

# **Engaging Photorealistic VR: An Aesthetic Process of Interaction**

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## *Abstract*

This thesis investigates the potential of aesthetics in the design of Human-Computer Interactions (HCI). In particular, it aims to provide a means by which aesthetics can be applied in photorealistic virtual reality (VR) to create ‘engaging’ experiences. Indeed, the author of this thesis suggests that much can be gained from looking at the aesthetics of *photorealistic* VR content as opposed to the more traditional HCI approaches that have primarily focused on the performance and efficiency issues of the technology. The thesis is motivated by the very notion that the aesthetic potential of photorealistic VR content is, and continues to be, underestimated whilst the emphasis on the development of newer and more efficient visualisation technologies to create engaging VR experiences increases. Challenging this, the research is firmly based on the premise that the aesthetic content of photorealistic VR environments holds at least as many possibilities for the creation of more complete and ‘engaging’ experiences.

To explore this, the thesis describes the *aesthetic-interaction* as a new type of interaction that focuses primarily on how one aesthetically interacts with an interface (as opposed to how one cognitively interacts with interface metaphors to activate certain aspects of its functionality). By concentrating on the design and the aesthetic content of photorealistic VR, more so than the building and enhancing of its functional capabilities, the research aims to probe how the user might be sensually attracted and aroused into the sharing of information and hence the creation of new and ‘engaging’ experiences. In particular, this thesis examines the role of narrative in VR and from this, moves to the visual-narrative which for centuries has employed the use of aesthetics to ‘engage’ the spectator in its process of storytelling. Integrating traits of the VR medium and the visual-narrative, the author develops a visual-narrative structure which is used to elicit a number of design requirements specifically for photorealistic VR. From this, a visual-narrative model is developed, and in a second study, it is demonstrated that the photorealistic VR environments designed with the visual-narrative model can, indeed, create more ‘engaging’ experiences.

In summary, this research provides a means by which the aesthetics of photorealistic VR (or other HCI technologies) might be strategically patterned and applied to the creation of various different types of ‘engaging’ experiences. By describing the *aesthetic-interaction* and how it can be articulated through a visual-narrative model, the research not only successfully highlights the experiential side of photorealistic VR, but also advances the new ‘design’ drive of HCI.

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# I: INTRODUCTION

## 1.1 Summary of Research

*‘The user-interface is the point of contact where humans and machines meet in order for exchange to take place. It can take many forms. It is at the interface... that the structures of the simulation designed for communication meet up with the human senses. Thus, the interface in virtual reality functions pervasively as the key to the digital artwork [design] and moulds both the perception and the dimensions of the interaction’* (Grau, 2003b, p.198)

In virtual reality and especially in photorealistic VR, the interface is the key to the experience. It is what provides us with a visual display that is as close as possible to a real-life context and an environment that can be explored in a similar way that one would the real world. However, in order to make this interface accurate and ‘engaging’, a huge emphasis is currently being placed on the technology and in trying to come up with the newest, fastest and most efficient technologies to capture, store and display the ‘real’ visual data. This thesis, itself, has emerged from the BENOGO project which centred on the development of a new image based rendering (IBR) technology to create more realistic VR experiences (see Chapter 3). Yet, in the midst of all this technological development, the author of this thesis believes that the VR content and its potential for ‘engagement’ has been underestimated.<sup>1</sup> In fact, what seems to be emerging in more recent years, is not so much the desire to achieve realistic representations but the desire to create believable and convincing environments (Roussou & Drettakis, 2003, line 35). Already, in mainstream HCI design, aesthetics has started to play a more important role (see Chapter 2). However

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<sup>1</sup> This statement is very much concerned with the visual aesthetic and photorealistic VR environments within the field of HCI. The author of this thesis acknowledges that there is currently a lot of research being executed in 3D gaming environments (see Chapter 2) as well as the field of virtual storytelling (see Chapter 3).

as this thesis will highlight, very little of this has yet filtered across into the design of the photorealistic VR environment. Consequently, the author of this thesis will see fit to draw from and then expand on the experiential developments of HCI in order to explore and develop the aesthetic potential of photorealistic VR environments. The overall aim of this thesis is therefore to illustrate how the *strategic patterning* of the aesthetic elements (particularly colour) in the photorealistic VR environment can make for a more ‘engaging’ VR experience.<sup>2</sup>

Indeed, an important criterion for evaluating this work will be obtained when ‘*emotion, association and intuition – which are the main ingredients of art – being [are] successfully simulated by digital subjects*’ (Dietrich, 1985, p.3) in order to create ‘engaging’ photorealistic VR environments and hence ‘engaging’ human-computer interactions. To achieve this, the author will introduce the concept of the *aesthetic-interaction*, which refers to the use of aesthetics in the design of the interface to sensually attract and arouse the user into the sharing of information and hence the creation of an ‘engaged interaction’. An ‘engaged interaction’ implies all that occurs between the interface and the users’ feelings, past experiences, memories, and knowledge that has the power to manipulate the perceptions of the user to create new thoughts and feelings about the interface (see Chapter 2). To articulate this in the design of the photorealistic VR interface, a visual-narrative model will be proposed (see Chapter 4). As we shall see, this model is a three tiered structure that is used to strategically pattern the aesthetic elements into a narrative framework in order to create ‘engaging’ VR experiences.

The terms engagement and ‘engaging’ will be used quite frequently through this thesis and will be used to convey quite distinct concepts. In fact, the quotation marks used above are used intentionally by the author to emphasise an important difference in meaning between the terms engagement and ‘engaging’. Engagement (without quotations) embraces the more widely used definition of the term (i.e. the act of being involved or drawn in) whilst the quoted version is closely connected to the author’s idea of the ‘engaged interaction’ and hence the *aesthetic-interaction*. The term engagement (without quotations) is primarily used in this thesis to describe the middle section of the visual-narrative model, which will explore the ways in which users can become more involved in the photorealistic VR environments. This idea of engagement in conjunction with the use of aesthetic elements and strategic patterns (i.e. what makes up the visual-narrative model) are what the

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<sup>2</sup> *Strategic patterning* is a term used by the author to describe the careful and considered organisation and arrangement of aesthetic elements in a photorealistic VR environment. As the following chapters will show, the visual-narrative model is introduced by the author as a means to execute this *strategic patterning* and in doing so to create ‘engaging’ VR environments.

author believes can create ‘engaging’ photorealistic VR experiences. Therefore, the term ‘engaging’ is envisioned by the author to describe a more holistic experience where the user not only becomes involved and drawn into photorealistic VR environments, but also as a result of this involvement, creates new thoughts, feelings and impressions about these environments. Indeed, aesthetics – which are at the heart of this experience – is about perceptual integration, participation and continuity (see Chapter 2); it is about the creation of a heightened, meaningful, and fulfilling experience which the author marries into one ‘engaging’ experience. Described by Dewey (1934) as transformational (see Chapter 2), it is where the user is no longer a passive spectator but instead an active and perceptually hardworking participant in control of their own ‘engaging’ experiences.

