The Philosophy of Computer Games Conference, Oslo 2013

Understanding Player Interpretation: An Embodied Approach

Jonne Arjoranta

Introduction

This paper applies research on embodied cognition in understanding games and players. This is not an entirely novel approach, as embodied and situated cognition has been discussed in game studies before (e.g. Lankoski & Järvelä 2012; Rambusch 2006; Rush 2011). There has also been research focusing on what games can tell us about cognition (e.g. Gee 2008) and attempts to see cognition in terms of games (Calvo 2008). More generally, this approach has also been taken in studying human-computer interaction (e.g. Antle, Corness & Droumeva 2009; Dourish 2001). This paper tries to build on this research.

In addition to presenting a framework of research and an approach to human meaning-making, this paper looks at two specific examples of using this framework to illuminate issues related to games. The first example is how human embodiment relates to experiences of spatiality and using controllers in games. The second example shows how interpretations made during play are affected by embodied cognition. The examples are discussed in this order because the first informs the second. While very limited in scope, these examples attempt to show how this framework can successfully be used in analysing games and how it illuminates some possibilities for designers and some limitations designers have to work with.

This paper discusses digital games, and this term is used as a blanket term to cover different kinds of games, without much attempt to map out the differences between them. This is intentional, as discussing differences between different digital media would be a too wide an area to cover in this paper.

Embodied Cognition

Proponents of embodied cognition argue that our mental processing is affected by the fact that we are physical entities with bodies of a certain kind. And not just any kind, but of a very certain kind; and those bodies affect how cognition works. This is in direct opposition to the Cartesian idea of a clear mind-body dualism that has been the classic approach to cognition since the days of René Descartes.

This is not an entirely new idea. In a clear counterpoint to Descartes, Maurice Merleau-Ponty (2005 [1945]) shows how perception is conditioned by the fact that we are beings with bodies.

Continuing in the phenomenological tradition of Husserl and Heidegger, Merleau-Ponty sees consciousness as an issue affected by our corporeality and our bodies as intentional. Another philosopher interested in the limits our physical nature places on our ability to form conceptions is Thomas Nagel (1974). He argues that being humans with certain kinds of bodies and perceptions of the world we form certain kinds of concepts of it. And perhaps even more importantly: are unable to form other kinds of concepts, because we lack the experiential anchors those concepts could be latched on to. These are of course only limited examples of the discussion in philosophy, but act as examples of how the question of embodiment has been approached before.

The approach discussed here is based on more modern research, becoming influential starting from the 80's and usually unified under the label of embodied cognition. It is a combination of different strands of research, combining for example neuroscience, cognitive psychology and cognitive linguistics. Instead of the classic view of cognition as abstract symbol-manipulation, cognition is in this strand of research seen as strongly embodied (e.g. Calvo 2008). It is argued that because cognition needs to work in time-sensitive, real-world situations with limited resources, it needs to conform to those limitations. And because we share largely similar bodies (standard number of limbs, upwards posture etc.) and similar environments of experience (constant physical laws, similar physical needs) our embodied experience of the world is largely similar on a general level (Mandler 1992).

Often, proponents of embodied cognition connect slightly different arguments to the idea of embodied cognition. Wilson (2002) lists six common ones:

1. cognition is situated;
2. cognition is time-pressured;
3. we off-load cognitive work onto the environment;
4. the environment is part of the cognitive system;
5. cognition is for action;
6. off-line cognition is body based.

In order to understand these arguments it is important to understand the difference between off-line and on-line cognition. Off-line cognition is cognitive activity that takes places "in the absence of task relevant input and output" (Wilson 2002: 626). In comparison, on-line cognition concerns the here and now, task relevant cognition. Researchers argue that most cognition is on-line, and happens in situations of limited time. This is also how our cognition has evolved, as a tool for acting in the world.

The evidence for off-line cognition being body based comes from studies on memory, mental imagery, reasoning and problem-solving. It is argued that we use our bodies in both overt and covert ways for remembering and processing, building simulations and referring the problems back to our bodies, like counting with the help of our fingers. This is also an example of off-loading cognitive tasks to the environment: using fingers for counting, lists for remembering, boxes for organisation and so on. Wilson (2002) finds different amounts of evidence for different arguments, concluding that the fourth argument is the most problematic and the sixth best documented and possibly undervalued in the literature.

