

# DECONSTRUCTION-RECONSTRUCTION OF COMPUTER GAME AND IMMERSIVE ENVIRONMENT SEMIOTICS

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**Abstract.** Computer game technology produces compelling “Immersive Environments” (IEs) where our digitally-native youth play and explore. Players absorb visual, auditory and other *signs* and process these in real time, making rapid choices on how to move through the game-space to experience ‘meaningful play’. How can IEs be designed to elicit perception and understanding of signs? In this paper we explore game design and gameplay from a semiotic perspective, focusing on the creation of meaning for players as they play the game. We propose a theory of game design based on semiotics.

## 1. INTRODUCTION

We have all played games according to *rules*, in a socio-cultural space; marbles in the school playground, playing chess or monopoly where the space was convivial but the rules were motivating. Today the playground remains; there are no marbles, there are ‘gogos’. But the rules remain and are accepted within the play systems of our youth. Outside the playground our youth is playing another sort of game which is establishing a new culture, that of the “Digital Natives”. This culture has transposed space from the outdoor (UK) seasonal climate into an indoor space of human interaction with socio-collaborative opportunities, thanks to the affordances of computer technology. Previous generations of our youth have engaged with organizations such as the UK “scouts” or “brownies”. Our Digital Natives aspire to engage with similar active communities, but these are ‘on-line’ or ‘virtual’. What is going on here? To understand this, we must consider the ontology of computer games and the design processes of those who provide this. We propose that the design of computer games and the ensuing game play should be viewed from several perspectives. The first is ‘games as semiology’; in game play players actively construct meaning. The second is ‘games as rules’, (following traditional game design wisdom), informing the player how to react in the social context of the game. The third is the ‘game mechanics’, technical game affordances, such as textures, objects, characters.

This paper starts from the semiotic perspective and considers how and why players play games (Section 2). A deconstruction of game rules leads to the thesis that ‘classical’ game rules (such as Scrabble or Monopoly) when transferred to computer games, become identified with space (Section 3). A short consideration on the use of the *image* is given in Section 4. In Section 5 we present results of research on how *signs*

within various games influenced player choice. A theory of computer game design based on our findings is presented in Section 6. One IE we have developed based on our theory, for Primary School Mathematics teaching is discussed in Section 7. This paper is accompanied by associated web-pages providing example resources [1].

## 2 THE SEMIOTICS OF COMPUTER GAMES

People play computer games for a *reason*. People watch movies for a *reason*. But these *reasons* are not the same, even though both media are immersive and engulfing. By ‘reason’ we mean a human response to a cognitive, social or individual engagement with a medium. Computer games have been tagged as ‘immersive’, ‘interactional’ where ‘interaction’ has been associated with ‘engagement’. Yet the *reason* for this evident engagement must be understood. Salen and Zimmerman identify the viability of computer games as following from their ability to provide “meaningful play” [2]. This means that the player’s actions produce effects which create meaning, e.g., when a player activates a switch there is a *discernable* result; the door opens. The action also acquires meaning if the action has an affect at a later time in the game; picking up a weapon may slow you down now but it allows you to shoot the monster when it appears later. To create meaningful events and play, the designer should pay attention to the field of semiotics, the study of meaning.

Semiotics emerged from the studies of the linguist de Saussure and fed rapidly into other disciplines such as the anthropology of Levi-Strauss, the social mythology of Barthes, and the philosophy of Derrida. Semiotics concerns how meanings are made based on the concept of a *sign* (or *signifier*) and the *signified*, the object or idea to which it points. In the above example the switch is the *sign* and the *signified* is “opening”. Game semiotics has to be considered from the perspective of the level-designer as well as the player. Currently, game design can be seen as a process of “world building” which Holtzman describes as a process of how using “a system of symbols to represent a view of reality, the artist shares his consciousness of aspects of that reality” [3]. In a 3D computer game such as Half-Life or Unreal Tournament these signs are provided by static meshes, textures, sound, music, animations and other assets. Yet their use alone does not establish a *semiotic system* since it is the player who processes these signs and produces meaning which may extend beyond the artist’s project. Also, while these signs represent the world to the player (and refer to *signifieds* in the real world), they gain their semiotic value from their inter-relationships. This establishes a *semiotic system* as the player plays the game.

