The Challenge of Managing Affordances in Computer Game Play

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This paper discusses affordance *with respect to computer games and game play activity. The game environment, with its complex and seemingly multiple affordances, presents a challenge, for players as well as researchers, since it consists of two worlds: the virtual and the real one. For games to be played successfully, affordances of both worlds need to be integrated. However, since Gibson's* The Ecological Approach to Visual Perception *(1986), numerous different opinions on what constitutes an affordance have appeared, most of them deviating from the original Gibsonian conceptualisation. This has lead to confusion and misunderstandings among researchers, and is now also spreading into computer games research. This paper aims to raise awareness of what the affordance concept can, and cannot, explain and of the fact that some of the possible actions perceived by a player in a game also are rooted in socio-cultural conventions and the player's experience of having a body.*

Keywords: action, computer games, sequential affordances, situated cognition

What happens, cognitively speaking, when we play *Tetris*? The game is near impossible to win and yet it does not stop us from trying. The colourful and odd shaped blocks just keep falling and falling and we just keep pushing and pushing the buttons on our mobile phone or Nintendo DS in desperate attempts to make those blocks fit with each other. According to Kirsh and Maglio (1994), what happens is that we literally rotate the blocks on the game screen instead of doing it mentally to minimise our cognitive workload. Only, how do we know what to do in the

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first place, and how do we figure out how the buttons on our mobile phone or Nintendo DS are connected to those falling blocks? Researchers familiar with (usability) design will most likely reply to these questions with "It's the game's affordances".

Affordance has become a well-known term in the design world, and it is mostly used when researchers seek to explain how people discover the functionality of features in computer applications and other everyday products. It is probably not an exaggeration to say there are as many definitions of the term as there are researchers defining it. Only one researcher can claim original ownership of it though, namely James J. Gibson, who introduced the concept of affordance in his by now famous book *The Ecological Approach to Visual Perception* (1986). The affordance concept became quite popular among scholars and researchers outside the world of ecological psychology, especially in human-computer interacttion (HCI), when it was included by Norman in *The Psychology of Everyday Things* (POET) (1988), but it also spread from the scientific realm to more general and popular uses. At the same time, however, the popularisation has also lead to a subsequent devaluation of conceptual currency, as Torenvliet (2003) phrases it, because "somewhere on the way from academia to Starbucks […] something happened. The meaning of affordance became distorted and confused. At first it was subtle, but by now its meaning has bifurcated wildly" (13).

Much of the current confusion surrounding the affordance concept can be attributed to an incautious use of terminology in POET (Norman 1988). Today, the concept plays a significant role in HCI, but also in areas like situated/embodied cognition and artificial intelligence robotics (e.g. Clancey 1997; Duchon, Warren & Kaelbling 1998). Still, in all areas we see a misuse of the term in phrases like "learning an affordance", "developing an affordance", "representing an affordance", and "adding an affordance" (e.g. Cos-Aguilera, Cañamero & Hayes 2003; Stoytchev 2005; Valpola 2005). However, according to Gibson (1986), affordances are something we *perceive*, rather than "learn", "develop", or "add"; affordances are properties of objects, which are perceived in relation to an agent's bodily properties and capabilities. However, quite a few researchers, it seems, now ascribe the affordance label to almost everything that has a physical *appearance*, hoping it will explain how users perceive, for instan-

ce, virtual environments. And this is a problem since researchers have come to use affordance as a way to describe and talk about appearance. They use it to describe what the features of a computer application *appear* to be, for us, the users, and not, as was originally intended, to describe what their affordances *are*. Unfortunately, this misuse of affordance is now also spreading in computer game research (e.g. Gee 2005; Linderoth, Lindström & Bennerstedt 2006).

The perception of affordances is, without doubt, an essential aspect of human cognition, and it needs to be taken into consideration also when studying game play activities. Cognitive aspects of people's everyday game play activities are still far from understood, but the grounding of analyses in Gibson's concept of affordance will help provide valuable insights into such activities. When used in its original sense, affordance addresses the close, mutual relation between player and game environment; a relation in which players constantly escape their virtual confines and mingle with the physical and social environment (cf. Clark 1997). The study of the perception of affordance in computer games is, however, a bit tricky, to say the least, since the game environment consists of *two worlds*: a virtual and a real one. As players are engaged in game play, they face the challenge of perceiving and acting upon affordances in both worlds and we, as researchers, subsequently face the challenge of capturing and explaining them. The real challenge for players, though, is not the perception of affordances *per se*, but rather their integration, since players have to combine real world actions with actions in the virtual world.

