, agonistic games. And they do so by decoupling the mechanics of interaction from a rule-based competitive framework. The creative excellence of these games, then, is derived from their rhetorical manipulation of game mechanics. And to deeply understand the importance of these works, we first need to understand what game mechanics are.

In the following I will propose an expanded definition of game mechanics that builds on my previous work. I will not be adding anything substantially new, but I expect this definition to be more friendly to developers and design researchers, and to pose some new questions to concepts in game ontology that I argue are deeply related to mechanics, such as game loops and the idea of "space of possibility".

The definition of mechanics I propose here is still a formalist approach to one of the conceptual instruments that game ontology, both from a design and a critical perspective, uses to describe, analyze, and create objects to play with. Even though I will try to keep the player in mind at all moment, this (Avedon, 1971; Björk & Holopainen, 2005; Koster, 2005) definition is concerned with understanding the role of the concept of mechanics in the formal description of game designs, both from an analytical and a creative perspective.

Similarly, the reflections on game loops and the space of possibility are meant to be conceptual applications of the theoretical notion of game mechanics, illustrations of how to use this concept not only for critical or design purposes, but also to explore interesting technical and definitional elements that articulate games.

Defining (Game) Mechanics

I will start by defining game mechanics expanding my previous work. This will allow me to start from a particular case of mechanics – those connected to the structure of a game, from where I expect to define the broader concept of mechanics in games.

I define game mechanics as rule-based methods for agency in the gameworld, designed for overcoming challenges in non-trivial ways.

Let's unpack this definition:

"Rule-based methods" connects game mechanics with the concept of rules. Game mechanics are rule-based because they are conceptually and experientially connected to the rules that structure any game. All games have rules, frames that act both as creators of the game as an object and cultural activity (Juul, 2005). Rules define the boundaries of the activity, the goals of the activity, as well as other formal elements

that constrain a particular set of actions to give them the meaning of being a game. Rules here should be understood as the formal structures that articulate a game, rather than the cultural rules that emerge from player communities. A typical rule would be that given a variable "health", when the value of that variable reaches 0, the player is not allowed to play anymore and the game loop is stopped.

Game mechanics are instruments for player agency within the boundary of formally defined rules. Player agency is here defined as a "method", following object-oriented terminology (Weisfeld, 2000). In very basic terms, methods allow for the exchange of data in a computer program (Abelson et al., 1985). In games, methods can be seen as the actions agents can trigger to directly interact with the game rules, in order to alter the game state. Shooting to goal in a soccer simulation is triggering an action that evaluates the state of the game (does the player have legal control of the ball? Can the player perform the action of shooting), and given some conditions performs an action (shooting) that will have an effect in the state of the game (the ball will move from the player in a particular direction with a particular velocity).

In more layman terms, a game mechanic is a "verb" that can be used within the bounds of a rule system. Games are ontologically and "designerly" defined by both rules, as creators and frames of the activity, and by mechanics, as the modes and types of actions that a particular game affords to players.

However, we should not think that players exclusively as "the human players" – at least, not when keeping a formal, abstract perspective. Mechanics are available to any agent within the gameworld, hence the use of the concept of "agency. Traditionally we tend to think that mechanics are only available to human players. However, this is a fairly restrictive perspective if we think of those computer games in which artificial agents can play a role in the progress of the experience. An illustrative example can

be taken from any "emergent sim" game, like *Dishonored*, in which artificial agents have a large degree of autonomy (understood as the capacity to take decisions in their environments free from pre-scripted constraints) that is implemented by allowing agents to have access to game mechanics similar to those available to human players. In other words, mechanics are independent of agency, as agency is independent of humanity: any agent, human or not, can have access to game mechanics.

Game mechanics are contextualized in a "gameworld". Even though we tend to think of gameworlds as the complex simulated environments in which videogame actions take place, game mechanics take place in all kinds of sociotechnically defined gameworlds. For instance, the mechanic of betting is contextualized by the poker gameworld, which is a construct of humans and technology elements defined by a mutual agreement on rules and contexts. Similarly, a mechanic like typing in *Blackbar* makes sense on a textual world rather than on a 3D world. And in a more conventional gameworld world, the mechanic of "inspecting" articulates many of our interactions with the world of *Papers, Please* (Lucas Pope, 2013).