A useful definition of semiotics may be found in the work of the American semiotician C.S. Peirce. He defines a sign as “something that stands for something, to somebody in some respect or capacity”. There are four factors which describe a *sign*, these are (i) A sign represents something which is not itself, (ii) A sign must be interpreted, (iii) When a sign is interpreted then meaning is generated, (iv) Interpretation is shaped by context. One of de Saussure’s fundamental insights was that signs carry no absolute meaning, but that meaning is interpreted within a cultural context, such as game experience. When we come across a switch in a computer game and do not know its purpose, flipping the switch once has an immediate effect which produces meaning. It is the job of the level designer to ensure that the sign is placed

within a context or *semiotic system*. This links into the notion of ‘game rules’ which inform viable game play, like the rules of grammar in language. The impact of the cultural context becomes clear when we observe the game-play of our ‘Digital Natives’ (those born into a digital world) compared to ‘Digital Immigrants’, (those who have to learn this world). These native game players expect a semiotic system and instinctively hunt out the signs located in the game.

In computer game design, conventions for the use of signs are beginning to emerge. Spatial cues may be placed to direct the player; non-player characters (NPCs) may be deployed to engage the player providing e.g. instruction; lighting and sounds provide attraction and establish the tempo of game play.

The semiotics of computer games has been studied in detail by David Myers [4]. He points out that game play can be seen as a sequence of significations responding to encountered signs, but where there is a clear relationship between these signs. As a player moves through a level, the experience of encountering a succession of signs creates a context in which the next sign can be interpreted. This process of *recursive contextualization* creates meaning and also grounds the notion of “interactivity” within computer games. A comparison with literature is useful. Here the semiotic process involves a communication of meanings and values through a common language. Computer games do not have this language; game play is a process of discovering meaning which is not expressed in a language based on a grammar, but through a semiotic system. To some extent this liberates the player from the motivating (but restricting) literary experience.

Myers makes an interesting comparison of two ‘game genres’. In ‘action’ games (such as Doom or Unreal Tournament “shoot em up”) the signs are *first-order* or *denotative*. Value and meaning are given to these signs by a direct phenomenological experience of these signs and the patterns which emerge through reading these signs. On the other hand, in ‘adventure’ games such as Zork or Myst, the signification is *connotative* or *second-order*. In these games the player is expected to construct meaningful play by experiencing a stream of information, often presented as textual elements, and to assimilate each sign into a story. This requires much more player effort. Action games provide *oppositional* relationships between signs (the player kills the monster or gets killed) while adventure games provide *contextual* relationships between signs (the player uncovers text fragments which provide the game story). This recursive (and therefore infinite) semiotic process is a good model of how we make sense of the real world when interacting with cultural-specific signs. This aligns with the constructivist understanding of perception which asserts that the concept of an objective representation of reality is an illusion. All we do in the real world is to execute a continuous process of making meaning. Perhaps the real world is therefore, virtual?

### 3 THE ONTOLOGY OF COMPUTER GAMES

In a ‘classical game’ such as Scrabble or Monopoly, the ‘rules’ of the game are printed on the box. Computer game players eschew this box, and rush into the game to discover the rules. Their rules are not explicit; the gamer expects to discover the rules during play. This is especially true of ‘action’ games rather than ‘adventure’ games,

where rules may often have to be stated. The game designer conceives the rules as a set of player actions, and contextualises these within *space* [5]. We propose that the rules of classical games are embodied in the *space* of computer games, which therefore forms a part of its ontology. Yet this is not an *architectural* space but a space where the player's actions take place. The design of such a space may be called "design by verb" which is akin to the architects' manifesto "form follows function".