Regardless of the differences between different approaches to embodied cognition, there is a unifying idea behind these approaches: that human cognition is, at least to some extent, based on our bodies. However, treating embodied cognition as a single, unified viewpoint masks some of the differences present in the discussion. While scientifically important, the exact differences are not relevant in the context of this article. Instead, this article focuses on discussing the elements of embodied cognition most relevant to understanding games and players. While influential, the claims of embodied cognition are hardly universally accepted. There are stronger and weaker forms of it presented, defended and criticised (e.g. Adams 2010; Mahon & Caramazza 2008).

Conception and Perception

Theories of embodied cognition have the practical goal of trying to explain things like the existence and internal structure of concepts. This has been traditionally seen as a question of amodal symbol manipulation (Barsalou 2008), but theories of embodied cognition argue that embodiment plays a crucial role in the formation and structuring of concepts.

The traditional picture of cognitive processes is that modal perceptions are turned to amodal symbols for cognitive processing. These amodal symbols are concepts, and they are governed by different rules than perception. In contrast, Barsalou (1999) argues that concepts are built on modal percepts that act as a base to build concepts on. In other words, conception is heavily based on perception, which is a bodily process. Furthermore, concepts get at least some of their structure from percepts, which are affected by our bodily experience.

One important way the structure of perception affects our conception of the world around us is the inherent schematism of perception. Barsalou (1999) criticizes accounts of the perceptual system that view it as a recording machine. Instead of passively recording everything for the cognitive system then to code symbolically and store amodally, the perceptual system is already coding perception as percepts that are stored in modal form. This coding process is already an active, selective process that is also prone to mistakes (see Barsalou [2008] for examples).

Image Schemas

One of the ways to describe how we get from perception (or percepts) to concepts is the idea of image schemas (Johnson 1987). Image schemas are low-level conceptual representations that are created by our interaction with the world around us (Evans & Green 2006). They derive from our embodied perceptual experiences of the world and are more abstract than mental images: you can imagine a mental image, but not an image schema. They act as scaffolding for the creation of concepts.

A good example of an image schema is the containment schema[1]. We encounter all kinds of containers as part of our experience of the world ever since we are babies and start interacting with the world. First, the image schema of a container is very basic and related to physical containment. But as we become more accustomed to the world and how it works, we extend that idea of containment to cover other kinds of things, like states (be in love) or social structures (be in a group). What links these separate and ontologically different things together is the image schema behind them.

An important aspect of image schemas is that they are argued to be more or less culturally invariant. The specific image schemas may show some variation across cultures, but their existence is culturally invariant, and the more similar the range of experiences humans have the more similar the specific image schemas are. The range of image schemas is determined mostly by our experiences of own our bodies and how it interacts with the world as infants (Mandler 1992).

Cognitive Linguistics and Conceptual Metaphors

One of the approaches to figuring out the structure of our concepts is from cognitive linguistics and cognitive semantics. One of the central ideas behind cognitive linguistics is that language is not a separate domain of thought, but part of the general cognitive makeup of humans (e.g. Croft & Cruse 2004; Evans & Green 2006). This means that language reflects our general cognitive structure and is not processed differently from other cognitive tasks.

The cognitive approach allows cognitive linguistics to present data on the general cognitive makeup of humans. Experiments show that there is at least some cross-domain processing between linguistic and non-linguistic cognitive tasks (e.g. Boroditsky & Ramscar 2002; Zwaan, Stanfield & Yaxley 2002). Stronger positions state that there is a common conceptual structure reflected by our language, and that by accessing the structure of language we can access this conceptual structure.

One example of this is Lakoff and Johnson's (1980) study of the metaphoric structuring of language. They analyse conceptual structures like "argument is war" and show how everyday language is both permeated and shaped by these conceptual metaphors. Their position is strong in the sense that they do not see metaphors as simply as surface phenomena related to language but as deeply embedded in our conceptual structures. Linguistic metaphors are based on conceptual metaphors that are simply, but powerfully, understanding one domain of thought in terms of another domain of thought.

It is because of the conceptual metaphor "argument is war" that phrases like "I demolished his argument" or "your claims are indefensible" make sense (Lakoff & Johnson 1980). But because the metaphor is not simply a surface level phenomenon the underlying conceptual metaphor can be extended further while still remaining sensible. Because of the underlying

[1] Other examples include: up-down, in-out, balance, merging, matching and removal. See Croft and Cruse (2004) for a more complete list.

conceptual metaphor phrases like "they retreated into the trenches and discussion was pointless after that" can be made sense of.

