

The embodied and situated nature of computer game play

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Abstract

Computer games are being approached from a wide range of perspectives, but the activity of playing games, with the player and her actions in focus has, so far, not received much attention in academic research. Approaching games from a cognitive science perspective, however, it is argued in this paper that theories on embodied and situated cognition provide a strong basis for research on this particular issue since game play is a socially embodied and situated activity, shaped by the player's bodily experience and her interactions with the game environment.

Introduction

The tremendous interest in computer games and their widespread, expanding use has in recent years given rise to a strong interdisciplinary research interest. Research on games falls to a large extent under the heading of game studies, even though the status of the field is still uncertain since games are approached from a bewildering range of perspectives and only little consensus exists on which areas actually fall within this field, what to study, and which methods to use (cf. Wolf & Perron, 2005; Raessens & Goldstein, 2005). At a general level, computer games are usually approached from two research directions: researchers are either interested in the *effects of computer games on people* or they seek to understand *what computer games are*. It is of course difficult to distinguish clearly between these two approaches, which also is in line with Aarseth (2003) who argues that there are three, *interdependent* dimensions that characterise every computer game:

1. *Game play*: the player's actions, knowledge and strategies; the identification with game characters; motives; learning processes; social relations
2. *Game structure*: the rules of the game, including the simulation rules
3. *Game world*: fictional content, topology/level design, textures etc.

The latter dimensions are usually a topic in areas such as literature studies, media studies, or cinematography (e.g. Atkins, 2003). As far as the first dimension is concerned, much research has been undertaken from a humanities and social sciences perspective; the focus has to large extent been on people's motivations to play games (e.g. Crawford, 1982; Bryce & Rutter, 2005), the gaming experience (e.g. Douglas & Hargadon, 2000), moral issues

in game play (e.g. Consalvo, 2005), the potential negative influence of games on people (e.g. Gentile, Lynch, Linder, & Walsh, 2004), and the impact of games on people's learning performance and social behaviour (e.g. Holmes & Pellegrini, 2005). Surprisingly little attention, on the other hand, has so far been paid to the actual activity of playing computer games with the player and her actions in focus (cf. Ermi & Mäyrä, 2005).

From a cognitive science perspective, *embodied and situated cognition* (EC/SC) offers at this moment one of the most promising theoretical frameworks for a more nuanced understanding of people's game play since the activity of playing a computer game, although seemingly detached from the real world and usually not involving much actual physical movement, in many respects is a highly social activity, spanning brain, body and game environment. Game play is by no means an activity that takes place inside a virtual cyber-vacuum, but it is largely shaped by the player's bodily experience and her interactions with and use of the game environment, which includes both the game interface, e.g. input/output devices, and the surrounding environment, e.g. objects and other people. Game play, in other words, is a socially situated and embodied activity that is distributed across player(s), game world, and game interface.

This paper aims to describe and examine the embodied and situated nature of computer game play and empirical questions arising from it. With this in mind, the sections to follow describe in more detail the theoretical framework of embodied and situated cognition, discuss game play aspects from an EC/SC perspective and address theoretical and methodological issues of studying the activity of game play.

Embodied and situated cognition

For quite a long time, cognition was considered the product of internal (individual) processes, comparable to the symbol-manipulating processes of a computer (e.g. Pylyshyn, 1990). Accordingly, the focus in cognitive science traditionally has largely been on information and its mental representation and processing, thereby often reducing an agent's interaction with the surrounding environment to nothing but a set of interactions between external stimuli, mediating internal (symbolic) knowledge, and behavioural responses. In recent years, however, there has been a shift within parts of the cognitive

science community, leading to approaches and perspectives where in particular the interaction between agents and their environment is in focus (Hutchins, 1995; Clark, 1997). Drawing attention from the individual to individuals acting in a sociocultural context, much research indicates that the cognitive processes of human beings cannot be understood without taking into consideration the social and situated nature of human cognition. But not only the individualistic perspective has been questioned; many researchers are also opposed to dualistic and functionalist viewpoints, which in different ways presuppose the separation (non-relatedness) of mind and body. Going beyond this perspective, it has been argued that body and mind cannot be separated, since they strongly affect and depend on each other (e.g. Varela, Thompson, & Rosch, 1991; Clancey, 1997; Clark, 1997). Today, there is an increasing awareness of the cultural, embodied and situated nature of human cognition in different scientific fields of cognitive science.