From a situated cognition perspective (Clark 1997), game play is by no means simply the result of internal, individual processes; it can rather be conceived as an activity of continuous interaction, where meaning arises in the relation between the player and his/her environment (cf. Greeno 1994). This means that game play needs to be studied with respect to the socio-cultural context within which it takes place; the player's actions need to be understood with regard to the game environment, which not only holds and distributes information, but also *affords* certain actions in relation to, e.g., the artefacts and tools used in the game. This also means that we need to consider affordances in relation to players' context-dependent actions, which include interactions with other players

as well as objects. Objects, artefacts, tools – whichever term we use – constitute parts of a culture's intellectual history (Lave & Wenger 1991; Rogoff 2003; Susi 2006; Susi & Rambusch 2007; Vygotsky 1978), and the appropriation of knowledge about an object's functionality and its use in games seems to turn the individual activity of perceiving affordances into a social process.

In this paper, we specifically want to direct attention to two issues. The first concerns the various uses of the affordance concept, and the second is to show that the affordance concept alone cannot account for activities such as people's everyday game play. We may not provide ready-made answers, but we want to encourage researchers to further address and reflect upon analytical uses and theoretical conceptualisations of the affordance concept, to avoid replicating the mistakes made in, for instance, human-computer interaction (HCI).

Please Don't Confuse Affordances with Perceived Affordances,[1] or any Other Kinds of Affordances

As previously mentioned, computer game play presents a challenge in the sense that players are faced with affordances of two different worlds that need to be integrated for successful play. Even though players themselves are unlikely to ever consciously reflect upon "affordances" in their game playing activities, the issue is an interesting one; a good integration of different kinds of affordances is also a good integration of the player's virtual and real worlds (cf. Gee 2005). The challenge manifests itself in play situations where the very same object that affords a certain action in the real world does not afford the same action at all in the virtual world. A perhaps even greater challenge lies in understanding how real world actions affect actions in the virtual world. Before going deeper into the relation between real and virtual affordances,[2] however, we need to take a look at the *concept of affordance* itself, and (some of) its different uses. Most of us have a general understanding of the term, but the common generalness has also lead to a number of misunderstandings and confusions. Affordance is a useful concept, but if it is to be of any real analytical value in computer game research, we need to beware of how we use it.

Let us start with Gibson's own description of affordance. Gibson's (1986) ecological psychology turned against the traditional psychological mind-body dualism, with its ideas of psychological processes as operating upon incoming bodily sensations.[3] Instead, he saw perception as something direct, with no intermediary processes; an activity in which agent and environment form a reciprocal relationship. What we perceive are affordances, and they are what they provide or offer an animal in terms of possible actions, for good or for ill. An affordance is neither objective nor subjective in a narrow sense, instead it "points both ways, to the environment and to the observer" (129). And yet, an affordance is objective in the sense that it is invariant, and "it does *not change* as the need of the observer changes […] [a]n affordance is not bestowed upon an object by a need of an observer and his act of perceiving it. The object offers what it does because it is what it is" (138f.). That an affordance is invariant means that it is always there to be perceived, regardless of whether or not we perceive it. At the same time, an affordance is also subjective in that it is relative to an agent's bodily capabilities, locomotion, and orientation. According to Gibson, "different layouts afford different behaviors for different animals, and different mechanical encounters" (128). A surface, for instance, that is (more or less) horizontal and flat, and sufficiently extended and rigid, relative to the size and weight of the agent, affords support for that agent – it is, as Gibson says, "stand-on-able" and "run-over-able" (127). As Gibson further states, if such a surface of support is also knee-high above the ground it affords sitting on, but knee-high for a child is not the same as knee-high for an adult, so, again, the affordance is relative to the size of the agent.