Having established that *space* is a component of the computer game ontology it remains to consider how to extend such a framework to elicit 'meaningful play'. Space has been addressed by many; from Klee's "The Thinking Eye" [6] to Kevin Lynch's five elements of urban planning [7], *pace*, Einstein. Both Klee and Lynch imply a strata of composition, where 'points', 'lines', 'planes', or 'paths', 'edges', 'districts', 'nodes', and 'landmarks' overlay and interact. Such strata have been formally employed by the architect Bernard Tschumi in his design of "La Villette" [8]. Lynch suggests that urban designers should consider the *narrative* potential of geographical space. He describes city planning as "the deliberate manipulation of the world for sensuous ends". So he creates a link between location and narrative. This is also true of "La Villette" where performances are located in specific areas. Each *stratum* contains, but *between* the *strata* informs. These spatial strata may be usefully overlaid to create a gameplay semiosis. In our theory presented in Section 6 we assert that the ontology of computer games is grounded in space. It is within this grounding that other considerations such as 'game narrative', or principles of game design such as 'non-linearity', 'risk', 'goals', or 'tunneling' should be situated. The technological affordances of the computer game engine (movers, pickups, NPCs) also have to be situated in space. But the final stratum of this ontology is the semiotic level related to space. Our thesis is therefore that computer game ontology consists of strata of geographical space including technical elements of game design, semiotics and perhaps narrative.

To some extent this space shares some characteristics with architectural space. In Architecture, 'player' movement is called *circulation* which is defined by form and space, and to some extent lighting. Computer games also use form and space to define circulation, but make more use of images, music, sound and interactions to guide the player through the underlying semiotic system. Computer game design uses a particular form of circulation called 'tunneling' where the player is led through a series of sub-goals (e.g. challenges) on the way to the final goal (resolution of conflict). We interpret this as engaging with a series of semiotic sub-systems in which the player has to induce meaning in order to progress. Architects create places within space which are pleasant and comfortable. Game designers create places of danger and risk in which the player gains pleasure by overcoming these.

Our suggestion that *space* is a fundamental component of the ontology, without any mention of *time* seems strange in this post-Einsteinian epoch, until we remember the nature of game time. Games are played with a single time-scale, action games run at full speed with little opportunity to pause (except perhaps during cut-scenes). A player who pauses will get shot. Movies make use of variable time-scale (*pace*), fast action sequences are interspersed with moments of discussion. A movie-goer would not tolerate an action movie running from start to end at full speed. One way of creating a perception of a varied time-scale is the use of the "dramatic arc". Here a tension (between conflict and resolution) arises according to the player's uncertainty about the

outcome. Tension at the start of play is low where uncertainty is high. As the game is played this tension rises until the outcome seems inevitable when the tension falls. The player's perception of time tracks this level of dramatic tension. Perceived time may also be directly manipulated by the game designer through a change in the density of the *signs* located in the game. Space does not allow for a full discussion of time within computer games, though we have already alluded to this issue. It has been suggested that the study of cybernetic systems may be useful in adapting gameplay over time [9]. A simple example would be the use of negative feedback in reducing the strength of the opponent when the player is slaughtered too often. We suggest a more radical approach; the use of the theory of self-organizing dynamic systems where the designer crafts systems of objects and interactions to allow the expression of an *emergent* dynamic behaviour. This will be the subject of an imminent publication.

The power of computer games to engage the player is often attributed to their high degree of *interactivity*. While this may seem obvious, there is debate in the literature on the meaning of the word *interactive*. Within our ontology, interactivity emerges as a consequence of the player reading signs and responding to the signifieds. There is a two-way flow of information from the game to the player and from the player into the game. In this way *interactivity* is a consequence of the process of *recursive contextualisation* as mentioned above. It is as much to do with this process as with the mouse and keyboard (which have a limited input value).