As the findings of this research will demonstrate, the majority of the users who experienced the visual-narrative environment (i.e. the photorealistic VR environment designed with the visual-narrative model), did in fact, find it more ‘engaging’ than the non visual-narrative environment. In conclusion, as the following chapters will illustrate, the aim of this research is to promote the potential of aesthetics and particularly the idea of an *aesthetic-interaction* not only in the design of ‘engaging’ photorealistic VR but also within the wider field of HCI.

## 1.2 Subject area

This thesis focuses on photorealistic VR design, which the author envisions to fit comfortably into the current HCI movement as it combines areas of computing, literature, art and design (see Chapter 2). The goal is to probe the experiential side of photorealistic VR technology and to explore ‘*what technologies themselves (perhaps unintentionally) express and how they ought to be reconceived*’ (Mitchell et al., 2003, line 35). This thesis is concerned with the aesthetic, particularly an aesthetic process of interaction (i.e. *aesthetic-interaction*) which, when articulated through a visual-narrative model, encourages participants to be attracted to certain aesthetic objects in the photorealistic VR environment and, in doing so, to go on to form ‘engaging’ narrative experiences.

As mentioned, the work presented in this thesis emerged from the BENOGO project (2002-2005) which was part of a European Union initiative for researching ‘Presence’ (see Chapter 3). The main focus of BENOGO was on developing new photorealistic VR technology, which aimed to create a ‘sense of presence’ in VR environments using true-to-life visual and auditorial sensory information presented in real-time. Continuing on, the research presented in this thesis will take a different stance in that it asks what these

technologies themselves express and can express. Thus, instead of developing new technological VR possibilities, this work will aim to explore existing photorealistic VR technologies and to investigate how their content (particularly their aesthetic content) can be strategically patterned to create ‘engaging’ experiences. Unlike the main BENOGO ideology, this thesis focuses on the potential of the aesthetic to create ‘engagement’ in VR environments. As Mitchell et al. (2003, line 330) say ‘*an art and design perspective introduces a cultural awareness that is essential in the development of devices that not only are functional but also contribute to the quality of life in a less direct, but often more profound, way*’. This thesis is concerned with building the aesthetic profile of photorealistic VR development; it is keen to illustrate the individual power of the aesthetic and, in addition, ask how it might match and work within the technological developments of VR.

### 1.3 The Research Question

As Hoskin (2003, line 4) subtly questions: is VR more associated with the science than the art, more concerned with achieving that sense of illusion and realism than the aesthetic? <sup>3</sup> In terms of HCI design, the author of this thesis feels that VR requires a balanced combination of both science *and* art, and that aesthetics can play as important a role in photorealistic VR design as the building of illusion and realism. In fact, to counteract the general fixation on the science of VR (how does it work? how do we make it work more efficiently? etc.), this thesis will introduce the *aesthetic-interaction* and in doing so, will explore how this can be articulated to create more ‘engaging’ photorealistic VR experiences.

To initiate this, the research will look specifically to the experiential side of existing photorealistic VR environments (i.e. it will investigate the aesthetic as well as the current role of narrative in these VR environments). From this, it will move towards the visual-narrative and examine how this, for centuries, has incorporated aesthetics in its storytelling process. Teasing out a possible relationship between the visual-narrative and the VR medium, the research will propose a theoretical visual-narrative structure which in turn, will elicit two main studies – Study A and Study B. Study A will use this structure to probe existing photorealistic VR environments, it will examine what attracts participants attention in these environments, what enhances their engagement and then what might encourage

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<sup>3</sup> Hoskin (2003) opens his review of Grau’s *Virtual Art: From Illusion to Immersion* (2003), with the probing statement ‘*Virtual Art is less the work of art history and aesthetics (that context remains to be written), and (according to Joel Slayton in the foreword), more a history of illusion and realism*’

them to link things together to form stories. Its main objectives will be to identify a number of design requirements (specific to photorealistic VR) which can then be used in the design of the visual-narrative model. Study B, meanwhile, aims to test whether or not the integration of the refined visual-narrative model into the design of a photorealistic virtual environment increases ‘engagement’. It will achieve this by performing a standard comparative study to show that participants in the visual-narrative environment are more ‘engaged’ than the non visual-narrative environment. In confirming this, the research will demonstrate the strength of the aesthetic in the design of ‘engaging’ photorealistic VR and in effect, its overall findings will show that:

- A photorealistic VR environment designed with a visual-narrative model is more ‘engaging’ than a non visual-narrative photorealistic VR environment.
- A visual-narrative model can be used to strategically pattern aesthetic elements in a photorealistic VR environment to entice *aesthetic-interactions* and hence the creation of a narrative.
- *Aesthetic-interaction* is a new type of interaction that encourages ‘engagement’ and in doing so contributes to the further development of the experiential possibilities of HCI design.

## 1.4 Thesis Outline

Nearly forty years since its conception, the medium of VR is still an enigma. In many ways, it is a medium which is still spineless (i.e. structureless) in that it still lacks its own uniform language.<sup>4</sup> As mentioned, VR, and particularly photorealistic VR, is a medium that is so occupied in developing its technological capabilities that its other hidden strengths are often neglected. The research presented here is therefore interested in building a more holistic understanding of the ‘language’ of VR, and aims to look beyond the technological in order to explore the creative and experiential side of VR. The goal of the thesis is therefore not only to cross fertilise the fields of aesthetics and HCI, but on a more detailed level, to cross fertilise the areas of photorealistic virtual reality, narrative, and aesthetics. Through the development and testing of the *aesthetic-interaction* and the visual-narrative model, the following chapters will aim to convince the reader that aesthetics, and

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<sup>4</sup> In the early nineties, it was noted that VR still hadn’t mastered its own language (Bates, 1991, p.3) (Sherman & Craig, 1995, p.3) and today, the author of this thesis still feels that more work needs to be done before VR can be said to have its own universal set of rules.

particularly colour, holds huge potential for the creation of ‘engaging’ photorealistic VR experiences.

In the next chapter, the scene of this thesis will be set by highlighting the growing importance of aesthetics within the field of HCI. The chapter will commence by presenting a brief investigative review of recent literature on aesthetics and in doing so, will attempt to articulate what exactly is meant by the “aesthetic experience”. In conjunction with this, the chapter will also explore the development of HCI and will show how, in recent years, it has identified the need to branch out more towards the design of experiences. As is illustrated in the concluding sections, the chapter will interweave these two fields of HCI and aesthetics by introducing a new type of interaction called an *aesthetic-interaction*. The main purpose of the chapter is to therefore promote the concept of an *aesthetic-interaction* as an aesthetic process of interaction which, when articulated, seeks to create more ‘engaging’ experiences.