The affordance itself is specified through information in the environment (the pattern of light reflected from surfaces, which reaches the observer's eyes). Sometimes, however, we do not perceive an affordance, or we pick up "misinformation" about it. For instance, we might not notice that a door made of glass is actually closed and we walk right into it, which means the perceptual information we pick up (that is, air, which affords passing through an open doorway) is not the same as the door's real affordance. Of course, the door also affords bumping into, but that is not what we want to do. When it comes to objects, Gibson distinguished between attached and detached objects, and considered tools a

special kind of detached objects that are graspable, portable, and manipulable. Gibson pointed out that we are constantly grasping objects and that they are perceived in relation to the hands, and also that "the perception is constrained by manipulation, and the manipulation is constrained by perception" (224). As we (temporarily) attach a tool to our body, we extend our capacity of perceiving and acting. The capacity to attach something to the body suggests, in Gibson's view, that the boundary between us and our environment is not fixed at the surface of our bodies.

Considering that affordances are invariant, it implies they are also independent of cultural and social conventions. Gibson did, however, recognise that our use of objects is affected by "second-hand knowledge" (or mediated or indirect knowledge). As Gibson says, "wisdom is handed down […] this knowledge is communicated to the child" (1986, 260). A well-known example is the postbox that invites letter-mailing – an object that everyone "above the age of six knows what it is for" (139). However, despite mentioning second-hand knowledge, it seems Gibson left sociocultural aspects mainly unattended. We will return to this issue later.

To see how the affordance concept applies to computer games, we use a scene from *Escape from Monkey Island* (EfMI), PC version (2000). In Figure 1 below, we see how the player, in the form of the avatar Guybrush Threepwood, has entered a room through a window (at the far end of the room, to the avatar's right) to pick up things she needs. She is now about to leave the room, and explores whether she can use the door (in front of the avatar) instead of climbing back out through the same window from which she came. When she gets to the door, however, she soon finds out that she cannot pass through. We will use this same scene throughout the discussion of different uses of affordance.

Figure 1. Guybrush Threepwood in EfMI (2000) looks at the door and is just about to try to pass through.

What takes place in this scene, in the Gibsonian sense of affordance, is the following:

> *The player now wants to leave the room and she perceives information about possible actions, possibilities relative to her/Guybrush's action capabilities and the situation at hand. She sees the door with a plate on its right side, and perceives it as "approach-able" and possibly "pass-through-able".*

However, the possible passing through, in terms of affordance, actually stops short here (unless we invoke second-hand knowledge or something similar). The player must *do* something to make Guybrush pass through. She knows that doors in the game are not actually opened in the same

manner as in the real world; instead they are passed through by just walking into them (if it is a door that *can* be passed through), and she also knows that in order to do so, she needs to *keep pushing the button* that makes Guybrush move (in this case the avatar is controlled through a keyboard). However, the button (in fact, all buttons) affords pushing at any time, and there is nothing, no perceptible information on the door or any other part of the virtual game environment, that "affords" to push, or keep pushing, a button *outside of* the virtual game environment; neither when she wants to approach the door, nor at any other specific point in time. To explain how she actually knows she needs to push a button requires a conception other than affordance, but for now let us just go with the fact that she keeps pushing a button to pass through the door. We will return to this issue later, and in the meanwhile, *we denote this "affordance-action gap" with a [*]*, also when it occurs in the following examples. What we *do* know, however, is that while the player plays the game, she temporarily attaches an object (the keyboard) to her body, and thereby extends her action capabilities. In other words, the attachment of this specific object allows her to "reach" into the virtual world – but it still does not explain why, or what affords the pushing of the button.

*[*] She walks towards the door, and "bumps" into it because she cannot pass through. The door has the affordance "approach-able", but it does* not *have the affordance "pass-through-able". However, the information that the player perceives is "the door can be passed through", otherwise she would not have opted for that action. The "pass-through-ableness" of the door was a misperceived affordance.*

An elaboration of affordance that perhaps is the closest to Gibson's meaning of the concept, is found in Gaver (1991). In his view, affordances are the fundamental objects of perception, and he makes a distinction between "real affordances" and "perceptible affordances" (i.e. perceptual information that specifies the affordance). However, he also includes the notion of "false affordance" (when information suggests a nonexistent affordance), which is unfortunate and contradicts his own account, since either an affordance exists or it does not, and therefore it

cannot be false. Gaver further notes that affordances can be made perceptible by making attributes relevant for action available for perception. Since perception is direct, he says "perceiving that a door handle affords pulling does not require a mediating concept because the attributes relevant to pulling are available for perception". However, Gaver also recognises the role of socio-cultural settings, as he says "[k]nowing that a key should be turned inside a lock does require mediation because the relevant attributes are not available" (2f). In his view, the observer's culture, social setting, experience, and intentions partly determine the perception of affordances, but such factors are not central to affordances, they only "highlight" certain affordances.