The relation between embodied and situated cognition, however, is far from being clear or well-defined. Embodiment approaches bear many similarities to situated approaches to cognition and activity as many of the underlying assumptions in situated cognition and embodied cognition are closely related and to a considerable extent also have the same historical roots (e.g. von Uexküll, 1928; Vygotsky, 1932; Dewey, 1938; Mills, 1940; Piaget, 1969). Despite differing ways of attending the issues of embodied and situated cognition, however, there are a number of features that generally are associated with both perspectives and that in one way or another run through the literature on embodied and situated cognition (cf. Wilson, 2003).

Central assumptions

One of the cornerstones in the theoretical frameworks of embodied and situated cognition is the assumption that *cognition is situated*. In order to understand human cognition we cannot just look at separated parts such as the individual brain, but we have to view cognition as a dynamic process that emerges over time and in interaction with the surrounding environment (e.g. Hutchins, 1995; Clancey, 1997; Clark, 1997). Individual actions cannot be explained without taking into consideration what other people are doing and their shared, historically developed knowledge and understanding of the world (cf. Lave & Wenger, 1991).

People also *constantly off-load cognitive work onto the environment* as a consequence of limited cognitive capacities, and by taking advantage of the environment people relieve their cognitive workload by letting the environment hold information for them (Clark, 1997; Kirsh, 1995, 1996). As Clark (1997) pointed out, we can allow ourselves to be 'stupid' because we know how to arrange and use the surrounding world to our advantage. Norman (1993) defined those tools storing and manipulating information as 'cognitive artefacts', and in the following years there has been a growing interest in how artefacts (tools) affect human cognition (cf. Clark, 1999; Hutchins, 1995; Preston, 1998; Susi, 2006). Artefacts play, for in-

stance, an important role as organisers as they make information available and visible, e.g. a post-it on the desk, but they also contribute to coordination, cooperation and structure on a social level (Rambusch, Susi, & Ziemke, 2004). Moreover, the observation that the surrounding environment has an assisting role in cognitive activity has led to claims according to which *cognition is not the activity of the human mind alone*, but is instead distributed across mind, body, and environment (e.g. Hutchins, 1995; Port & van Gelder, 1995). Accordingly, it has been argued that in order to understand cognition scientists must study the situation and the situated cognizer together as a unified system. This way of thinking has, for instance, found its way into the field of human-computer interaction (HCI) (e.g. Hollan, Hutchins, & Kirsh, 2000; Dourish, 2004).

Embodied and situated approaches to cognition and activity view cognitive mechanisms also as being tightly coupled to sensorimotor activity (e.g. Maturana & Varela, 1987; Clancey, 1997). This perspective is closely related to ecological viewpoints on cognition and object manipulation (Gibson, 1979). From an ecological point of view, perception is an active process and all information necessary can be found in the environment. The term *affordance* has been central in theories on embodied cognition since it concerns the relationship between an actor and its environment. Hirose (2002), for instance, described affordances in terms of "opportunities for action that objects, events, or places provide for an animal" (p. 290) to clearly show the close and mutual relation of agent and environment. That is, the actions taken by an agent and its properties determine how a certain object is perceived, e.g. graspable object only affords throwing if the situation in question requires throwing and the agent has an arm to throw with. The idea of human cognition being the result of people's interactions with the physical environment has led an increasing number of researchers to claim that cognitive activity is the result of internal simulations of perception and action (e.g. Hesselow, 2002; Barsalou, 2003; Grush, 2004). It is argued that there is no difference between cognition on the one hand and perception and action on the other since cognition is viewed as being "inherently perceptual, sharing systems with perception at both the cognitive and the neural levels" (Barsalou, 1999). Glenberg (1997, p. 1), in addition, argued that the traditional view of memory as a storage device for abstract representations needs to be replaced by a view of memory "as the encoding of patterns of possible physical interaction with a three-dimensional world".

However, even though no consensus exists as to what extent human thinking is the direct result of perception-action simulations (e.g. Wilson, 2003), there is nonetheless a growing number of studies providing solid evidence that human cognition is inextricably intertwined with perception and action. A number of studies indicates, for instance, that our language is deeply affected by and rooted in everyday bodily experience (e.g. Lakoff & Johnson, 1980; Rizzolatti & Arbib, 1998; Roth, in press). Moreover, recent findings in neuroscience sug-

gest that a shared understanding between individuals is grounded in the human ability to recognise and simulate the actions of conspecifics (Rizzolatti, Fadiga, Fogassi, & Gallese, 2002), and action and manipulation seem also to be fundamental for acquiring knowledge about and the use of objects since the identification (naming) of objects activates premotor areas typically associated with visuomotor transformations for grasping and manipulating objects (Grafton, Fadiga, Arbib, & Rizzolatti, 1997). The body is also frequently used in human communication and social interactions (Goldin-Meadow, 2003) and serves as an important tool in developing and understanding abstract concepts and knowledge (Lakoff & Johnson, 1980; Roth, 2002).