Chapter 3 will continue the train of thought introduced in Chapter 2 by looking specifically at the aesthetic potential of photorealistic VR environments for ‘engaging’ its users. To do this, the chapter will examine some recent research on engagement in VR environments. In particular, it will look at the role of narrative and will explore how traditional literary narrative structures are currently applied to VR developments in order to engage its users in story making (i.e. how older semiotic techniques have directly influenced the design of current narratives in VR). To take this forward, the chapter will promote the aesthetic possibilities for the development of the narrative in VR. It will compare the semiotic sign and the aesthetic object, and in doing so, will support the aesthetic process of interaction and the aesthetic object as a means of broadening the narrative experience and the creation of ‘engagement’ in VR.

Next, Chapter 4 will move from the role of narrative in VR to look specifically at the visual-narrative. Simply put, the visual-narrative can be defined as pictures that tell a story. It is of particular interest to this research in that the visual-narrative has, for centuries, employed the use of aesthetics to ‘engage’ spectators in a storytelling process. In detail, the chapter will discuss the idea of aesthetic reading by looking specifically at the visual grammar and the use of colour in a carefully planned composition. By exploring a brief history of the visual-narrative from prehistoric cave paintings to modern day interactive technologies, the aim will be to identify how the aesthetic has been strategically patterned through history in order to tell a story. The overriding goal will be to identify techniques that could be transferred across to the design of a visual-narrative in photorealistic VR. The chapter will aim to illustrate the idea that *aesthetic-interaction*, when structured and then

articulated through a visual-narrative, has the necessary power to ‘engage’ users in a certain VR experience.

Chapter 5 then will act as a bridge between the preceding chapters and those yet to be read (i.e. Chapters 6 & 7). It will do this by starting to put the thoughts of the ‘*aesthetic-interaction*’, ‘photorealistic VR’ and the ‘visual-narrative’ into practice. To succeed, the presented research will move beyond the BENOGO environments and will consider a more ‘narrative’ inclined VR environment. To do this the author will choose an interior sitting-room environment. From the literature reviews, the author will then devise a visual-narrative structure which will disclose a design process for the further design of this *sitting-room* environment (i.e. the visual-narrative environment). The final section of this chapter will discuss the appropriate methodologies for gathering and analysing data and in doing so, will set the scene for the following chapters and the evolution of the visual-narrative model and the ‘engaging’ visual-narrative environment.

Chapter 6 will focus primarily on Study A; this study will use the theoretical visual-narrative structure on existing photorealistic VR environments in order to tease out a set of design requirements that in turn will be used to refine the visual-narrative model. In detail, Study A will consist of three interrelated parts and will look at what attracts people’s attention in photorealistic VR environments, it will examine how these can be enhanced to further engage people in the photorealistic VR environment and then entice them into the creation of a narrative. The findings from Study A will be integrated into the visual-narrative model to support the design of ‘engaging’ photorealistic VR environments.

In Chapter 7 the revised visual-narrative model will be utilised in the design of an ‘engaging’ visual-narrative environment. The aim of this chapter will be to demonstrate how a visual-narrative environment (where people aesthetically interact with the content) can be more ‘engaging’ than a non visual-narrative environment. To do this, the chapter will present Study B, an empirical study, which aims to determine whether the majority of participants in the visual-narrative environment find it more ‘engaging’ and enjoyable than in the non visual-narrative environment. The results from Study B will support the argument that the experiential side of photorealistic VR design, particularly its aesthetics, can provide a feasible means for creating ‘engaging’ VR experiences.

Finally, Chapter 8 will draw together the thoughts and findings from the previous chapters. It will conclude that colour has the potential to create ‘engaging’ photorealistic VR experiences, and that an aesthetic process of interaction when articulated in the form of a visual-narrative, can successfully ‘engage’ participants in specific feelings and thoughts in VR environments. In addition, this chapter will also contain a number of suggestions for

further research, particularly those regarding the development and application of the proposed model to other areas of human-computer interaction.

## 2: AESTHETIC- INTERACTION

For several years (from roughly 1982 to 1995) the fields of aesthetics and human-computer interaction design were perceived to be quite separate.<sup>5</sup> Indeed, the older discipline of aesthetics was seen to be very much located within philosophy and the arts, while the younger HCI was seen to be dominated by usability and efficiency considerations. However, in more recent years (early 2000 to the present day) voices in support of the importance of aesthetics in HCI have started to emerge (Tractinsky, 2004, p.11-20).<sup>6</sup> In fact, it has become clearly apparent that as technologies develop, so too does the experience of *'the beautiful, the ugly, the sublime and the elegant; of taste, criticism, and fine art; and of contemplation, sensuous enjoyment and charm'* (Scruton & Munro, 2003, p.1). And, as designers are now realising, there is more to computers than efficiency and performance issues; they are now recognising that *how* we experience computers is just as important. We have reached a stage in HCI design where, in order to move forward (i.e. to develop and improve new technologies), we need to take a more holistic approach to HCI design by considering the overall experiences that these technologies create.

The goal of this chapter is twofold. First, it aims to make sense of, and then build a robust and comprehensive understanding of, today's aesthetic experience. Secondly, it intends to highlight the potential of aesthetics for HCI and particularly the design of photorealistic VR environments. To achieve this, the chapter will explore an

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<sup>5</sup> In 1982 HCI emerged as a discipline and in 1995 Kurosu and Kashimura were amongst the first to look at aesthetics in HCI, they did a study exploring the relationship between user's perceptions of interface aesthetics and usability. The results show high correlations between perceived aesthetics of the interface and a priori perceived ease of use of the system (Tractinsky, 2004, p.11-20).

<sup>6</sup> In fact, a new area of study *Aesthetic Computing* has emerged which looks specifically to the application of theory and practice of art to the field of computing (Fishwick, 2006, p.6).

interdisciplinary approach to defining the term “aesthetic experience”. Following that, it will discuss the history of Human Computer Interaction in tandem with its recent interest in design. In fact, by discussing these recent ‘design’ developments in HCI, the chapter aims to demonstrate an increasing overlap within the current field of aesthetics and HCI. It aims to highlight a need within HCI to open out and to start considering the creation of ‘experiences’ while at the same time, to promote the potential of aesthetics in HCI research to create these experiences. The final section evolves from this overlap by introducing *aesthetic-interaction* as a new type of interaction which embodies the idea of creating an ‘engaged interaction’ and ‘engaging’ experiences.