Gaver also addresses complex affordances and includes *exploration* as a means to perceive *sequential* and *nested affordances* (the latter was implicit in Gibson's work, even though he did not use the term). Sequential affordances refer to "situations in which acting on a perceptible affordance leads to information indicating new affordances" (Gaver 1991, 4). Passive observation alone does not reveal all possible operations of an object – instead they are revealed over time. A door handle, for instance, may afford grasping, but the affordances of turning it, or using the handle to open the door, are not indicated. Instead, it is only after the handle has been grasped and exploratively pushed downwards that the affordance of turning it is revealed (through tactile information). Once the handle is fully pressed down, it is natural to pull (or push) it, and the result of pulling it reveals whether or not the door affords opening.

The player looks for a way out of the room and she sees the brown object that separates itself from the wall, and it has a plate on one side of it. In her culture such objects are doors. But merely observing the door does not reveal all its possible actions. But she perceives information that the door affords approaching and possibly passing through, so she walks towards it…

The player now needs to keep pushing a button outside the virtual world to pass through the door. Since no relevant attributes for such an action are available (there is no such perceptible information), it requires medi-

ation – the player's cultural setting partly determines her perception of affordances, and *highlights* the affordance of pushing the button.

…and "bumps" into the door. This exploration reveals no further affordance, and the result of the action is that she cannot pass through the door. The perceptible affordance in this case did not lead to information indicating new affordances.

The second concept, nested affordances, refers to affordances that are grouped in space. While a part of an object may afford some kind of handling, separate parts in themselves do not reveal the possibilities of the whole object as such. In the case of a door, as Gaver (1991) points out, a door handle alone suggests different affordances, but it is only when we see the affordance of pulling the door handle, as nested within the affordance of pulling the door that we perceive the affordance of opening the door.

The player is looking at the door, but the door itself does not reveal all its possible actions. It is only when she "sees" the affordance of pushing the button as nested within the affordance of approaching the door that she perceives the affordance of (possibly) passing through the door.

Now, let us turn to Norman's view on affordance. When he wrote of affordances (as presented in POET, 1988), it included both real and perceived affordances, although not clearly distinguished as such. It is this initial description that has caused much of today's misuse of the term. In Norman's use of the concept, affordances focus on the objects, which leaves out the agent of the original mutual agent-environment relationship. For Norman, affordance refers to "the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used" (1988, 9). Also, in Norman's view, perceived properties may or may not equal the real ones, but they are nevertheless affordances. Since perceived affordances are the same as real ones, it seems the agent actually comes to "decide" which properties of an object are relevant. Norman also emphasises the role of social con-

ventions and interpretation, and says the way affordances are perceived depends very much on those.

> *The player looks at the door and sees its large flat surface. There is no handle or knob on the door that can be grasped or turned, but there is a plate on the right side of the door. She knows that such a plate on a door usually means one should push to open the door because that is how people do. But in the game, doors are not opened in the conventional way (i.e. as in the real world), instead they are passed through by walking right into them. She perceives the door as "approach-able" and possibly "pass-through-able", so she walks towards it. As she reaches the door, she "bumps" into it because she cannot pass through. So, the door's real and perceived affordances are both the same, that the door is "approach-able". It is also perceived as possibly "pass-through-able".*

If real and perceived affordances are indeed considered one and the same, the player decides which properties the door has, and in this case the door's affordances are that it is "approach-able" and "pass-through-able". But in reality (the virtual one…) the door only has the affordance "approach-able" in relation to the game character. To be fair, Norman (1999) has clarified that it was a mistake to write of affordances when what he really meant was perceived affordances. On that account, the door's "pass-through-ableness" is only a perceived affordance, not a real one.[4]