Another important part of cognitive linguistics is the study of frames. This approach was developed by Charles Fillmore (1976) and tries to present human knowledge in terms of schematic frames[2] that store conceptual knowledge in long term memory. The idea is that any meaning a word has is relative to the frame it is related to. Therefore, understanding any word requires understanding the frame in which it works and the rules that govern that frame. Again, this is not a theory about words, but about the nature of language and cognition: how conceptual knowledge is stored and accessed. In this way, Fillmore's work relates to Wilson's (2002) points about the situated nature of cognition.

Cognition, Players and Embodiment

It is easy to forget that players, too, are beings with bodies, when it is typically the screen where all the action happens. If we accept the arguments presented by the theories of embodied cognition, we have to consider players as embodied beings. While the research on embodiment is far from finished, there are certainly things that can be taken into account when discussing players. If embodiment affects the way we think, act and react, then actions in games are also affected by embodiment. Players are not simply input and output devices with abstract cognitive processing happening in between (cf. Klemmer, Hartmann, & Takayama 2006). They are physical entities with bodies.

The relationship between the player and the game world is often portrayed through the concepts of immersion (Ermi & Mäyrä 2005) or presence (Lee 2004; Lombard & Ditton 1997). Both of these concepts are problematic in that they portray the relationship between the player and the game as one-way (Calleja 2011). In these theories the player submerges into the virtual world, excluding the external world from consideration. An embodied approach would see the relation as two-way (cf. Calleja 2011). The environment is part of the player in the sense that it exists in the players mind, and the player is part of the environment in the sense that they are part of the virtual space. This view takes better into account the embodied nature of the player.

An example of embodied processing that goes on during gaming is what Kirsh and Maglio (1994) call epistemic actions. They looked into playing Tetris (1984) as a cognitive task and found that experienced players do more rotations when playing than inexperienced players. If one assumed that rotations are simply used to angle pieces to put them into right places, the amount of moves would diminish as the players grew more experienced, and were better at judging the correct placement. Instead, experienced players use additional moves to ease the processing task of figuring out where to put the pieces, essentially off-loading cognitive tasks onto the game.

[2] There is an another theory of frames more commonly known in game studies, based on the work of Erving Goffman (1974). These theories are largely compatible, and for our purposes very similar. Fillmore's work is mentioned here instead of Goffman because Fillmore is part of the cognitive linguistics tradition.

Interfaces, Motion Controllers and Spatiality

Next, we will discuss game interfaces, how players interact with them and how notions of spatiality come into play. In this context, interfaces are understood broadly as both the hardware and software elements that enable interaction between player(s) and a game (cf. Llanos & Jørgensen 2011).

Players interact with games through interfaces, both physical (gamepads, keyboards and computer mice etc.) and digital (buttons, charts, avatars). Yet, the interaction is usually limited to looking at the screen and pressing buttons, reducing the presentation of the players body to two sense-organs (eyes, ears) and some fingers (Klemmer, Hartmann, Takayama 2006). However, that is not what the player's body is like, whether the system acknowledges it or not.

With the addition of haptic feedback and motion-controllers (e.g. Microsoft's Kinect, PlayStation Move, Nintendo's Wii Remote), players' bodily experience and interaction with game systems is more varied than simply with a gamepad or a mouse and a keyboard. Systems using these kinds of motion-controlled interaction methods can better take into account how players interact with the system using their bodies (cf. Wilson 2011). When using motion-controllers the player simulates digital actions with similar physical actions.

There are also two different accessories for PlayStation 3 that try to change the PlayStation Move controller to resemble a gun. These try to change the experience of holding and using a gun in a game to resemble holding and using a gun in physical space. However, the player must still use control sticks to both orient themselves in the game space and to move around, so the combination of physical similarity to actually using a gun and the requirement to still submit to the rules of how games are controlled can prove to be disorienting.

Even with game controllers like gamepads and keyboards, where the user interacts with the controller in a very limited fashion, it can be argued that, eventually, the controller becomes an extension of the players body (Crick 2011). Assuming the player does not give up before that happens, the player becomes accustomed to the controller to the extent that the controller stops existing for them, becoming a way of interaction comparable to their own bodies. This line of argumentation follows the phenomenological tradition of thought, exemplified especially by Maurice Merleau-Ponty (2005 [1945]).