## 2.1 Aesthetics as it exists today

The fact that aesthetics has had a long and flowery history might suggest that it has had ample time for self definition, yet in truth, *‘aesthetics has struggled to establish itself and its subject matter, its material and its methodology, its proper problems and its structure, its order of working and its order of work’* (Berleant, 1991, p.1). It is quite a perplexing phenomenon: when we take a general overview of the subject, we see that the concept firmly belongs within the field of philosophy, though at the same time, it has strongly defined ties within the fields of art (i.e. visual aesthetics), anthropology (i.e. aesthetic realism) and psychology (i.e. aesthetic perception). So much so, aesthetics seems to take on many variations of meaning (and purposes) depending on what respective field (i.e. philosophy, art, anthropology, psychology etc.) is being investigated. In addition to this, there are also more and more new technologies emerging which are enabling us to combine and blend aspects of these different disciplines to create an even newer aesthetic and meaning. Therefore, it is becoming increasingly important to devise a complete yet interdisciplinary way of understanding the ‘aesthetic experience’. As this section discusses, the field of aesthetics needs to consider broadening its boundaries, it needs to join forces and evolve as a combined entity to meet the demands of today’s changing world.

### 2.1.1 Pragmatic Aesthetics

This research is particularly interested in a vein of aesthetics called *Pragmatic Aesthetics* which originally emerged in the late 1800s in North America.<sup>7</sup> Its main drive was to bring theory closer to the experience of art and in implementing this it caused traditional

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<sup>7</sup> It was part of the philosophical movement of Pragmatism.

questions about aesthetics *'to shift to the idea of experience...'* (Berleant, 1991, P.10). It was a movement that began with Dewey, for whom all art is the result of the interaction between the living organism and its environment: *'every experience is the result of interaction between a live creature and some aspect of the world in which he lives'* (1934, p. 45). It was an integration of both the body and the mind – an aim to *'serve the whole creature in his unified vitality'* (Shusterman, 1992, p.7). Indeed, Dewey firmly believed that a person must engage their feelings and energies as well as their physiological sensory responses in order to appreciate art: *'to see, to perceive, is more than to recognise. It does not identify something present in terms of a past disconnected from it. The past is carried into the present so as to expand and deepen the content of the latter'* (Dewey, 1934, p. 12). In his book *Art as Experience*, he describes the experience as *'the result, the sign and the reward of that interaction of organism and environment which when it is carried to the full is a transformation'* (Dewey, 1934, p. 22).



Fig. 1: A Representation of Berleant's 'Aesthetic Engagement'

In more recent times, the philosopher Berleant follows a similar train of thought when he discusses aesthetics with a strong emphasis on engagement: *'one's active and constructive activity and participation in which an object or environment invites him'* (Rantala, 1999, p.2). This 'aesthetic engagement', he believes, joins the object and the appreciator into perceptual unity. In *Art and Engagement*, Berleant talks about three related characteristics of aesthetic engagement: continuity, perceptual integration and participation (see fig. 1). He promotes the idea that art and other individual and cultural experiences are intertwined and cannot be separated (i.e. continuity). He believes that aesthetic engagement joins the senses and creates further meaning (i.e. perceptual integration) as well as bringing together the sensory, conscious, physical, social sharing and integration of both the perceiver and the object in the aesthetic situation (i.e. participation). For Berleant

(1991, p.26): *'artists have been forcing us to realise that entering the world of art requires the active engagement of the total person and not just a subjective cast of mind'*.

Furthering that, he also feels that new technologies are not only influencing the way that we make art and design, but they are also having an effect on how we engage with and appreciate the arts, and the way that we understand art and design (Berleant,1991).<sup>8</sup> It seems that *'not only have contemporary arts vastly extended the range of the traditional aesthetic senses and objects, they have also drawn on sensory capacities never before allowed or at least recognised'* (Berleant, 1991, p.38). As previously mentioned, new technologies are enabling us to combine a variety of diverse disciplines in the creation of new and exciting designs and as a result the aesthetics of today is not just a pure discipline of philosophy, instead, it is also becoming an interdisciplinary field of inquiry.<sup>9</sup> Aesthetics has reached a stage where it must examine the changing artistic media and practices and, in doing so, consider how best to respond to them. As artists, technologists and designers of today, it is necessary to open the boundaries of traditional aesthetics and then to recast *'aesthetics into a unified theory that reflects the continuity, perceptual integration and engagement of our new encounters'* (Berleant, 1991, p. 31). In the next section of this chapter, the author will argue that an interdisciplinary approach to aesthetics will help form a greater understanding of the concept as we know it today.

## 2.1.2 Aesthetic Experience

Like *aesthetics*, the term *aesthetic experience* also lacks a universal meaning among philosophers. In fact, definitions for aesthetic experience are *'so various and make such diverse claims that it is difficult to find any clear defining characteristic of it or any single feature that is shared by all its descriptions'* (Collinson, 1992, p.111). To address this, the following section will employ an interdisciplinary approach to defining the term. This approach will draw from the pragmatist theory of aesthetics as well as from aesthetic psychology and the visual arts. The main drive of the argument in this section is to use our varied knowledge of aesthetics (i.e. from philosophy, psychology and the arts) as a means of building a more comprehensive and robust understanding of the aesthetic experience.

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<sup>8</sup> The author will tend to use the terms art and design interchangeably within this thesis. Even though art and design are two totally different entities, the author sees the theories of art being very relevant to the creation of design. As Vihma (1995, p.157) says with reference to her own work *'I have used theories from studies of works of art. I see no hindrance to their application in an analysis of design products. On the contrary, analyses of works of art are thorough and delicate and thus useful for design purposes'*

<sup>9</sup> Is it purely a branch of philosophy? Or is it an interdisciplinary field of enquiry? Gaskell (n.d.) argues that it is both

Leath (1996, line 1) describes an aesthetic experience as a *'pleasurable and desirable experience.'* He says that *'among all people, at any time, the aesthetic experience involves concentration on some aspect of the environment'* (Leath, 1996, line 5). Dewey sees it as the interaction between the subject and the object, the idea of 'engaged interaction' as opposed to passive reaction (Weddington, 2004, p.120). It is about *'what the viewer brings to the experience as well as what the viewer can discover about the fixed meanings embedded in the work of art'* (Fairchild, 1991, p.273). As Weddington (2004, p.121) says (in reference to Dewey) *'we should never think of the aesthetic in terms of a reaction to some stimuli but rather as an interpenetration of energies shared between subject and object.'* Dewey (1934, p.309) himself goes on to say that when art is being experienced *'actuality and possibility or ideality, the new and the old, objective material and personal response, the individual and the universal, surface and depth, sense and meaning, are integrated in an experience in which they are all transfigured from the significance that belongs to them when isolated in reflection.'* It is an experience which *'is guided by an intense focus, strong emotions and active reflection and results in stored knowledge within our cognitive framework'* (Aylor, 2002, p.1). Berleant calls this a participatory engagement in the appreciation of art (i.e. art entices us into intimate participation in its workings) and in doing so it joins the perceiver and the object into a perceptual unity. He sees this perceptual unity as being conditioned by cultural and personal influences and it is a unifying component of the aesthetic field (Berleant, 1991).