While Norman's use of the affordance concept placed focus on the object, others have instead focused on the agent and its cognitive operations, at the expense of the object which is left out of the original mutual agent-environment relationship. Just to mention a couple of examples along this line of thinking, there are Cooper's (1995, in Torenvliet 2003) and Kirsh's (1996) versions. Cooper prefers Norman's definition of affordance ("the perceived and actual properties of a thing") to be read as "the perceived properties of things", which would refer to what we *think* objects can do instead of what they actually *can* do. This detaches affordance from the environment and makes it all about perception; it becomes "purely cognitive". Kirsh (1996), on the other hand, talks of strategies, or actions, that are undertaken because they affect the way a task is *perceived*

and *understood*, and because they create *cognitive affordances*. For instance, when counting coins, a person can keep track of the ones already counted by pointing, which off-loads her cognitive processes and leads to more efficient performance of the task.

> *As the player entered the room through the window she had not planned how to get out, but now that she is done in there, she is trying to figure a way out. Does she have to climb out the window again or is there another way out? Instead of planning ahead, she uses cues in the environment which help her choose a strategy. She sees the door, which she thinks is a possible way out, so the strategy she chooses is to try the door instead of the window. [*] She approaches the door and "bumps" into it, not able to pass through. She thought of the object as "a way out", only this time, her strategy actually did not lead to a more efficient performance.*

Yet another perspective on affordances is one that actually throws the concept right back into the very dualistic information processing view of cognition that Gibson wanted to avoid in the first place. A good example is "honesty of affordances", which means that "a tool tells the truth, the whole truth, and nothing but the truth about the capabilities it has" (Fitzgerald & Goldstein 1999, 179). With reference to Gibson, Fitzgerald and Goldstein argue that the use of an object is determined by its properties, and that a mapping between actual and perceived affordances is not enough. Instead, they emphasise the role of *the designer who chooses which affordances a tool conveys*. Affordances are seen as a means of communication between designer and user, and the underlying idea is that the possible uses of a designed tool can be intentionally communicated through its affordances. The general idea, then, is straightforward: "design things so people can see what they are for". It is also recognised in this view that objects afford some capabilities due to social histories and conventions. Nevertheless, this approach resorts to a de-contextualised information-processing view; it is assumed that ready-made knowledge can be "transferred" from a designer to a user, and it boils down to "adding" the right affordances to a physical design. Not much left of a mutual agent-environment relationship there!

*The player sees the door, and perceives it as "approach-able" and a way out, so [*] she walks towards it and "bumps" into it because she cannot pass through. There is not a good mapping between the perceived affordance and the door's real affordance – the door is not telling "the truth, the whole truth, and nothing but the truth about its capabilities". The designer who chose which affordances to convey did a bad job; her design does not communicate the door's possible uses to the player because she did not add the right affordances.*

In the case of designing interfaces for use in, e.g., work environments, it certainly makes sense to "design things so people can see what they are for" (albeit it cannot be done by "adding" the right affordances). But, when it comes to games and game play, "honesty" presents an interesting twist – *do we always want affordances to be "honest"*? *Would we like to "see" the whole truth?* Is not the exploration itself an essential part of the game adventure? Probably neither game designers nor players would want everything to be made obvious.

There are several other interesting interpretations and formulations of the affordance concept, but they cannot all be discussed here. Just to mention a few, though, there are the affordances identified by Zhang and Patel (2006): *biological* (based on biological processes), *physical* (for tasks constrained by physical structures), *perceptual* (provided by spatial mappings), *cognitive* (provided by cultural conventions), and *mixed affordances* (provided by combinations of more than one module). Further, in Hartson (2003), we find: *cognitive affordance* (a design feature that helps thinking about something), *physical affordance* (a design feature that helps physically doing something), *sensory affordance* (a design feature that helps the user in sensing), and *functional affordance* (a higher-level user enablement, a function that helps the user do something in the work domain). Yet another angle is provided by McGrenere and Ho (2000), who argue that it is too simplistic to say that affordances either exist or not. Instead, they claim it is more useful to think in terms of the *degree* of perceptual information, and the *degree* of affordances.