#### 4 THE PLACE OF THE IMAGE

As the scientific understanding of the human mind and the human visual system has progressed, so has our understanding of the meaning of the *image*. No longer is an image a pictorial or abstract representation of an *object*. Images have become a process, a part of our daily activities and culture. Moreover, through digital technology they have become an interface between humans and computers which bind that technology to being a human in context *nouveaux*. How has the computer game industry engaged with the image? The historical thrust of the industry has to improve hardware and software to strive for increasing levels of *realism*. Yet high-fidelity realism can detract from player enjoyment. Crawford suggests that enhanced realism may impede communication [10] Perhaps the player feels insufficiently removed from reality to be motivated to play? Or perhaps realism detracts from a semiotic engagement; an inability to read the signs? Here it is important to understand how Digital Natives interact with image-spaces. Burnett notes, "The digital revolution is altering the fabric of research and practice in the sciences, arts and engineering and challenging many conventional wisdoms about the seemingly transparent relationships between images and meaning, mind and thought, as well as culture and identity" [11]. Images no longer need captions to explain, they explain themselves. The communication primacy, traditionally associated to written (or spoken language), and its linguistic baggage, has been overcome. Grammar-less images communicate directly. While there a resulting potential desire to assert the primacy of image over text, this desire must be suppressed, since alternative modalities such as sound and music will then be in turn neglected. A multi-modal semiotics must be embraced. Full circle: why neglect the textual component of communication in computer games?

## 5 MEASUREMENT OF GAME-PLAY SEMIOTICS

Research was performed into how players moved through game levels which included *signs* such as visuals, text and audio (sounds and music). Some 20 students at Worcester University collaborated in this project. We augmented several Unreal Tournament, (UT2004) game levels with invisible ‘locators’ programmed to record players’ location in the game, including a time-stamp, and a screen-shot. We also designed specific levels to factor out semiotic elements such as visuals and audio signs, and to explore inter-relations between these.

There were three phases to these investigations; movement through (i) existing UT2004 game levels, (ii) game levels we designed using an external environment (iii) game levels we designed depicting an internal ‘labyrinthine’ environment. The results of (i) were used to inform the design of (ii) and (iii).

The analysis of data from augmented UT2004 game levels revealed some strong behavioural factors: (i) faced with a left-right choice of movement, most players chose left, (ii) faced with an up-down choice most players chose down, (iii) players were influenced by animated rather than static visuals such as ‘adrenaline capsules’, (iv) players followed explicit dynamic ‘arrow signs’, (v) in external ‘terrain’ levels, players tended to run through valleys rather than climb mountains, (vi) players responded highly to NPCs (and chose to shoot them). These identified factors above were used to create levels where factors were separated ensuring that the synthetic levels did not contain any extraneous signs. These levels were based on a common external environment based on a Japanese Temple theme (Figure 1.)

