Between Thinking and Actuation in Video Games

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Abstract: Action involves thinking and actuating, processes that respectively rely on cognitive and physical effort. When playing a video game, these processes — that may be seen as two stages of player action — do not need to be strictly ordered (thinking–actuating) and they may not even be, in fact, interdependent. This paper explores three types of player action that result from exploring the interdependences of thinking and actuating: from actions that are the consequence of a thought-out plan, to actions that are the result of embodied or mechanized reflexes, and to actions that are visceral responses of the body to external stimuli and internal mental activities or thoughts.

The dialectical relationship that the player and the game system establish is mediated through these actions, undertaken in response to the challenges that the player needs to overcome, through what we may call a *learning process*.

This paper pinpoints a new and still under development approach to game design that aims at recognizing the player as a biological entity, and consequently at identifying the need for the game system to interpret and transcode her biological traits. We believe that multidisciplinary studies in affective computing, psychology, neurosciences, biology, and game design are needed in order to raise a better understanding on how these can affect gameplay.

1. Introduction

In this paper we focus on the actions of the player and not those of the system. We also regard action as "the means through which the player can make changes to the game state." (Bjork 2005, 20) In other words, actions are the way through which the player operates within the game world.

This paper explores alternate modulations between the interdependences of *conceptualizing* a determinate action and its corresponding *actuation*. These two moments in player action correspond to stages of *preparation* and of *enactment*, respectively. We may say that conceptualization consists in the mental effort involved into ideating or conceiving a determinate action. On the other hand, *actuation* consists in the effort that is employed by the player when she tries to instantiate a certain action. We may say that the first moment consists in the effort that is employed by the player when she forms the model that her actuations will instantiate in the second moment, which is a physical operation capable of sending information to the game system.

In *The Art of Computer Game Design* (1984, 44) Chris Crawford presents a taxonomy of computer games that is organized in two major categories: "skill-and-action ('S&A') games (emphasizing perceptual and motor skills) and strategy games (emphasizing cognitive effort)." We may say that our approach is based on a different perspective on this subject. We believe these two categories are somehow still visible in contemporary computer games, although positioned in different subcategories. Nevertheless, we think that computer games have been discarding the fact that human players are biological beings, with specific biological functions and operations. And a category that may encompass this fact is in order.

So, player's actions can be the result of a conscious choice, of an unconscious reflex, conditioned or trained behavior, or even emerge from the biological functions and operations of her own body. And each of the previously enunciated types is obtained through different modulations between the conceptualization and actuation phases. In this paper we describe three types of action that are based in these premises.

The work presented here is in a certain way related with the work of Donald Norman demonstrated in *Emotional Design: Why we love (or hate) everyday things*, in which he presents three levels of the brain that use alternative thinking processes, requiring different styles of design. "The three levels in part reflect the biological origins of the brain starting with primitive one-celled organisms and slowly evolving to more complex animals, to the vertebrate, the mammals, and finally, apes and humans." (2004, 21) Summarizing, Norman defines the visceral level as prewired, preconscious, pre-thought, focused on the present time, dealing with fixed routines; the behavioral level as unconscious, concerned with use, experience and performance, also focused on the present time, and on routine behavior; and the reflective level as slow, conscious, contemplative, vulnerable to variability through education and culture, and focused on long-term relations. But where Norman is interested on usability and the relationship we establish with everyday objects, we converge our attention to the phenomena of action in the context of video games.

2. Premeditated Actions

We may call *premeditated* those actions that require the player to invest conscious mental effort conceptualizing them. They result from the player's conscious thought and may be planned thoroughly. In other words, the player is aware of what she is going to do, independently of how complex of her plan might be or how long it will take.

These are *deliberate*, *intentional*, *controlled*, and *voluntary* actions. The player takes her time to consciously process information in order to deliberate the preferred course of action.

> (...) the human brain can think about its own operations. This is the home of reflection, of conscious thought, of the learning of new concepts and generalizations about the world. (Norman 2004, 23)

The player resorts to these actions when she has to deal with complex or heavy loads of information. Therefore, they are usually slow, because she has to analyze a given situation, deliberate her course of action, and only then actuate. And the more time is available to her, the further she premeditates her actions. She may even premeditate complete sets of actions instead of one at a time.