Of the perspectives discussed here, only Gaver's view sticks to the original meaning as described in Gibson (1986), and also provides an elabo-

ration to account for *complex* affordances. The others largely deviate from the original concept. Norman (1988), for instance, only takes "half the system" into account, focusing on the objects and their properties. His early mixed use of terms was the starting point that lead to the upshot of all the different kinds of uses and conceptualisations of "affordances" seen now. However, in Gibson's perspective, there is *affordance* (which either exists or not) and *information that specifies the affordance* (which sometimes can be misperceived), and they are always *relative to the agent's action capabilities*. This means that no matter how many different kinds of (cognitive, functional, or whatever) affordance labels we invent for different kinds of phenomena, they are actually *not* real affordances, at least not in the Gibsonian sense. The question is, if we are to keep the affordance concept as valuable as it actually is, as a concept that addresses the reciprocal agent-environment relationship, would not we be better off finding and using other concepts for phenomena that really are not affordances in the Gibsonian sense? If not, it may be difficult to get out of the present conceptual quagmire we now find ourselves in.

Previously, we mentioned that Gibson did mention mediated or second-hand knowledge, which suggests that previous knowledge of conventional ways of using an object affects our ways of using it. We also discussed, in the first case where the player tries to pass through the door, that she somehow *knows* she needs to push a button, even though in reality there is no affordance for such an action within the virtual environment. To explain such knowledge, we need additional conceptions, besides affordance. In our view, computer game research could find inspiration for explanations of such knowledge and other game play behaviours in theories and concepts available in situated/embodied/distributed cognition or socio-cultural studies that emphasise the roles of both the social and the material sides of human activities (Clark 1997; Rogoff 2003). Other conceptualisations that focus on agent-environment relationships could also prove useful, such as Heidegger's "equipment" and von Uexküll's "functional tone" (for a detailed discussion on these, and Gibson, see Susi & Ziemke 2005). It is now time to consider how the player actually knows what is required in order to approach and (try to) pass through the door.

Transparent Boundaries and Professional Vision

Game play is a situated activity in which players perceive and act upon affordances in *both* the real *and* the virtual world. This "being in two worlds", however, is at odds with how players often experience their playing activities. Terms like *flow* or *immersion* come to mind here (Douglas & Hargadon 2000; Ermi & Mäyrä 2005); players can be so engrossed in their playing activities that they actually feel like they are *in* the game, while everything around them is "tuned out", and, subsequently, is not part of the game. But just because players *experience* themselves as being in one world, the game world, it does not mean that they actually *are*.

Research on tools and artefacts has shown that objects, particularly those that we use frequently, tend to disappear because they have become transparent to us; we are not consciously aware that we are using the objects (Gauvain 2001; Suchman 1987), which is also what happens when people play computer games. Look at how skilled many players become in using mouse and keyboard or the game pad. In those cases it almost seems as if the game's control devices have become an extension of the player's body, through which the virtual world is directly perceived (cf. Rambusch 2006). This example is very similar to the well-known example of a blind man using a stick, where the stick no longer is sensed as a thing itself as the user gets accustomed to using it (e.g. Hirose 2001). Hirose describes this process as an act of embodying, a process where objects cease to be objects and instead become parts of the body. This, of course, might affect how players perceive the game world. As Hirose points out (although not explicitly referring to computer games), "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" (292).

Beginners are quite aware of what they do both in the virtual world and in the real world since they need to get used to the game equipment; they need to learn how actions that involve objects like mouse or keyboard are related to actions in the game world. In EfMI, for instance:

She has to learn that pushing the arrow keys has an effect on Guybrush's movements in the game. She has to learn that those arrow keys are connected to Guybrush in the game since the guy does not have an affordance such as "movable with arrow keys" or "controllable with arrow keys"; what she has to learn is that a game character can be moved in a game and she also has to learn how to do this.

The keys themselves, of course, have an affordance, the affordance "push-able", but the arrows on those keys reflect a cultural convention; we have *learned* that an arrow pointing in a certain direction has a specific meaning, which in this case means "going forward", "going backwards", "going to the left", and "going to the right". This also clearly demonstrates how our perception is affected by contextual aspects, which are closely related to our actions. Those same arrow keys have somewhat different meanings in, say, Microsoft Word; while we wrote this article those arrows meant, e.g., "one line up", "one line down", "one letter to the left", and "one letter to the right". And even in EfMI, the meaning of those arrows can change; every time she looks at the objects she has collected during the game (Figure 2), the arrows mean "one object to the left" or "one object to the right". Obviously, we cannot talk about affordances here. "Push-able", on the other hand, *is* an affordance and it *remains the same in all computer applications*, be it Microsoft Word or a game like EfMI. This is what Gibson (1986) meant by "invariant affordances": the affordance of an object is always the same, no matter what we do, but depending on what we *do,* we may perceive different affordances.