In *The Aesthetics of Environment*, Berleant makes the point that all aesthetics is in some sense applied. He describes *'the fine arts – with which aesthetics has traditionally been associated – have always had practical components: something has been made, it has various effects and it may be useful'* (Berleant, 1992, p.xii). From a psychological standpoint *'sensation is the datum of the aesthetic experience, the first thing there, while its power to express depends upon a further process which links up with thoughts and feelings'* (Parker, 2003, line 117). For example, when a person first looks at a painting he-or-she is attracted to various colours which then embody further meanings and feelings. Csikszentmihalyi & Robinson (1990, p.18) describe the aesthetic experience as *'when information coming from the artwork interacts with information already stored in the users mind. The result of this conjunction might be a sudden expansion, recombination or ordering of previously accumulated information, which in turn produces a variety of emotions such as delight, joy, or awe.'* Collinson (1992, p.112) says an *'aesthetic experience is grounded or has its beginnings in sense experience'*. She argues that through its forms, lines, colours, spaces, and textures, we come to the aesthetic experience of a work of art. As Shusterman (1992, p.50) highlights: *'they [i.e. its forms, lines, colours, spaces, and textures] are not simply external causal conditions of the consummatory end of aesthetic experience; they are integral ingredients of it'*. Collinson points

out that it is the *grouping* of these art elements that establishes the distinctive character for the aesthetic experience. It is these arrangements of the elements that causes a connection between *'the art object and the stored visual images, personal feeling, past experiences, or formal knowledge of the spectator'* (Csikszentmihalyi & Robinson, 1990, p.34).

From a visual perspective *'aesthetics is not an abstract concept but a process in which we examine a number of (media) elements such as lighting and picture composition and our perceptual reactions to them'* (Zettl, 1999, p.4). In *Sight, Sound and Motion – Applied Media Aesthetics*, Zettl describes applied aesthetics as the branch of aesthetics that deals with sense perceptions and he shows how we can influence aesthetic experiences through fundamental image elements such as colour, light, space, time, motion and sound. He believes that *'visual aesthetics influences the understanding of the viewer through manipulating their perceptions and intensifying and interpreting events'* (cited in Hoffman & Krauss, 2002, p. 207). In fact, he is not the only one, there has been quite a lot of research that has looked to the role of lighting in VR (particularly the 3D game environments) as a way of directing the users gaze to important areas as well as evoking certain moods and emotions. In their research, Seif El-Nasr et al. (2006) believe *'an understanding of the ways in which illumination supports play and adapts to participants' needs as they engage in virtual space, narrative, and play activities will open the door to new game experiences'* (Seif el-Nasr, 2006, line 311). In this thesis, the interest lies in colour and how it might be used to influence participant's feelings and thoughts to 'engage' them in the photorealistic VR environment. Indeed, like in the design of 3D game environments where *'a better understanding of the uses of colours would improve the game experience...'* (Zammitto, 2005, p.1-14), the author feels that colour can also be used to improve the design of the photorealistic experience. However, as Knoppel (2005, p.1) notes the 'good' use of colour in visual interface design is often underestimated, therefore, the aim of this research will be to explore the full potential and strength of colour to trigger powerful aesthetic experiences in VR environments.

In summary, from a philosophical perspective, the aesthetic experience can be seen as an enriching experience resulting from an 'engaged interaction' between the spectator and the artwork, where the artwork entices the spectator into further thoughts and feelings. From a psychological perspective, the 'engaged interaction' occurs initially through the senses when the information of the artwork combines and interacts with the information (i.e. knowledge, experience, memories etc) of the spectator to create new and exciting meanings. From a visual perspective, meanwhile, we can initiate the 'engaged interaction' and hence the aesthetic experience through the use and groupings of different art elements (i.e. colour). The aesthetic experience *'not only involves perceptual awareness but also to varying degrees judgement, imagination, thought, interest, pleasure and dissatisfaction'* (Friday,

2002, p.25). It is an enriching experience that results from the specific use and grouping of certain art elements which sensually attract and arouse the spectator into the sharing of the information between the artwork and the spectator. It is this 'engaged interaction' between the artwork and the spectator's past experiences, memories, knowledge etc. that has the power to manipulate the perceptions of the spectator and create new thoughts and feelings.

### ***2.1.2.1 The Environmental Aesthetic Experience***

This discussion of aesthetics has so far been very much centred on the appreciation of art and the artefact. However, recent research has shown that much of our aesthetic experience also encompasses nature.<sup>10</sup> For example, a beautiful rustic red landscape has always had the potential to 'engage' our senses just as much as a painting or film. However, it was only in the second half of the twentieth century that people began to realise this and, as a result, a new area of aesthetics called *environmental aesthetics* has emerged.

Environmental aesthetics can be described as extending '*beyond the narrow confines of the art world and beyond the appreciation of works of art to the aesthetic appreciation of human-influenced and human-constructed as well as natural environments*' (Carlson, 2002a, line 7). It is about appreciating environments, and it takes on board the fact that when we appreciate these environments, we are immersed within the object of our appreciation: '*if we move, we move within the object of our appreciation and thereby change our relationship to it and at the same time change the object itself*' (Carlson, 2000, p. xviii). We, as appreciators of the environment, become 'engaged' through the senses to play integral parts in the environment itself. It is not only about looking; it is about being in and part of any environment (i.e. seeing, hearing, feeling, touching and smelling the environment).

Environmental aesthetics includes natural environments as well as manmade environments (i.e. VR environments) which can range from large landscapes to small and more intimate environments, from ordinary to extraordinary scenes and places. As Berleant defines it, '*an environment is the fusion of an organic awareness of meanings both conscious and unaware of geographical location, of physical presence, personal time, pervasive movement*' (1992, p.34). In terms of the aesthetic experience, an environment is very different from the more traditional art piece, in that '*appreciators are confronted by, if not intimately and totally immersed in, objects of appreciation that impinge upon their senses, are constantly in motion, are limited in neither time nor space and are of a non predetermined nature and meaning*' (Carlson, 2002b, line 16). Though like artefacts, it is important to appreciate nature for what it is and for the qualities that it has (Carlson, 2000, p.51). Environments

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<sup>10</sup> See Carlson (2000, p.51), Berleant (1992, p.34)

have been described as having *'sensory richness, directness and immediacy, together with cultural patterns and meanings that perception carries and these give environment its thick texture'* (Berleant, 1992, p.20). To aesthetically appreciate an environment: *'we experience our surroundings as an obtrusive foreground, allowing our knowledge of that environment to select certain foci of aesthetic significance and perhaps exclude others, thereby limiting the experience'* (Carlson, 2000, p.51/50). We, as appreciators, are the artists, we are attracted to certain things in the environment, and we 'engage' with this content and create our own personal experiences. As Carlson (2000, p. xxi) says: *'every environment whether natural, rural, urban, large, small, ordinary or extraordinary offers much to hear, see, feel much to aesthetically appreciate'*.