It is pretty common for strategy-based games to resort to this type of action due to their orientation on heavy planning. In their case, play may be divided into turns, in which players act alternately. In some of them, turns do not even have a temporal limit in which their actions need to be enacted, rendering real time irrelevant in the overall gameplay. Thus elevating the importance of planning, of the effort in making conscious and rational decisions. *Worms* (Team 17, 1995), *Sid Meier's Civilization* (MicroProse, 1991), *Utopia* (Daglow, 1981) are good examples of strategy games played in turns.

Real time strategy games maintain the overall characteristics of traditional strategy games, but they use time as a gameplay element, providing immediate feedback, pressuring the player into making decisions faster and coordinating several elements (almost) simultaneously. Games like *Populous* (Bullfrog, 1989), *Warcraft: Orcs & Humans* (Blizzard Entertainment, 1994), *Age of Empires* (Ensemble Studios, 1997), *Black & White* (Lionhead Studios, 2001), *Supreme Commander* (Gas Powered Games, 2007), *Starcraft II: Wings of Liberty* (Blizzard Entertainment, 2010) help illustrate this.

This kind of action doesn't need to always be related with strategy games. In many other games, the player has to plan her actions no matter how brief that moment is. Even action games require planning at some point, or some kind of premeditation. But the emphasis on this type of action that is evident in strategy games makes them good examples.

Besides games that have planning at their core, the player may also resort to these actions when in other games she is confronted with an entirely new situation. The fact that she is not familiar with a certain set of circumstances is enough to ignite an analysis process, simply because that is the cautious decision.

Yet another situation that invokes premeditated actions occurs when the player's actions do not produce an expected outcome, as when she is constantly defeated at the same location or by the same opponent, or when she simply fails to achieve her objectives.

At that point she may recognize the need to implement a new and better strategy (no matter how simple or complex the plan may become).

On the other hand, when the player is confronted with familiar situations, she may employ already tested or tried actions to produce expected and preferred outcomes. And because a plan has already been outlined, the ideation stage is bypassed, resulting in speedier response: her actions will be faster. When this process becomes fast enough, resulting in unconscious processes, we discover another type of action.

3. Trained Actions

We may call *trained* to the player's unconscious actions that were learned through instruction and practice. They are automated and sometimes choreographed acts. As António Damásio notes, not all the actions commanded by a brain are deliberated. We can assume that most of the actions happening at a given moment in time are not deliberated at all, and that they constitute simple answers, from which reflex movements are an example: a stimulus transmitted by a neuron that leads another neuron to act. (1994, 128)

For example, an experienced typist doesn't usually think about how her fingers hit the correct keys on the keyboard when typing. Conversely, that usually happens to an individual that has less experience, although with practice she may improve to a point where typing does not require the attention and effort that it previously did. That's what we usually call *experience*. So, the player may refine her actuation, getting better and faster with practice. And as her experience increases, so do the chances of her actions' effectiveness. And as her actions become more and more embodied they require less and less mental effort, becoming *unconscious*, *conditioned* and *automated* processes.

> If I asked you to describe how you got to work in the morning in some detail, you'd list off getting up, stumbling to the bathroom, taking a shower, getting dressed, eating breakfast, leaving the house, and driving to your place of employment. That seems like a good list, until I ask you to walk through exactly how you perform just one of these steps. (...)
>
> Odds are good that you could come to an answer if you thought about it. This is called a morning routine because it is *routine*. You rely on doing these things on autopilot. This whole routine has been "chunked" in your brain, which is why you have to work to recall the individual steps. It's basically a recipe that is burned into your neurons, and you don't "think" about it anymore. (Koster 2005, 20)

These actions may be *voluntarily ignited and terminated* by the player, but they are *not consciously controlled or performed* by her. We may rather say that they are invoked, performed in correspondence to some sort of training the player has undergone.

> The behavior level in human beings is especially valuable for well-learned, routine operations. This is where the skilled performer excels. (Norman 2004, 23)

They can be automated performances as when an experienced driver steers a car. It seems that she does it without thinking, intuitively. They can also be conditioned performances, as when we respond to perilous situations, such as the presence of a dangerous animal or other physical threat.