Figure 2. Choosing an object (e.g. the letter) in EfMI.

Experienced players, on the other hand, have already gained the knowledge discussed above. They no longer have to think that much about how the keyboard or the game pad are related to a game, and this usually enhances the playing experience considerably. It has been suggested such knowledge constitutes a "development of professional vision" for affordances, as discussed by Linderoth, Lindström, and Bennerstedt (2006) in the context of the game *TimeSplitters 2*. An alternative explanation, however, is that such knowledge has less to do with professional vision than with the equipment becoming an extension of a player's body, which affects his/her perception of the game. An experienced player perceives a door in *TimeSplitters 2* as something that "can be opened through a click on the game pad", because she has learned that a door can be opened by a click on the game pad button, and such an action has become an automatic action. A beginner, on the other hand, probably perceives the same

door simply as "can be opened". None of these perceptions, though, are real affordances of the door, since no matter how skilled a player becomes at controlling her game pad, no matter how much of a professional vision she develops, she will never ever pick up the affordance "'open-able' by pressing a button on the control". There is absolutely nothing in the game or in the game environment that tells the player "you can open a door by clicking button x" for the simple reason that there is no such affordance – not on the screen, not in the virtual room, not on the virtual door itself, and not on the game equipment. The action of opening a door has to be learned by means other than can be picked up on the screen. And it is *here* that professional vision comes into play.

Professional vision is, as Goodwin says, "*socially* organized ways of seeing and understanding events that are answerable to the distinctive interests of a particular social group" (1994, 606, emphasis added). Goodwin's findings are based on studies of archaeologists and their practice of *coding schemes* to categorise events relevant to their work, their practice of *highlighting specific phenomena* in their environment for better visibility, as well as their *production and articulation of material representations,* such as archaeological maps. These practices are, according to Goodwin, embedded within webs of socially articulated discourses, i.e., the ability to *see* relevant objects or events is not the result of the individual mind alone, but arises within a "community of competent practitioners" (626).

Following this line of reasoning, the development of professional vision in game play is, in other words, a social process in which players learn through "socially articulated discourse", *within the community of (competent) game play practitioners*, what a game pad is for, how it can be used, and what information is relevant in different kinds of game genres. Professional vision has subsequently very little to do with the differentiation of "the information for a specific set of *affordances* which is relevant to a certain group in a certain situation" (Linderoth, Lindström and Bennerstedt 2006, 4, emphasis added). Rather, affordances relevant to a certain group in a certain situation entail from socially articulated discourses, i.e., they have been socially negotiated or agreed upon, or emerged implicitly among the group members (as social norms often do). In a sense, this is at odds with Gibson's view on affordance – after all, an affordance

is relative to *an* animal, not to *groups* of animals. On the other hand, it points to the importance of mediated or second-hand knowledge, and that the use of objects can be affected by social norms. That, in turn, may be taken to indicate that Gibson was aware that perhaps not all aspects of the animal-environment relationship can be explained in terms of affordances.

However, one could also interpret Linderoth, Lindström, and Bennerstedt's argument in the sense that the development of professional vision is not about the negotiation of affordances, but something that instead leads to new ways of perceiving the game environment, i.e., the development of professional vision leads to the perception of *different kinds* of affordances in the game. But again, in Gibson's view, *affordances are directly perceived by an agent in relation to its motion* and not in relation to negotiated, agreed upon, or implicitly emerged knowledge. Linderoth, Lindström, and Bennerstedt surely have a point in discussing how players try to grasp the properties of a game world and how they learn to discriminate between "relevant features" and "decorations" in it, but it is important to realise that this is not so much about *learning* right and false *affordances* (which do not exist in the first place), but more about learning to *recognise* which parts of the game one can and cannot interact with. Affordances in the Gibsonian sense afford actions, but *not* non-actions. A picture on a wall in a game does not afford "ignore me", but an experienced player has learned, through interaction with his social surroundings and through exploration of the game world, that pictures in, for example, a shooter game, rarely are related to the game; players know they are simply there for the purpose of creating some sense of realism in the game. So, it is not a matter of learning affordances, but rather a matter of learning to recognise the interactive parts of the game – which is not the same as perceiving affordances in the Gibsonian sense. Such knowledge, then, affects players' perception of the game environment, a conclusion supported also by Rogoff (2003), who argues that socio-cultural practices to a considerable extent shape people's perception of their environment.