Some games try to make the learning process easier by relying on the player's experiences of their own body. The simplest version of this is mapping the buttons on the controller to different sides of the character's body. For example, when playing Dishonored (2012) with a gamepad, triggers on the left side of the gamepad are mapped to the characters left hand and triggers on the right side are mapped to the characters right hand. Assassin's Creed (2007) extends this mapping further by having the four action buttons on a gamepad correspond to four different parts of the characters body: the topmost button controls actions related to the head (mostly seeing) and the bottom one things related to the characters feet. The correspondence does not work as well with the left and right buttons, with both of them having actions mostly related to the dominant right hand. But this does correspond with how the majority of the players experience their interactions with the world, with a dominant right hand.

Problems arise when bodily expectations clash with traditions: it is customary that when playing first-person shooters on a computer (on default settings) the left mouse button fires whatever gun the character is holding. Typically the right mouse button is used for aiming or secondary fire modes. This control-scheme has been expanded to different types of games that are played from the first person perspective, for example Skyrim (2011) and Borderlands 2 (2012). In the PC version of Skyrim, the left mouse button is used for attacking and the right mouse button is used for blocking, essentially controlling the right hand with the left mouse button (characters are always right-handed), and vice versa. Skyrim also features the possibility of using spells, with the character raising their hands in front of them when ready to cast spells. If both hands are used for spell casting, both of the hands are visible on the screen. However, the left hand is still controlled with the right mouse button and the right hand with the left.

A similar example can be found from the PC version of Borderlands 2 (2012). Normally with the default controls the left mouse button is used for shooting and the right mouse button is used for aiming. One of the characters is able to dual-wield two guns at the same time when using their special power. When dual-wielding, both of the mouse buttons are used for shooting a gun, but because the extra gun is drawn in the secondary hand, the right button is also remapped to shooting. Therefore, the left mouse button is used for firing the right gun and the left mouse button is used for firing the right gun. It seems that the makers of Borderlands 2 have noticed how this might feel unintuitive to the player and they have provided an option for switching the function of the mouse buttons when the character is dual-wielding. Regardless, the way the controls work in the PC versions of Skyrim and Borderlands 2 is potentially much more confusing than the trigger-based controls of gamepads. The left-right-side correspondence would be easily achievable also on the mouse, but the convention of the left mouse button being for primary tasks prevents the easiest solution of remapping the buttons by default the other way around.

Some games try to increase the feeling of embodiment by hiding as much of the user interface as possible (cf. Llanos & Jørgensen 2011). This has led to, for example, health bars being hidden away and being replaced by other forms of communicating that information to the player, typically turning the screen red when the player character is hurt (e.g. Call of Duty 4: Modern Warfare [2007]; Battlefield: Bad Company [2008]). Another approach is to make the interface part of the game fiction, like for example in Assassin's Creed (2007), Crysis 2 (2011) and Syndicate (2012). In Assassin's Creed the interface is part of the digital environment the protagonist is immersed in. The presence of the interface is highlighted by its disappearance when the character is not in the Animus system. In Crysis 2 the interface is part of the nanosuit the main character wears and therefore is also an interface within the fiction. The interface in Syndicate is similarly the result of a cybernetic enhancement and an ubiquitous online connection, which becomes even more apparent when the interface is offline in part of the game. However, Assassin's Creed, Crysis 2 and Syndicate all have interface elements that are not part of the fiction, but are there to help the player, for example, by showing button mappings on the screen ("Press X to…").

Regardless of how the interface is constructed and what kind of controllers are used there is still a mapping of movement in a physical space onto a virtual space within the game system. Player's bodies are not the same as their avatar's bodies: they may be different sized and shaped, be subject to different laws of physics, and very importantly one is physical and one is virtual. Conversely, there is usually no mapping of the digital space onto the player's body, even when the motion-controls map physical space onto the digital. An exception to this would be the 3RD Space Vest, which provides force feedback onto the players body as a response to the player character being hit.

When designing embodied interfaces for interaction Antle, Corness and Droumeva (2009) suggest some guidelines for design. First, different interactions should be easily discovered by chance by a user trying out the system. Second, there should be a structural isomorphism between the kinds of actions the user does and the kinds of actions that are simulated. Third, there should be clear feedback from the actions. This makes it easier to accidentally find the possible forms of interaction and create a mental map of the structure of possible actions. Interaction with this kind of embodied system might lead to high levels of performative knowledge (i.e. ability to perform actions) without the corresponding explicit knowledge (i.e. ability to describe how to perform the actions).