A cognitive perspective on game play

The embodied and situated nature of human thinking needs, of course, to be taken into consideration when studying game play in terms of activity and cognition. It is not enough to study the player and the game (environment) separately since neither can be fully understood without the other. The game environment alone, even though it plays an important part in the game, would not tell us much about the ongoing gaming activity, because without a human being or a device that can provide feedback there would not be any interaction at all. The player's actions, on the other hand, also need to be studied with regard to the game environment which not only affords certain actions, but also holds and distributes information. This presents something of a challenge for people since the game environment consists of two worlds, a virtual one and a real one, i.e. the affordances of both worlds need to be combined for a game to be played successfully.

The embodied and situated nature of the human mind becomes, for instance, visible in how players make use of their game environment. As shown by Kirsh and Maglio (1994), people playing TETRIS™ use the video game's screen to decide whether or not an L-shaped brick fits in between other bricks by rotating the brick directly on the screen. The offloading of cognitive work onto the environment has been proven to be an essential part of human thinking, an aspect that also can be observed in more complex computer games. In ESCAPE FROM MONKEY ISLAND, EFMI™, for instance, you get a sheet with clock times and compass headings on it, which comes in handy when you try to find your way through a marsh. The only problem is that the sheet is not visible during the navigation through the marsh, which requires you to keep all the clock times and compass headings in mind (see Figure 1). From own experience I know that this is not an easy task and after having gone in the wrong direction for the tenth time I got tired of it and wrote all necessary information down on a piece of paper. This is a very clear example of how we off-load cognitive workload onto the game environment, which in my case also included a piece of paper.

Some people, however, might consider this cheating since a piece of paper is not part of the game as designed by the game developers (cf. Kücklich, 2004; Consalvo,



Figure 1: Navigating through the marsh can be tricky

2005). The game structure (the rules of the game) can, in other words, also affect the ways in which computer game players make use of their game environment. The above example might even indicate a serious usability problem because the game interface prevents you from structuring the virtual environment. Most researchers interested in usability aspects would therefore probably argue that, because of limited cognitive capacities, computer games need to be designed in a way that does not require extensive structuring of the game environment. It might not be as simple as it sounds, though. Computer games that do not require people to off-load parts of their cognitive work onto the environment may not always be that successful as one might expect. The constant and active adaptation of our environment is part of what we are, who we are and is subsequently also a very important part of our interactions with computer games because it allows us to be active rather than reactive.

Still, many computer games do not offer many opportunities for the off-loading of mental workload onto the game environment, and people playing computer games are often also distributed over several locations and time zones. Take the example of FPS games such as COUNTER-STRIKE™ and STARCRAFT™ (Figure 2).



Figure 2: COUNTER-STRIKE™: a game with limited opportunities for players to make use of environmental structuring

These kinds of games are played under extreme time pressure, require constant, focused attention on what is on the computer screen and do not provide many opportunities for players to manipulate the game world, other than their own position in it. An interesting and relevant question accordingly is how people deal with at

times static virtual environments that allow very little or no adaptation at all, how and under what circumstances they use environmental (virtual) resources as cognitive aids and to what extent off-loading extends into the ‘real world’, which in many cases also includes other people. Playing COUNTER-STRIKE™ is a team effort and teams can develop complicated strategies and advanced divisions of labour.

Human thinking is also largely related to bodily experience, which of course also has an impact on game play. The identification with a game character seems, for example, to be fundamentally related to the physicality of having a body, which manifests itself in a player’s *Game Ego* (Wilhelmsson, 2006). Research undertaken by Newman (2002) also indicates that body-related behaviours such as reeling, swerving, and ducking considerably increase people’s gaming experience even though these movements are not registered by a games’ control/input devices. However, the experience of having a body can sometimes cause considerable confusion since you as a player often have two bodies – a physical one and a virtual one. Which arrow key would you, being Guybrush Threepwood in EFMI™, press to move to the right (see Figure 3)? “From *his* perspective or from *my* perspective”, you might ask. Well, that is the problem here – if you want go to the right from *your* point of view you have to picture yourself as *Guybrush* and press the *left* arrow key.