The idea of having to learn to *recognise* the interactive parts of the game seems to be consistent with Neisser (1992, in Greeno 1994), who argued that we need to distinguish two kinds of perceptual processes,

namely *direct perception* and *recognition*. According to this view, direct perception provides us with information for locomotion and orientation in space, whereas recognition provides us with information about the identification and classification of objects and events, and recognition is more effective if we are able to accumulate information about the features of an object or arrangement. Neisser's idea comes close to Gibsons' theory of *perceptual learning* (1955), which is described as "responding to variables of physical stimulation not previously responded to". Perceptual learning, in other words, is about learning differentiating qualities of stimuli in the environment, such as a person's ability to identify different types of sherry or red wine. They point out, however, that their theory of perceptual learning does not account for misperception, as it does not tell us anything about how imagination, fantasy, or wishful thinking might affect our perception of objects and events in the environment, aspects that are arguably integral parts of game play activities.

Another complementary explanation for how players perceive possible actions in a game might be found in the area of embodied cognition. We have already mentioned that as we attach some object to the body, we extend ourselves and our action capabilities in an act of embodying. Recent research on embodied cognition also suggests that the *recognition of objects and their use* is related to bodily experience, which does not simply specify perception and action aspects of an object but – in the Gibsonian sense – the mutual relationship between agent and environment (e.g. Grafton *et al.* 1997; Johnson-Frey 2004). For instance, the recognition and naming of objects appears to be related to sensorimotor experiences, i.e., we simulate previously performed actions. This would mean that:

> *She perceives the door as a door and as "open-able", because she associates the picture of it with previous bodily experiences of opening and passing through doors.*

A Herculean Task?

Undoubtedly, opinions on what constitutes an affordance are mixed, resulting in confusion and misunderstandings among researchers and designers. So far, when trying to explain the relevance of affordances in people's interaction with virtual worlds, most researchers focus almost

entirely on what is visible on the screen whereas socio-cultural aspects are routinely downplayed; this can now also be seen in computer game research. The affordance concept, however, requires us to think more than screen deep (Torenvliet 2003). There are never any easy answers in science, and the same goes for computer game research. And we certainly cannot rely on what is visible on the screen *or* on socio-cultural aspects alone. To merely turn to either one or the other "side" in the study of game play activities would be "as pointless as asking whether people rely more on their right leg or their left leg for walking" (Rogoff 2003, 65, on the interplay of biology and culture).

We need to understand and realise that even in computer games, biology and culture are equally important and go hand in hand. As valuable as the affordance concept is for our understanding of computer game play, we need to be careful in our use of it, and avoid *overusing* it. It is quite possible that "virtual affordances" to a large extent are not affordances in the Gibsonian sense, but instead are more rooted in mediated or second-hand knowledge – cultural values and practices – and the experience of having a body, which includes more than visual sensory perception, which Gibson (1986) mainly focused on. There certainly is a great need for more studies that take into account both "sides" of playing activities, e.g., how and what players learn from each other in the process of becoming skilled players. The story certainly does not end here, and we strongly encourage further, interdisciplinary discussions regarding the meaning and use of affordance – even though the great many definitions and uses of affordance may make it seem something of a Herculean task at the moment.

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Notes

1. The phrase is borrowed from Norman (1999).
2. The terms real and virtual affordances are here used merely as a way to distinguish between affordances in the real and the virtual environments, respectively.
3. The dualistic mind-body view, with its focus on internal psychological/cognitive processes, is a basic idea still prevalent, for instance, in mainstream cognitive science and cognitive psychology (Smith & Kosslyn 2007).
4. The confusion on affordance has now become an issue of discussion and clarification (see e.g. Hartson 2003; McGrenere & Ho 2000; Norman 1999).

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