### 2.1.3 Discussion

*'It is sometimes said of works of art that they are 'worlds' which spectators imaginatively enter in the course of aesthetic engagement with something made in order to effect this imaginative transportation. The thoughts, emotions, and judgements provoked by such an engagement with a work are important to spectators at least partly because they may remain with the spectator, enriching their understanding in ways that have a bearing on practical life. This ability of art to deepen understanding in ways relevant to our practical and reflective lives is another reason why human beings care so much about art and their aesthetic experience of it'* (Friday, 2002, p.28).

The main discussions in this section have served to highlight the fact that aesthetics needs to broaden its boundaries and in doing so, establish a more 'complete' existence and meaning. To explore this, the author has taken on board pragmatism's idea of aesthetics, she has linked these theories with some of those from psychology and the visual arts and has formed a more robust and practical understanding of the concept of *aesthetic experience* as it exists today. Indeed, by defining the term, the goal (as Friday subtly emphasises in the above quotation) has been to start to reveal the power of the aesthetic to enhance not only how people interact with, think and feel about artefacts, design products and environments, but ultimately, the creation of experiences.

## 2.2 HCI and Experience Design

Recent research shows that aesthetics has the potential to play an intrinsic role in HCI design (Lavie & Tractinsky, 2004; Tractinsky, 1997; Tractinsky, 2004; Tractinsky, 2005; Petersen et al, 2004; Djajadiningrat et al, 2000; Hoffman & Krauss, 2004).

However, in truth, it has taken many years for people (i.e. designers, developers, researchers etc.) to fully understand and realise the extent of this potential within HCI. For years the emphasis of the field of HCI has been on usability and particularly efficiency considerations such as those involving objective performance criteria, time to learn, error rate and time to complete a task (Lavie & Tractinsky, 2004, p.270).<sup>11</sup> Even today, reminiscent of Card et al. (1983, p.425) many researchers believe that all HCI requires is a science base of knowledge (built from cognitive psychology and allied sciences) about human performance on which designers then can draw from for their designs.<sup>12</sup> However, as Hoffman & Krauss (2004) have pointed out, modern HCI design has placed too much emphasis on performance issues and not enough on other aspects, like aesthetics. In his PhD thesis, O'Neill (2005, p.40) agrees that '*the cognitive psychology approach although still the mainstream of HCI theory, struggles to provide theories that can articulate the specific problems of these new kinds of interaction*'.<sup>13</sup> In view of this, the following sections will explore the new "design" approach to HCI which is starting to allow for these new kinds of interactions. In particular, this research will show how aesthetics can play a strong role in people's attitudes towards and interactions in photorealistic virtual environments. Its aim is to illustrate the fact that aesthetics can play an integral part in VR system designs, so much so that '*aesthetics and interaction are interwoven concepts rather than separate entities*' (Djajadiningrat et al, 2000, p.1).

## 2.2.1 HCI and Usability

HCI is an interdisciplinary subject drawing on knowledge derived from the subject areas of science (physical and social sciences), engineering, and art (Johnson, 1992, p.1). This diverse mix of subjects brings with it an even broader gathering of interest and, as a result, HCI at times can be quite difficult to pinpoint: '*there is no agreed upon definition of the range of topics which form the area of human-computer interaction*' (Hewett et al, 1996,

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<sup>11</sup> Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them (Hewitt et al, 1996)

<sup>12</sup> For example, Card et al. (1983, p.428) believe that the approach to HCI design should be based on a theory of the user as an information processor (with a primary emphasis on task analysis, calculation and approximation).

<sup>13</sup> O'Neill talks about our interaction with new media as being very different from our interaction with the desktop. He described these new kinds of interaction as '*a far more complex contextually defined type of interaction where convergent layers of media are engaged simultaneously at any one time*' (O'Neill, 2005, p. 40)

line 1).<sup>14</sup> Nevertheless, what all of these disciplines have in common is the understanding that HCI involves the study of interactions between people and computers.

The term HCI stems back to around 1982 when the discipline of HCI officially emerged with two main foci: the first on the development of methods and techniques to improve usability; the second on inventing new and more usable software and tools (Carroll, 2001, p. xxvii).<sup>15 16 17</sup> In these instances, usability can be seen as being a quality attribute that assesses how easy user interfaces are to use (Nielsen, 2003, line 8). So right from the beginning, usability took a central role in HCI; so much so, that the discipline has been portrayed '*as the study and the practice of usability. It is about understanding and creating software and other technology that people will want to use, will be able to use and will find effective when used*' (Carroll, 2001, p. xxvii). As the previous section has shown, this desire for usability very quickly became entwined with a cognitive psychology theory (i.e. it became enthralled with finding out how fast or easily a user can cognitively interpret the interface in order to efficiently complete a task). In fact, this made such an impact on HCI that even today researchers are applying processes which feed into and support this way of designing. For example, over the last ten years semiotics has started to play a more prominent role in HCI. This idea of the '*coupling of a sign process and a signal process*' (Nake & Grabowski, 2006, p.65) feeds into cognitive theory where '*the notion of the sender and reader in semiotics is not dissimilar to the notion of designer and user or system and user in HCI*' (O'Neill, 2005, p.26).<sup>18</sup> As Nadin (1988, line 1) says '*to design means to structure systems of*

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<sup>14</sup> For example: from areas such computer science, artificial intelligence, cognitive science, human factors, psychology, design, sociology, library and information science etc.

<sup>15</sup> Carroll believes that HCI emerged because of the combined result of four different threads from the 1960s and 1970s. These included: 1) prototyping and iterative development from software engineering, 2) software psychology and human factors of computing systems, 3) user interface software from computer graphics, and 4) models, theories and frameworks from cognitive science (Carroll, 2001, p. xxvii).

<sup>16</sup> Carroll describes the method's focus as concerning techniques to achieve better usability (i.e. clarifying the concept of usability with respect to learning, skilled performance and subjective experience like satisfaction and fun). This became known as usability engineering and involved the development of models and theories and laboratory studies of people learning and using systems and of techniques for evaluating systems (2001, p. xxx).

<sup>17</sup> The software focus of HCI became known as user interface software and tools and was primarily concerned with inventing and refining graphical user interface concepts and techniques to make systems more powerful, more useful and more usable (Carroll, 2001, p. xxx).