Figure 3: Moving to the right – which arrow key to press?

Obviously, controlling a game character with the arrow keys on a keyboard is not that easy, something that also might explain the success of the more intuitive, graspable game pad. Controlling a character with an analog thumb stick is often experienced as being more ‘natural’ since the movement of the hand to some extent mirrors the body’s movement. The most natural ways of moving in and through a virtual environment, however, would probably be provided by input/output devices that allow the player to move as they do in the real world, that is, instead of controlling a character with the buttons on a keyboard or game pad the player would ride a bike, walk on a ‘walk pad’ or use the game controller like a tennis racket. Controlling a character with more intuitive input devices might also make it easier to avoid confusions as described above since the activity of, for instance, walking might facilitate and enhance the identification with a game character.

These are basically just plausible educated guesses, though. So far, very few empirical studies have been carried out concerning the impact of different input devices on people’s game play and gaming experience. The idea of providing players with more intuitive game control devices seems, nonetheless, to be rather intriguing which, for instance, explains the recent development of games such as EYETOY:PLAY™ and DANCE DANCE REVOLUTION™ (Figure 4). In these kinds of games motions such as jumping and waving are captured by motion sensitive input devices.



Figure 4: Controlling a game with your feet

However, people playing games can often play for hours without realising the time spent, which, of course, is not possible if they actually have to walk. No one has the energy for such an extreme playing session. Also, people who sit in front of their computers can eat and play simultaneously which a person riding a bike would probably find somewhat difficult. Many games with their game structure and game world are thus likely not fitted for ‘natural’ control devices. A quick Internet search has also revealed critical voices about the potentials of games such as DANCE DANCE REVOLUTION™, “rigid and bearing little resemblance to actual dancing” was one of the comments at www.wikipedia.org. This raises important questions regarding the impact of different control devices on game play in terms of gaming experience and performance. More intuitive interactions with computer games might not only be related to more ‘natural’ kinds of input devices, but also to other game play aspects that, so far, have not been fully understood yet.

How could we otherwise explain why computer games have been spectacularly successful for around three decades now, *despite* apparently limited interaction opportunities for the users? Successful interactions between player and game apparently take place whenever people get caught up in their gaming activities, regardless of the interaction mode. Many players display, for instance, a remarkably skilled use of keyboard and mouse, indicating that these control devices have become an extension of the players’ body through which the (virtual) world is perceived directly. This process seems to be very similar to what Hirose (2002) defined as an *act of embodying*, a process where objects cease to objects and

instead become part of the body. How do players develop such advanced skills of manual dexterity, and which impact do they have on their game play and the strategies used in the game?

Studying game play activities

To summarise the previous section, we can say that game play in terms of activity and cognition consists of two elements: the physical activity of playing a computer game (‘handling the game’) and the player’s meaning-making activities, her understanding of a game. Both elements are closely related since the operational part of game play also has an impact on our thinking processes. As Hirose (2002, p. 292) pointed out, “the body may change with tools [and these] changes in the body may alter the observer’s action capabilities, and thus the observer must adjust perception of affordances to these changes in order to fit the environment” – be it the real or the virtual world. Also, the skilled use of keyboard and mouse alone is no guarantee to win a game, but people have to do the right things, that is, they need to have an understanding of a game in order to succeed. That means, if we are to understand game play we have to account for both elements and their co-dependencies. It requires subsequently a framework that presupposes the interrelatedness of handling processes in games and people’s meaning-making activities (cf. Rambusch, Jakobsson, Pargman, & Ziemke, submitted).

The theoretical framework of embodied and situated cognition is a strong candidate because it considers sensorimotor activity to be inextricably intertwined with higher cognitive processes such as problem solving and decision making. Moreover, and importantly, theories on the embodied and situated nature of human thinking are also highly consistent with areas of research undertaken in the field of game studies (e.g. Tosca, 2003; Salen & Zimmerman, 2004). A balanced thorough understanding of game play requires more than the mere application of existing methods and theories on the computer game domain; if we are to understand game play we need more intimate knowledge about computer games than that ‘they are played for fun’. This cannot be sufficiently captured by the theoretical framework of embodied and situated cognition. The field of game studies, on the other hand, with its many descriptive and detailed accounts of computer games, can provide us with perspectives for seeing computer games in a variety of ways, and is thus a necessary and valuable complement for the study of game play in terms of activity and cognition.