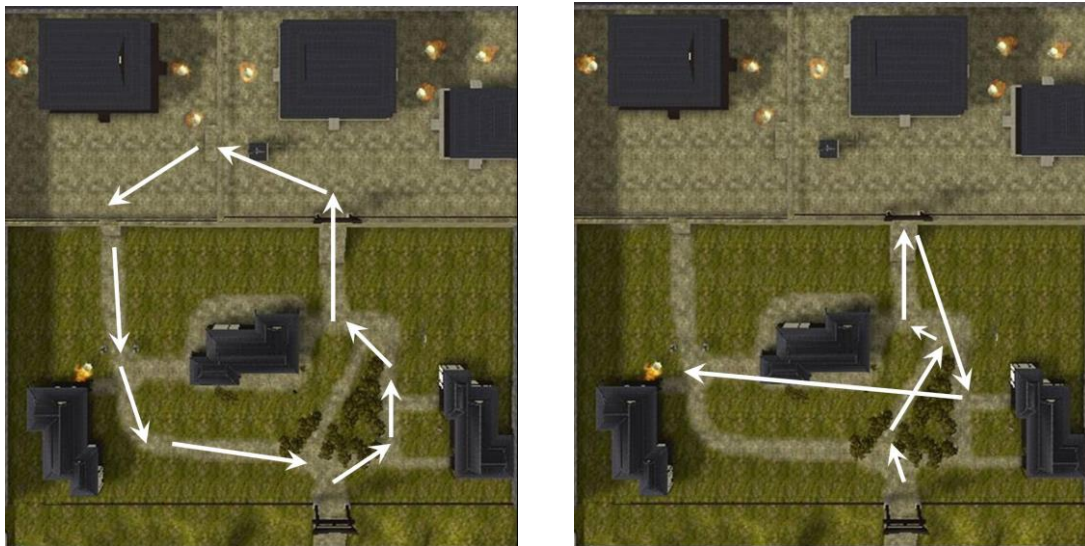


**Figure 1.** Left shows aerial overview of the ‘Fires’ Japanese Temple IE. Right shows the third-person viewpoint of the player

This aerial view shows a division into two spaces. The lower space is a landscape with grass, paths and trees. There are three buildings and a Japanese ‘gate’ providing a clear entry point. The player starts the game below this entry point. The upper space is

flat and is divided into two areas containing buildings and a temple. A number of variant levels were investigated based on this common spatial map. Each variant map was supplemented with different semiotic elements. These were: (i) Localised fires which were intended to attract the player, located at points around the temple, (ii) Generalized fires located at the top-right temple area, (iii) Deployment of objects to attract the player, (iv) Three levels where trees were presented to guide the player, (iv) Iconic semiotics involving signs such as “danger do not enter” or dynamic arrows designed to influence movement, (v) Objects situated in areas within the level.

Analysis of player movement through these levels revealed several general patterns: (i) players were attracted to dynamic textures (such as fires), and some players chose to explore, (ii) players were not attracted to static objects, such as clusters of barrels or a whisky bottle, (iii) players were not influenced by the spatial structures provided by avenues of trees, (iv) players responded well to the dynamic arrows. Interestingly, the analysis showed a significant difference in player movement based on their previous experience with computer games. Game-players exhibited a more structured approach to movement, whereas game novices showed a more random or experiential approach (Figure 2).



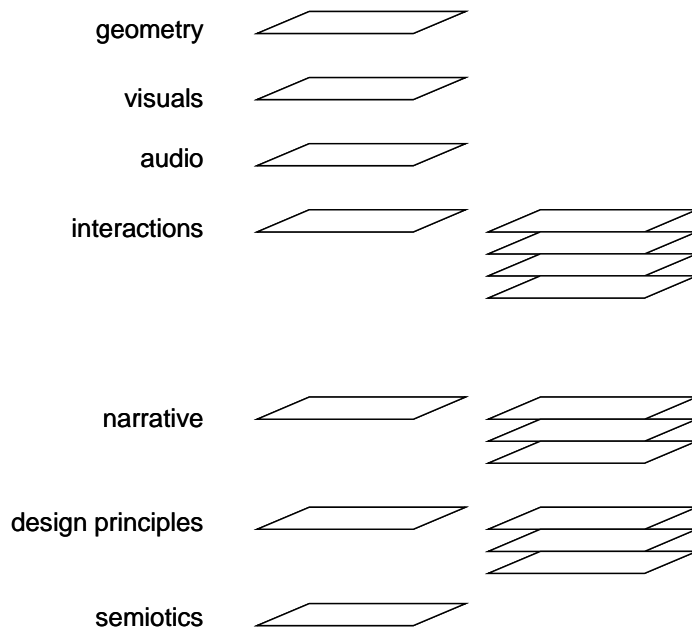
**Figure 2.** Arrows show the circulation of two players through the “Fire” level. The experienced game player (left) makes a systematic exploration of the level while the novice player (right) is immediately attracted to the fire signs.