<sup>18</sup> Semiotics is the study of sign systems; it is a process concerned with meaning making through the creation and interpretation of signs (Chandler, 2002, p.2/p.17). A semiotic process is where the output of one system (i.e. computer) is perceived and interpreted by the other system (i.e. human) (Nake & Grabowski, 2006, p.65).

*signs in such a way as to make possible the achievement of goals*’, so much so, he believes that all HCI is grounded in semiotics.

However, what seems to have been forgotten or perhaps cast aside until recently is the fact that usability is actually made up of several components. Usability is a collective term for all aspects of an activity’s performance that can be affected by the use of technology (Whiteside et al. cited in Newman & Lamming, 1995, p.30). As Sutcliffe (1995, p.226) points out, an interface has good usability if it can be learned quickly, is easy to operate, can be remembered and is satisfying. He decomposes usability into the following components: effectiveness (i.e. the measure of how well the system performs in achieving what the user wants to do); learnability (i.e. how easy a system is to learn); memorability (i.e. remind the user of previous); and attitude/satisfaction (i.e. attitude is the subjective part of usability which quantifies user satisfaction with the system) (Sutcliffe, 1995, p.226). Even though HCI has been described as promoting and enabling *‘work and other activities to be performed more effectively, efficiently and when performed by people, with more enjoyment and satisfaction’* (Johnson, 1992, p. xiv), it has only been in the last few years that the focus on usability has shifted from effectiveness, learnability and memorability issues to also include the satisfaction component. In terms of VR design (and particularly photorealistic VR design) the focus still remains on performance and efficiency issues (see chapter 3). Indeed, the main drive of this research is to broaden this outlook and to develop a more holistic approach for the design of photorealistic VR environments. It aims to look at an aesthetic process which fully addresses the satisfaction requirements of a photorealistic VR system as well as opening the doors for the creation of ‘engaging’ and meaningful experiences.

### **2.2.2 HCI and Design**

The main goal of HCI has always been to contribute to the development of more usable digital artefacts (Löwgren & Stolterman, 2004, p.147). However today, these goals take on a different perspective as design has emerged as a central focus within HCI (Karat & Karat, 2003). In fact, the HCI field has become more and more interested in the design process. As Karat & Karat (2003, line 404) say: *‘As the field moves more toward considering systems that people value for purposes other than as tools, we are finding an increasing need to consider aesthetics and other factors that can contribute to the value of a system or an artefact’*. Nowadays, it is essential that HCI designers consider the more holistic approach to understanding usability. They need to consider the learnability, effectiveness and memorability of an interface, but also to consider Sutcliffe’s fourth usability component:

*satisfaction* (1995, p. 226). The emphasis has now shifted from performance to the user's experience and designers are realising that they need to explore *design* as a means of understanding how people feel and their attitudes towards systems.

In actual fact, the goals of HCI and our conceptions of the role of technology have changed from solely increasing work productivity to now also allowing for the creation of meaningful experiences in people's lives (Karat & Karat, 2003). As Zimmerman (2003, p.1) says '*more recently with the growing acceptance that emotional responses to products and interfaces play a dramatic role in people's perception and evaluation of devices and services, the role for design in HCI has become a little clearer*'. As a result, new HCI research topics are now of interest. These include the relationship between experience, design, and emotion, and how to design for tangible and sensual interactions (Forlizzi, 2006). As Forlizzi (2006, line 11) points out, '*for these reasons, interaction design has developed a larger role within HCI*' and for these same reasons, the author of this thesis feels that aspects of experience design could – and indeed should – also play an intrinsic role within HCI and the design of photorealistic VR environments.

### **2.2.2.1 Interaction Design**

For many people Interaction Design, like HCI, is all about goals, tasks and usability. However, it is actually more than that: it also includes '*the responsibility for ethical and aesthetical (as well as functional) qualities of digital artefacts*' (Löwgren & Stolterman, 2004, p.xii). As Löwgren & Stolterman (2004, p.5) describe, it is '*the process that is arranged within existing resource constraints to create, shape, and decide all use-oriented qualities (structural, functional, ethical, and aesthetic) of a digital artefact for one or many clients*'. Interaction design is concerned with the shaping of digital artefacts for better user experiences, in terms of both function and appearance.

Interaction design is a comparatively young field, and even though it has strong affiliations with HCI, it is different in that it is a design discipline.<sup>19</sup> As Winograd (1997, line 165) points out: '*It draws on elements of graphic design, information design, and concepts of human-computer interaction as a basis for designing interaction with (and habitation within) computer-based systems*'. Interaction design is about how the computer looks as well as how it operates. It involves both the structural and functional, as well as the ethical and aesthetic qualities of the technology and, in order to understand this union, the interaction designer

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<sup>19</sup> 'It is a design discipline which means that concepts and theories from other design disciplines and from the transdisciplinary academic field of design studies are relevant in understanding and developing interaction design' (Löwgren & Stolterman, 2004, P.6).

needs to consider the user, the content and their environment. They need to understand how the user interacts with the interface in terms of feeling, thoughts, memories and intuition. They *'need to take a broader view that includes understanding how people and societies adapt to new technologies'* (Winograd, 1997, line 202).

Interaction design is about giving the user a certain amount of control over their experiences. It *'presumably, means envisioning and creating some kind of map of how this should be done in a specific application'* (Marion, 1999, line 33). As O'Neill (2005, p.46) points out, semiotics promises to be a very useful tool in developing new ways to comprehend our interactions with new media. In his PhD thesis, O'Neill (2005) broadens the process of semiotics in order to consider new kinds of interaction with new media. In fact, he argues that the older semiotic approaches are simply not enough when it comes to analysing new interactive media systems. He compares variations of product semiotics (Vihma, 1995), visual semiotics (Kress and Leeuwen, 1996), and cultural and social semiotics (Eco, 1996) and suggests that when considered together, they provide the possibility of an integrated semiotic theory for new media (i.e. the study highlights different types of signs, how they are organised/structured and then manipulated sequentially in order to establish meanings). What is interesting is how people use signs to construct meaning mediated by personal experience and culture, and that things like colour and style play an important role in the sensemaking.

In this thesis the focus lies on the aesthetic object where it constitutes an appreciation within itself as well as having the potential to lead the user (through feelings, intuition, past experience, cultural interpretations as well as intellect) to new meanings and activities (see Chapter 3). As Vihma (1995, p.156) concludes *'aesthetic experience can be characterised as a sense impression, a subjective appreciation of an object in which, however, also interpretations of references take part.'* In particular, this research is interested in how a subjective appreciation of an object can feed into one's overall interpretation. In many ways, as Dewey (1934, p. 22) says it is a *transformation*, which is as much about influencing as it is about being influenced by the design. As McCarthy & Wright (2004, p.9) point out: *'interaction with technology is now as much about what people feel as it is about what people do'*.