Affordances, Frames and Interpretation

Next, we are going to discuss the embodied aspects of interpretation. This is done mainly through the concepts of affordances (Gee 2008; Linderoth 2011; Rambusch 2006) and frames (Fillmore 1976). They are discussed together to show how they affect each other. Affordances for interpretation mean that the game enables some kinds of interpretations more easily than others; it also creates disaffordances, making some interpretations less likely. Interpretations about the game then lead to players taking or refraining from some actions. By affecting what kind of affordances are available the designer can try to design how interpretations are made (cf. Gee 2008). Frames are here understood in the sense of Fillmore (1976), as specific contexts for understanding something. The meaning of a word is affected by the frame it is related to, a classic example being the commercial event-frame. Words like buy, sell, customer and vendor activate the commercial event-frame, and so bring to mind other concepts in the process. The same applies to the frame(s) of gaming. Different concepts related to gaming activate other aspects of it, with words like frag, debuff and grind bringing specific frames with them.

Affordances can be created in code and so can be quite constant and created beforehand by a designer. Whether an object in a game can be picked up, thrown or destroyed is functionality that must be designed by a designer and implemented by a programmer. This is very simple interaction, but the same applies to more complex interactions, like interacting with other characters. Whether it is possible to hug, slap, kiss or punch characters in the game affects what kind of a world the player inhabits. Affordances for different kinds of actions portray a certain kind of world, affecting how players view the rest of the world. Some affordances can be added by the presence of other players (social interaction) or unintended use of objects (e.g. rocket jumping). Players will assume affordances based on their bodily experiences and experiences of other, similar, games. A ladder is used for climbing outside the game, so the players will assume that it works for climbing within the game. However, players experiences of what a ladder looks like may vary greatly.

The presence of other players immediately adds affordances for new actions, even if the possibilities of interaction are minimal (e.g. Journey 2012). The amount and type of interaction is at least partially defined by the affordances created by the designers, but players can use the shared environment creatively to communicate with the other players present, or not present, if the players are able to modify the play space and leave behind evidence of their presence. The minimum amount of interaction between players is the awareness of the presence of other players, even if they are only spectating the events. This changes the gameplay from single player gaming to performance. Players may also record their gameplay, creating performances that are preserved in time.

There can also be affordances not intentionally designed into the game, but still present due to the creativity of the players. Once invented, communication between players – inside or outside the game – can spread these practices until they become commonplace, becoming affordances to all or next to all of the players. An example of this is the use of rocket jumping (e.g. Quake 1996). It was an unintended side effect of the fact that explosions propel the characters away from the explosion, according to the rules set by the physics engine used in the game.

A combination of these two is players using massively multiplayer online role-playing games like World of Warcraft (2004) to engage in social interaction not designed in the game and only indirectly supported by the game mechanics, like any form of sexual interaction. While a very common form of social interaction outside the game, it is not supported by the game engine in World of Warcraft. However, players still find ways of simulating sexual activity by using the interaction methods provided by the game engine, like using emotes and text-communication. The game frame does not initially support this kind of interaction, but players import an important social frame into the game and use the affordances meant for other kinds of interaction to overcome the mechanical limitations.

However, it is still a design choice whether to include sexuality and sexual interaction within a game. For example, Second Life[3] (2003) has explicitly enabled sexual interaction and has rules concerning where and how sexuality can and should be expressed. This leads to different expectations from the players, changes the frame, and can also work to make the limits of those expressions more explicit. For example, the makers of Second Life have published rules

[3] Second Life is not always recognized as a proper game, since it lacks some qualities that definitions often find important. However, for the current discussion, these differences are largely irrelevant.

on how users can and cannot act with regards to sexuality. These rules must be much more comprehensive than, for example, the rules for World of Warcraft, since more types of activity are permitted.