Players tended to read signs placed in the far field (such as the fires). Once moving they were reluctant to change direction; the signs presented by near-field visuals rushed by like countryside viewed from within a train. Even though the player may think they are moving through the IE, their perception may be one of the IE flowing by. This could explain why players were not attracted by the avenue of trees. Static objects or objects with static textures tended not to attract the player; only dynamic objects or textures worked as signs. In the image-rich IE they required a *difference* to be able to recognize a sign. Analysis of these observations informed the construction of the ‘Labyrinthine’ levels where objects, lighting and audios were introduced. Labyrinths started on the

drawing-board as an 8x8 matrix of interconnected rooms. Interconnections were removed randomly with a change of 1/3. The design of these levels was quite sophisticated involving choices of visuals, objects and sounds. Sounds were associated with rooms (moving into a dark room the player heard a scream, moving into a bright room the player heard laughter). One level labelled each room with Cartesian coordinates, again signs whose meaning had to be discovered. These levels were then offered to players. At the time of writing the primary data is coming in and we look forward to sharing our analysis on the associated web-pages.

## 6 TOWARDS A THEORY OF GAME DESIGN

The starting point for any theory has to be an accepted game ontology, which we suggest starts with *space* as discussed above. Time is bracketed (for the moment). Taking the lead from architects and planners such as Lynch and Tschumi, we propose a number of *strata* which embody game-design principles, approaches to narrative, and the technological affordances of the game engine. Other *strata* include game design principles and, of course semiotics. This is illustrated in Figure 3. There are a number of primary strata: (i) Geometry, (ii) Visuals, (iii) Audio, (iv) Interactions. These refer to the technological affordances of the game engine. Then we have (v) Narrative, (vi) Game design principles, (vii) Semiotics. Various strata have sub-strata. Each stratum is a 2D geographical map of where elements in that stratum, are located within the game.



**Figure 3.** Our proposed computer game ontology: From the top down, four strata of game technology, a narrative stratum, a stratum of computer game design principles and the semiotics stratum. Sub-strata are indicated on the right.

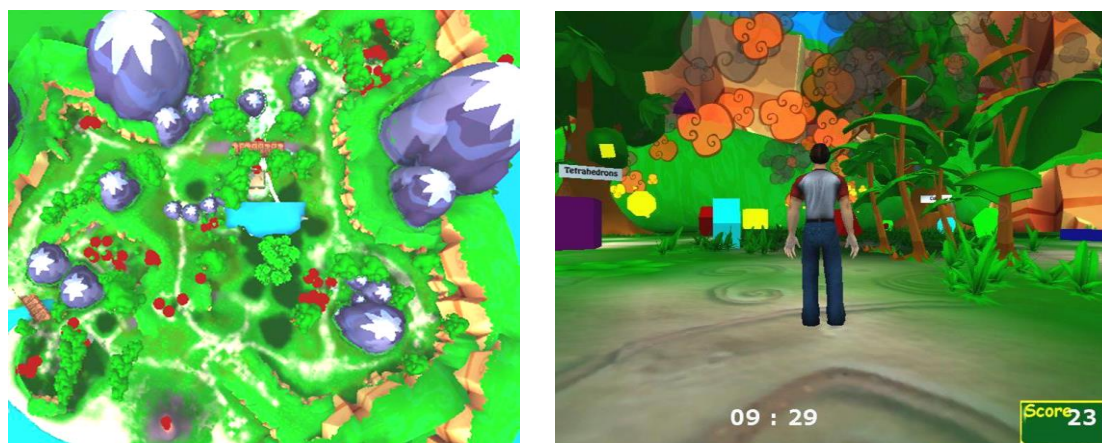
We suggest that the game design process will involve a simultaneous consideration of all strata, e.g., the location of a sound and the associated visual (bird on a tree) is linked to the local geometry (hillside) and the sign (entering a pleasant area devoid of



opposition). This point-location must be brought into association with other geometrical elements, e.g. a line (path along the hillside) and hence into association with the game design (tunneling through challenges). The line then becomes a sign for challenges. This suggests that to achieve a consistent semiotic system, all lines would have to be associated with challenges. The semiotic stratum becomes an *organizer* to provide a game geometry which will support meaningful play.