> Your body reacted in an attenuated replica of a reaction to the real thing, and the emotional response and physical recoil were part of the interpretation of the event. As cognitive scientists have emphasized in recent years, cognition is embodied; you think with your body, not only with your brain. (Kahneman 2011, 51)

Therefore, games where the player must excel through speed or must somehow develop some dexterity, often deal with this kind of action. They usually present increasingly harder challenges, training the player into embodying several combinations of keys, movements, etc.. Games as *Super Mario Bros.* (Nintendo Creative Department, 1985), *Sonic the Hedgehog* (Sonic Team, 1991), *Super Street Fighter II* (Capcom, 1992), *Tekken* (Namco, 1994), *Wipeout* (Psygnosis, 1995) are just some of the many examples that explicitly use these actions.

4. Autonomic Actions

We may call *autonomic* to actions that are the result of *automatic*, *mechanical* or *organic responses* enacted by the player's body, and that occur without her direct control or will. The player's conscious thought is not directly entangled with this kind of actions; they are a direct result of the player's body biology and mechanical operation, regarding its activities and behaviors.

> When you stick your finger in the fire, you snatch it back before your brain has time to think about it (seriously, it's been measured).
>
> Calling this "muscle memory" is a lie. Muscles don't really have memory. They're just big ol' springs that coil and uncoil when you run electrical current through them. It's really all about nerves. There's a very large part of your body that works based on the autonomic nervous system, which is a fancy way of saying that it makes its own decisions. Some of it is stuff you can learn to bring under more conscious control, like your heart rate. Some of it is reflexes, like snatching your fingers out of the fire. And some of it is stuff you train your body to do. (Koster 2005, 28)

These actions may be triggered by actions of the same kind, but also by conscious thought. For example, it is possible that the player's heart rate goes up and her legs may start to shake when she is reminded of a traumatic event she endured in the past. These actions may also be heavily influenced by the mood or emotional state that player may be under. For example, if she is feeling stressed, her heart rate may be higher than normal, or she may be sweating, etc.. As Damásio states, emotion is a collection of changes in the state of the body, that are induced in several organs through the endings of nerve cells under the control of a dedicated cerebral system, that responds to the content of thoughts related with a certain entity or event. Although some of these alterations may only be sensed by the person in whom they are occurring, many can effectively be perceived by others. (1994, 189)

Here her body acts by itself, without her direct control, although some behaviors may be shaped through proper training. "Animals such as lizards operate primarily at the visceral level. This is the level of fixed routines, where the brain analyses the world and responds." (Norman 2004, 23)

The *PainStation* (Morawe and Reiff, 2001) is an interesting example that deals with this type of action. This game is a variation of *Pong* (Atari Inc., 1972) in which the player that looses points is physically punished through electro-shocks, whippings and extreme heat applied to the left hand which, if removed from the game panel, leads the player to loosing the game altogether. Thus, this game tries to measure the player's resistance to pain, and its rules force her to endure punishment in order to continue playing. Here, the reflex of avoiding pain and the conscious decision to continue playing the game are confronted and in constant turmoil.

5. Conclusions and Future Work

Looking back into the history of video games we may notice how extensively they have explored premeditated and trained actions. Since the early days, computer games were divided into two major categories that seem to be close to the two types of action. Video games have also excelled at manipulating the player into transforming premeditated actions into trained ones.

Games force players into optimizing their performance, usually by presenting them with challenges that grow increasingly more complex and harder to solve, requiring them to master their current abilities. Overcoming these challenges unlocks new abilities, restarting the cycle. In most cases, this happens when players succeed in embodying basic essential actions, freeing mental resources, thus allowing them to solve new and usually more complex situations. In other words, throughout the game the player is trained into increasing her skills, either physical or mental.

This increasing difficulty that is usually presented in video games is a good example of how game systems teach their players something that is not necessarily related with narrative or storytelling.

> Games seem on the face of it to be very different from the stories and to offer opposing satisfactions. Stories do not require us to do anything except to pay attention as they are told. Games always involve some kind of activity and are often focused on the mastery of skills, whether the skill involves chess strategy or joystick twitching. Games generally use language only instrumentally ("checkmate", "ball four") rather than to convey subtleties of description or to communicate complex emotions. They offer a schematized and purposely reductive vision of the world. Most of all, games are goal directed and structured around turn taking and keeping score. All of this would seem to have nothing to do with stories. (Murray 1998, 40)

Instead, they teach something intrinsic to their dynamics. And for players to progress in the game they have to keep on learning, and in many games this happens until closure.