Viewing game play as a socially distributed and embodied activity has, of course, significant implications for how game play is approached in empirical research. The approach advocated here, and to be pursued further in future empirical studies, is inspired by cognitive ethnography and distributed cognition (Hutchins, 1995; Hollan et al., 2000), with observations, video recordings, and interviews. The combination of these techniques makes it possible to capture both the operational part of game play as well as large parts of a player’s meaning-making activities; parts of these activities are expected to be-

come visible in the player’s interactions with the game, but interviews are nonetheless necessary if we are to understand why a player, for instance, chose one strategy instead of another. In the remaining part of the paper, the theoretical issues discussed in this section and the preceding sections are briefly illustrated with empirical studies conducted (being conducted) by our research group at the University of Skövde.

Empirical studies

Large parts of the studies have been (will be) undertaken in the game research lab at the University of Skövde, which is specifically designed for research on the human use of and interaction with computer games. An important role plays an apartment-like room which roughly corresponds to a common student’s living and working environment (Figure 5). The room is equipped with video surveillance technology to monitor and record user activities and all technology necessary to play computer games on different platforms with different kinds of control systems (e.g. game pad, keyboard).



Figure 5: ‘The apartment’ in the game research lab at the University of Skövde

One of the questions discussed in this paper has been what different game interfaces afford to players in terms of action opportunities and how this affects the outcome of the game and the game experience. An initial case study has been undertaken to investigate the *impact of different input devices* such as game pad and a modified training bike on people’s game play (Rambusch, to appear). The participants were divided into two groups and the playing session was videotaped. Also, after each session, an interview took place and players were asked to fill a survey questionnaire. The main hypothesis was that people controlling the single player game PAPERBOY™ with a game pad play the game in a different way than do people who control the game character with the modified training bike.

However, preliminary results indicate that there is in fact no significant difference between the groups in terms of performance, action frequency, and gaming experience. What caught our attention, however, was that the input devices seemed to have a strong influence on people’s expectations about the kind of interaction they allowed. It was difficult to control the game character for

both groups, but the bike group blamed the bike rather than the game while the game pad group, although experiencing similar problems, had a more negative attitude towards the game itself. This suggests that ‘natural’ input devices for computer games can lead to high user expectations that are difficult to match with the technology available today.

Another, more long term study aims to investigate *expertise and learning processes* in COUNTER-STRIKE™. Counter-strike is one of the most popular FPS games around and a team effort, and teams (called ‘clans’) can, as mentioned earlier, develop complicated strategies and advanced divisions of labour. A closer look at game play in Counter-strike can help us to further the understanding of the distributed, embodied and social nature of game play, that is, how single individuals in front of a computer coordinate their behaviour and learn from each other. As a first step, a pilot study was undertaken to gain a better insight into the Counter-strike world. The participant in this study was a member of a Swedish Counter-strike clan for several years, and his playing session, consisting of several rounds at a public server, was videotaped. Afterwards, a four-hour-long interview took place where we asked questions covering game play aspects most interesting to us (e.g. his ways of playing the game, his depth of knowledge and career in the Counter-strike world). One person alone, however, cannot tell us much about how game play activities are coordinated and planned between the members of a CS-clan. Future steps, accordingly, require setups where we actually have access to the members of an active CS-clan and their training sessions and matches.

Conclusions

Computer games have become a major factor greatly affecting society, politics, and the everyday lives of people. An increasing number of people spend more time in ‘virtual worlds’ than what they do in the ‘real world’ (Castranova, 2001) which indicates that computer games have become a thriving and lifestyle changing part in those people’s life. This has not gone unnoticed in the scientific community and now computer games are a priority on many research agendas.

Approaching games from an embodied and situated cognition perspective can greatly broaden our understanding of how an (on the surface) individual game play in front of a computer is distributed across different places and persons, how people, in spite of sometimes limited interaction techniques, communicate with each other, how they learn from each other, how they make sense of and solve problems in virtual environments provided to them. Due to the complex socially situated, and increasingly body focused nature of computer games, computer games offer also an *interesting field of application for SC and EC research*, making it possible for scientists to gain a deeper understanding of the situated and embodied nature of human cognition in general, and whether or not, or to what extent, the use of computer games affects the ways in which people perceive and explore their surrounding environment.

Research on games from an EC/SC perspective can also be expected to make a *valuable, qualitative contribution to the field of game studies*; computer games are being approached from many different research directions, but the situated and embodied nature of computer game activity with the player in focus is still a largely unexplored issue.

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