The purpose of mechanics in games is help players "overcome challenges". That is, any game is designed to be a series of challenges that players needs to overcome in order to complete the specifications demanded by the rules to either reach an end state, or to keep on playing. Mechanics are designed as actions related to these challenges: limited by them, so they are engaging, but at the same time created to overcome them. For instance, in *GIRP* (Bennett Foddy, 2012) the mechanics of holding to a stone in order to climb are coupled to the rules of physics that determine the behaviors of the avatar on screen, as well as to the actual keyboard layout. The challenge is created by the physics system as well as for the careful disregard for ergonomics in the mapping of the keys: it is difficult to find the next key to press, and

time that input with the physics-based swing of the avatar. However, that mechanic is also the only tool we have to try to win the game. The rules create the challenges by constraining the mechanics in engaging ways.

And remaining within that design perspective, game mechanics are designed to overcome challenges in "non-trivial ways", that is, mechanics need to be sufficiently complex to require a type of investment from players, be that of their skills or their emotions, so the actions are perceived as meaningful within the context of the game.

Game mechanics are, then, the actions afforded to any agent in order to overcome challenges in a game. But game mechanics are only a subset of the broader concept of mechanics, which could be defined as any methods afforded to agents within a gameworld. Any action that is allowed to an agent in a game is a mechanic, and those that are explicitly related to completing the goals of a game as defined by the rules are game mechanics.

Works like *Dear Esther*, then, operate within the expressive and rhetorical boundaries of "games", deflating mechanics of their "gameness" to explore agency and being in virtual environments. If these games are interesting is, among other things, because they force us to play with mechanics that are not mechanics that are not agonistic evaluations of performance against rules. These are actions designed in the twilight between game mechanics and mechanics: resonant of "gameness", engaging us in a playful mood, yet afar from the agonistic evaluations of conventional games.

Game mechanics are formal building blocks of games, and as such can be used to understand more complex structures that appear in games. In the following, I will analyze game loops and the concept of the space of possibility using this definition of (game) mechanics.

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Understanding Game Loops

From a programming point of view and on a certain level of abstraction, all games are loops: once input is given they process the data, actualize the state of the game, and provide feedback, waiting for the next input. These loops are only broken when the game reaches a state in which a rule dictates the loop needs to break: when a player reaches the goals, or when players fail.

From a design point of view, the concept of loops, phrased in different ways but with the same essential idea behind the formulation, has become common in describing the design of gameplay, particularly in free to play games and in gamification projects (Pedersen, 2003; Rouse, 2005; Schell, 2008; Fullerton, 2008; Deterding et al. 2011a, 2011b; Zichermann & Cunningham, 2011). Designers discuss the creation of core loops, and how they can be used to engage players and tie that engagement with monetization strategies, often described as the "metagame". Game loops are, then, essential formal elements that articulate the flow of interaction of a game – but how are they related to mechanics?

I define game loops can be understood as dynamic linkings of rules and mechanics designed to structure the input, computation, and feedback processes of a game. If mechanics are bound by rules, loops are the structures in which a mechanic is coupled with a rule in order to create identifiable processes of interaction. While mechanics are the actions afforded to players, what we perceive when playing are loops: mechanics coupled with rules that change the state of the game and give us feedback on the process of playing.

For example, a basic game loop in a resource management game consists of harvesting resources, relocate them, process them and turn them into materials required to achieve the goals of the game. In more detail, a game can ask players to

mine metals, transport them to a furnace, to turn them into weapons, so they can build an army. In any of the steps of these linkings between mechanics and rules designers can add challenges (resource scarcity, extended production ties), which can be meaningful both from a play experience perspective and from a monetization angle.