> Moreover, the potential uses of video games extend far beyond the playing of games. They could be excellent teaching devices. In playing a game, you have to learn an amazing variety of skills and knowledge. You attend deeply and seriously for hours, weeks, even months. You read books and study the game thoroughly, doing active problem solving and working with other people. These are precisely the activities of an effective learner, so what marvelous learning could be experienced if only we could use this same intensity when interacting with meaningful topics. Thus, game machines have huge potential for everyone, but it has not been systematically addressed. (Norman 2004, 44)

We can even state that this process has been a favored form of learning that players have endured in video games up until now. Perhaps it is because of this learning process — that is very advantageous to games when it comes to their replay potential — that games have been heavily focused on premeditated and trained actions. While the player is capable of transforming the first type of action into the second, we don't think it is possible to transform either of the previous into autonomic actions. We know that unconscious and conscious thought influence them, but there seems to be no direct correlation between the first two and the third. At least, not in the way that we are used to experience between premeditated and trained actions.

Another aspect that as come to our notice is the fact that nowadays few games explore autonomic actions. There is a huge gap here. It is very unusual for the player to be able to influence the game system through autonomic actions. Traditional hardware in which video games run is simply not equipped with the adequate sensors or even software that is able sense and interpret most of these actions. And although the player keeps sending information that derives from them (because it is in her nature), the game system is not capable of receiving and interpret it. It literally goes to waste.

Another aspect that may have contributed to this is the fact that the player is not able to consciously act on the game through these actions because she is not able to directly control them. It is precisely because of that that this unlocks a new approach to game design, an approach that can be closely linked with affective computing, psychology, neurosciences, and biology. An approach that should perhaps start by asking: How can a game be played if the player does not exert direct control over her actions? If the player is a biological entity, how can a game system interpret and transcode her biological traits transforming the outcomes into actions of play? And how can they influence the game system?

Some experiments with brain-computer interface (BCI) devices seem to be focusing on finding alternate ways for the player to send information to the system. Through these devices the system is able to monitor player's autonomic actions related with her brain activity. *Brainball* (Smart Studio, 1999) is an experimental game that aims at inverting conventional approaches to competitive games. Here the winner is the player that is able to achieve the most relaxed mental state, the most passive and calm. Both players wear on their heads a strap that contains biosensors that measure the electrical activity of their brains. Depending on their brains' activity a ball that sits on the table moves back and forward until it reaches one of the player's sides.

BrainBattle (ARS Electronica Futurelab, 2012) is an experiment in which players play a version of *Pong* (Atari Inc., 1972), *Space Invaders* (Taito Corporation, 1978) and *Pac-Man* (Namco, 1980) resorting exclusively to BCI devices. Here players are forced into a higher level of concentration just to move the characters they are controlling with their mind and in most cases success in controlling those characters is hardly guaranteed.

But BCI is not the only way to introduce autonomic actions into games. The spectrum of means through which humans communicate is very wide and diverse. The human body, particularly the face, is highly expressive, and computer vision (CV) devices, for example, can be powerful tools to monitor those expressions. But, most of contemporary video games primarily use CV for motion tracking, granting the player direct control over certain game elements — like the Microsoft Kinect that visually traces the movement of the player's body. *Kinect Star Wars* (Terminal Reality, 2012) can serve as an example here.

Augmented reality has been another focus in CV based games, but, in this context, it just seems to be another variation of the previous. *LevelHead* (Oliver, 2007/2008) or *Invizimals* (Novarama, 2009) are examples of this.

Video games will only be able to include players' autonomic actions into the gameplay when they are capable of sensing and interpreting the modulations of their various states: anxious, excited, relaxed, disoriented, aroused, for example, through bodily responses such as heart rate, skin galvanic response, pupil dilation, facial and body expressions, etc.. We believe that this may uncover an yet unexplored path to exploratory and multi-disciplinary studies in computer games, that will not only expand our knowledge on these but also on how our own biology interacts with computational systems and ultimately will allow the development of innovative video games.

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