## 7 CASE STUDY – PRIMARY SCHOOL MATHEMATICS

The results of the analysis presented above and subsequent theory has been applied to the design of an Educational Immersive Environment (EIE) to support the learning of mathematics within the UK Primary School system. We have worked for some time with this school producing EIEs. Our approach is iterative, where teachers critically analyse a series of prototypes which converged to their needs. At each stage of the EIE design process, the strata and their vertical inter-relationships were considered. The semiotic stratum was taken as a focus, to coordinate the other elements of design. The context is a cartoon world where the learner discovers various ‘learning areas’, ‘play areas’, ‘danger areas’ which are indicated by various signs. Through experiencing denotative signs, the learner soon constructs meaningful ‘play’. The EIE is shown in Figure 4.



**Figure 4.** An educational immersive environment for Primary Maths education: Left shows an aerial view showing areas connected by paths situated in a terrain. Right shows a learning area showing consistent textures used on trees, smoke and on the terrain.

The semiotic stratum has been realised in a number of ways. First, all textures have been chosen with a theme of a spiral motif. This is applied to the ground, hills, trees and fires to produce a consistent visual experience with no oppositions. The learning areas are identified by the audio sign of the “Mission Impossible” tune, play areas are signed the tune from the “Magic Roundabout” and forbidden areas are signed by the sound of howling wolves. Connections between areas are signed by the use of worn-down paths (in a contrasting colour). All of these signs induce meaning when they are first experienced. A series of huts is used to teleport (rapidly transfer) the learner between various areas. These huts act as signs for the signified teleportation, again their meaning is learned through experience. The learners discover that trees which start to grow

signify the correct solution to a problem. This high level of semiotic design has produced an EIE which the learners can first genuinely explore to expose the ‘game rules’, and then to use these in a process of enhancing their math skills. But of course, both processes of exploration (fun!) and learning (fun?) occur together. The learner is motivated through a realisation that the EIE contains many signs and signifieds which are there to be discovered. It is clear that a correctly designed game ontology based on a strong semiotic system is able to motivate the learner and to provide fun implicitly, without resorting to an artificial ‘fun’ design element.

## 8 FINALE: A GENERATIVE SEMIOTIC SYSTEM

While playing a computer game, the player moves relentlessly through the game level engaging with an underlying semiotic system without realising it exists. The player experiences a phenomenological momentum: go forward means go forward... ‘go forward!’. Some visuals ‘flow by’; others are seen and interpreted as signs. These signs generate meaning and so inform the next action, ‘What to do next?’ Meaningful play ensues. On the one hand the game designer develops the semiotic game stratum, on the other, in game-play, this is deconstructed by the player who must learn the semiotics step by step, and perhaps even challenge it (through the use of ‘cheats’). Reconstruction is obtained when the player has learned the rules and feels confident to play the game *for its own sake*. The semiotic system is realised. Meaningful play ensues. The player has fun. Enormous and *significant* fun!

## 9 ACKNOWLEDGEMENTS

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### References

- [1] Supporting web-pages at [http://www.worc.ac.uk/departs/bm\\_it/colin/Resources/EVA2009/index.htm](http://www.worc.ac.uk/departs/bm_it/colin/Resources/EVA2009/index.htm)
- [2] SALEN, S and Zimmerman, E: *Rules of Play*. 2000 MIT Press
- [3] HOLTZMAN, S: *Digital Mantras: The Languages of Abstract and Virtual Worlds*. 1994 MIT Press
- [4] MYERS, D: *The Nature of Computer Games* 2003 Peter Lang
- [5] TOTTEN, C,W: *Game Design and Architecture* (Master of Architecture thesis, Catholic University of America, Washington DC) 2008
- [6] KLEE, P: *The Thinking Eye* 1961 London Percy Lund.
- [7] LYNCH, K: *The Image of the City* 1960 London MIT Press
- [8] TSCHUMI, B: <http://www.tschumi.com/>
- [9] SALEN, S and Zimmerman, E: *Rules of Play*. 2000 MIT Press
- [10] CRAWFORD, C: *Chris Crawford on Game Design* 2003 New Riders.
- [11] BURNETT, R: *How Images Think* 2005 MIT Press (page xv)