The most interesting concept to expand through the concept of mechanics is that of core game loops. A core game loop defines the main actions that a player has to perform to play the game, and that identify the structure and genre of the game. For example, resource management games are defined by their loops based on time challenges and resource scarcity: harvest, build and expand faster than your opponents. Competitive shooters like *Counter Strike*, on the other hand, are defined by loops structured around quick movements in 3D space to occupy privileged locations, while scouting the environment and shooting to other players.

Understanding game loops as linkings linkage between mechanics and rules opens up too the possibility of thinking formally about issues like game balance, which could be defined as a consequence of the formal relation between rules and mechanics, particularly focused on the potential actions that a player can perform given their skills at a particular time. Or, if looking at the monetization of games, a designer could argue that to be successful in being engaging but also profitable, a game loop should be constructed to be engaging on its own, yet carefully modular so the addition of paid mechanics enhances the essential enjoyment of the game.

Game loops are, then, the consequence of the combinations of the formal building elements of games. If we increase the abstraction level a bit more, we could argue that what game loops generate is a particular set of actions afforded to players in order to interact with the game, or what designers have called a space of possibility. In the

following section I will look at the concept of space of possibility from the perspective of game mechanics.

Space(s) of Possibility and Mechanics

In this formal definition of mechanics, I have related the rules of the game, understood as frames and evaluators of the game situation, with mechanics, understood as the actions afforded to the player – being game mechanics those actions directly tied to overcoming the challenges proposed by the rules of the game. As it is obvious, I have presented these two concepts as interrelated using a metaphor of space: rules frame a context, in which players act by using mechanics. Let's extend that spatial metaphor a bit more.

If the notion of game loops can be used to explain not only the connections between rules and game mechanics, but also the structures of games, we should consider how these loops are interrelated, and specifically, what do they tell us about the structure of a game as a device designed to make people play. That is, game loops are formal concepts useful for design and analysis, but what players experience might be different from the specifications of the formal system. In design research the concepts of system image, user image and designer image (Norman, 2002), as well as the notions of gulf of execution and gulf of evaluation (*ibid*), have been used to explain this process. In games, a similarly productive approach can be reached by applying the concept of space of possibility (Salen and Zimmerman, 2004).

This concept of space of possibility has been used to describe the potential actions available to a player at any given time in the game. The concept, phrased this way, is clear, illustrative, and useful in solving specific problems of design, such as the amount of information available to a player for solving a specific challenge. But the concept can be even more useful, from a game design and analysis perspective if we

observe it through the perspective of game loops and game mechanics. Let's complicate things.

Given our definition of mechanics, we can define at least 4 different types of spaces of possibility in games:

- An abstract game space of possibility, which comprises all the possible actions that a player can take at any time in order to complete the game using game mechanics. For instance, the game *Tic Tac Toe*, given its simplicity, can have its abstract space of possibility totally defined, with every movement available at any state defined. This abstract game space of possibility could be absolute, comprising all possible actions in the game, or relative to a particular state from which we analyze.
- An abstract space of possibility, which comprises all possible actions in the game situation, both game-related and performative, or not directed to the completion of the game. For instance, there are actions that can take place in a game that are not directly related to winning the game, but that form part of rituals or habits of players. Or, there can be modes of interaction that are decoupled from game rules and just present in the game for aesthetic or simulation pleasures.
- A perceived game space of possibility, which comprises all the actions a player perceives at a particular point in time as available to her in order to play the game.
- A perceived space of possibility, which comprises all the actions that a player perceives as possible in the context of a game, be those related to the game or not.

The concept of space of possibility, then, becomes productive when approached through a formal definition of game mechanics. What designers construct is two things: an abstract (game) space of possibilities, and a perceived (game) space of possibility, which is what they are presenting to players with. However, if we take a step away from game design theory and we look into player behavior, we could see how playing a game is a process of understanding and engaging with game loops in order to create perceived spaces of possibility, being the task of the designer to ensure that the actual and the perceived spaces of possibility are at all times sufficiently closed so that the experience of the game by players is close to the experience envisioned and authored by the designers.

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