It is not always up to the designers to decide what acceptable behaviour within a game is. An illuminating example of this is the case of Twixt (Myers 2008) in City of Heroes/Villains (2004). Myers documented his experiences of playing his character Twixt in City of Heroes according to the rules set by the designers of the game, while not abiding to the social rules constructed by the player community. His experiment resulted in him becoming one of the most reviled players in the game, regardless of the fact that he played the game exactly according to its (designed) rules. This is an explicit example of how the affordances and the frame of the game can clash: the designers have enabled certain behaviours that the players do not find acceptable. There is a frame of reference in the game that defines the characters either as heroes or villains, following the archetypes borrowed from comic books. But following this frame against the frame constructed by the player community is still not accepted.

Players will use the affordances available in the game, the frame the game presents and some frames they import from outside the game to make sense of the game. Controlling exactly how these three interact is impossible, because the last element is always outside the control of the designer. However, the first two can be designed by the designer and the third is also possible to influence. By situating the game as part of some genre, by drawing on themes popular in certain demographic or focusing on some game mechanics, some developers try to influence the frames outside the game and so make the game more appealing to certain demographics. This can be done, for example, by influencing the game-related material the players encounter before playing the game – the paratexts of the game (Genette 1997; cf. Karhulahti 2012). However, there is a risk of simultaneously marginalising or alienating other player groups.

While it is often the goal to make the game as easy to understand as possible for the player, this is not always the case. In most games uncertainty can lead to frustration. However, sometimes it is desirable to leave some uncertainty or openness to interpretation in the game. This may be due to artistic aspirations, or because uncertainty is a useful tool for horror games. Having very little knowledge about the surroundings in a threatening environment breeds uncertainty and dread. Also, in the case of puzzle games the state of incomplete knowledge is crucial for the enjoyment of the game.

Conclusion

Proponents of embodied cognition argue that our cognition is deeply affected by our bodies. While exactly how much and how this is true is not set in stone, understanding players as embodied beings can provide a useful perspective for game studies. If our cognition indeed is situated, time-pressured, body-based, action-oriented and done in conjunction with the environment, it is very suitable for dealing with the kinds of problems most games present. Players playing digital games act in the physical world and the digital world, and embodiment affects both of these. The actions taken during gaming are situated and time-pressured, but parts of the cognitive load are off-loaded onto the environment, for example the game system (cf. Kirsh & Maglio 1994).

Embodiment affects how players experience the spatiality in games, and how they map that space onto their own bodies. This is true regardless of the control-method used, whether it is a gamepad, mouse and keyboard or some form of motion control. If the controls are intuitive enough, the controller will stop existing for the player and become a transparent way of interacting with the game world (Crick 2011). Good control methods are easy to learn by accident, map isomorphically to the actions the player is trying to achieve and provide clear feedback to the player (Antle, Corness & Droumeva 2009). Even traditional control methods can benefit by designers paying attention to how the controls map onto the players experiences of embodiment (left-right side correspondence, handedness etc.).

When players try to make sense of their game environments, they use the affordances available in the system and use the frames inside the game together with any frames they import with them (Fillmore 1976; Gee 2008; Linderoth 2011; Rambusch 2006). Designers can affect the first two, choosing what kind of affordances to implement in the system and influencing the frame of interpretation by designing the theme, genre and other relevant aspects of the game to guide how players interpret and act within the game. Some of the frames are carried on from game to game, as part of the vocabulary of games (e.g. the meaning of red barrels is almost universal in games). However, players are able to import their own frames into games and find affordances not intentionally designed by the designers. These may be products of imaginative uses of the game's systems or emergent results of the players' interaction and social organisation. Players may also override design choices by social contract, effectively cancelling some affordances originally designed into the game or adding new affordances where there originally were none (cf. Myers 2008).

Games

ASSASSIN'S CREED. Ubisoft, PC, 2007.
BATTLEFIELD: BAD COMPANY. Electronic Arts, PC, 2008.
BORDERLANDS 2. 2K Games, PC, 2012.
CALL OF DUTY 4: MODERN WARFARE. Activision, PC, 2007.
CITY OF HEROES/VILLAINS. NCsoft, PC, 2004.
CRYSIS. Electronic Arts, PC, 2011.
DISHONORED. Bethesda Softworks, PC, 2012.
ELDER SCROLLS V: SKYRIM. Bethesda Softworks, PC, 2011.
JOURNEY. Sony Computer Entertainment, PlayStation 3, 2012.
QUAKE. GT Interactive, PC, 1996.
SECOND LIFE. Linden Research, PC, 2003.
SYNDICATE. Electronic Arts, PC, 2012.
TETRIS. Pajitnov, Alexey, E60, 1984.
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