However, as current trends show, interaction design needs to start exploiting human's natural abilities in the design of human computer interactions and of stimulating all the human senses, not only the audio-visual ones (Knutslie, 2001. p.1). In *Where the Action is – the Foundations of Embodied Interaction*, Dourish places interaction at the centre of the picture (i.e. what is being done but also how it is being done). He sees interaction as more than a set of physical devices (i.e. mouse, keyboard, and screen) or a set of virtual devices (i.e. dialog boxes, scroll bars and menus). Instead it is the ways in which the

computer fits into our environments and our lives (Dourish, 2004, p.27). Today, Interaction Design needs to approach the design of interaction in terms of what experiences it can create. It needs to look at developing perceptual unity within its designs and, as Berleant (1991, p. 26) describes, it is about creating continuity, perceptual integration and participation between the user and technology. Shedroff (1994a, line 1) sums it up when he says that: we are dealing with *'the art of effectively creating interesting and compelling experiences for others'*.

### **2.2.2.2 Experience Design**

Experience Design is an approach for creating successful experiences for people in any medium. Experience of technology refers to something larger than usability or one of its dimensions, such as satisfaction or attitude (McCarthy et al, 2004, p.6). It is the overall impression, feelings, interactions that a user has with a product or service. As Shedroff (2005a, line 24) points out, it considers all three spatial dimensions, time, all five common senses, interactivity, as well as customer value and personal meaning. It is about creating experiences beyond just products and services, about creating relationships with individuals, creating an environment that connects on an emotional or value level to the customer (AIGA, 2006).

Until recently, HCI has seemed to have ignored many of these aspects of design, so much so, that experience is now becoming an increasingly important problem for HCI research (Wright et al, 2006) – especially when HCI designers are realising that experience is a critical issue for design (Forlizzi et al, 2004). Experience design encompasses traditional HCI design but also takes it further by addressing all aspects of the product, service, environment and their relationship to the individual. In detail, it *'deals in a holistic manner with all aspects of a user's experience: visual design, interaction design, sound design, animation, industrial design, etc'* (Saffer, 2004, line 3). Today, HCI practitioners and researchers (Yamazaki & Furuta, 2007), (Zhou & Fu, 2007), (Mahlke & Lindgaard, 2007), (Buur & Stienstra, 2007) are realising this and, as a result, have started to become concerned with *'developing broader conceptions of usability to encompass enjoyment, engagement, identity, trust and loyalty'* (Blythe et al, 2006, p.1692). Indeed, by encompassing and considering some of these aspects of experience design, designers can create *'desired perceptions, cognition, and behaviour among users, customers, visitors, or the audience'* (Jacobson, 2000, line 20) which can then enhance the user's experience of the interface or device. However, as already said, VR design seems to be lagging behind; photorealistic VR design, especially, needs to start to think beyond the efficiency issues and the bare cognitive processes of interaction and,

like experience design, consider other processes of interaction which focus more ‘*on the interactions between people and products and the experiences that result*’ (Forlizzi et al, 2004, p.261). As McCarthy & Wright (2004, p.5) point out ‘*It is no longer considered sufficient to produce a computer system that is effective, flexible learnable and satisfying to use – the characteristics of usability according to Shackle (1990) – it must now also be useful in the lives of those using it*’.

### 2.2.3 Discussion

‘*Good design has always been concerned with the whole experience of interaction. Although most people think that design is about what we see – form, shape, proportion, colour and finish – the aesthetic value comes from the whole experience, including gesture and ritual, what we feel and hear perhaps even what we taste and smell*’ (Moggridge, 1999, p.17).

The above section has briefly mapped the HCI journey from its origins in the more ‘performance’ aspects of usability to its now more ‘design’ orientated stance. By doing so, it has subtly highlighted the increasing need for photorealistic VR design to follow suit, to move beyond its fixation with efficiency and performance matters (see chapter 3), and to consider a more aesthetic process of interaction and hence a more holistic approach which encompasses the senses, intellect, intuition, sentiment and cultural interpretations. In fact, through the careful delineation of interaction and experience design, this section of the chapter has indirectly pushed and promoted a more experience orientated drive for photorealistic VR design. It has also set the scene for the next section of this chapter which introduces the concept of *aesthetic-interaction* as a possible vehicle for the creation of ‘engaging’ photorealistic VR experiences.

## 2.3 Aesthetic-Interaction

As the boundaries of aesthetics are broadening out to take on board and appreciate the experiences of new technologies, so too, the HCI designers of these new technologies are realising the power of aesthetics to create ‘engaging’ user experiences. In this section of the chapter, the interest will lie in the crossover between these two fields and the question of how people aesthetically interact with computer interfaces (i.e. particularly photorealistic VR technologies) in order to create their own individual and ‘engaging’ experiences. To explore this, the author will introduce the idea of *aesthetic-interaction* as a new type of interaction which has been inspired by the broadening field of aesthetics as well as the more holistic ideologies of experience design. *Aesthetic-interaction* will be presented as an aesthetic

process of interaction that promotes the use of aesthetic elements to sensually attract and arouse the spectator into the sharing and interpretation of information. It encompasses the ‘engaged interaction’ (that was previously discussed), an interaction between the technology and the spectator’s feelings, thoughts, past experiences, intuitions and memories etc. that has the power to manipulate the perceptions of the spectator and create new enriching experiences.

### 2.3.1 What is Aesthetic-Interaction?

*‘Aesthetic interaction is not about conveying meaning and direction through uniform models; it is about triggering imagination, it is thought provoking and encourages people to think differently about interactive systems, what they do and how they might be used differently to serve differentiated goal’* (Petersen et al, 2004, p.271).

Petersen et al. (2004) propose that aesthetic interaction belongs as the fifth perspective of interaction design; they see it as the experiential aspects of the interactive systems, such as creating involvement, experience, surprise, and serendipity in interaction when using interactive systems.<sup>20</sup> They feel that by focusing on intriguing and sometimes even ambiguous aspects, they aim to encourage the user to explore and playfully appropriate the system (Petersen et al, 2004, p.274). Likewise the author of this thesis is of the opinion that aesthetics involves more than just supporting the user’s physical interaction (in terms of pressing a button on a joystick or clicking a mouse), she also sees aesthetic interaction as putting ‘*an emphasis on an actively engaged user with cognitive skills, emotional values and bodily capabilities*’ (Petersen et al, 2004, p.274).<sup>21</sup> However, in terms of this research, aesthetics can be seen as more, in that it is an interaction in itself. By this it is meant that the role of aesthetics is individually active; *aesthetic-interaction* facilitates through the use of sensual stimuli an ‘engaged interaction’ between the user and the interface which, in turn, feeds into the users overall experience.

In terms of photorealistic VR, it is not just about enhancing or even facilitating the functionality of a system but more about creating a visual interaction where users ‘engage’ in and enjoy the VR environment before they ever touch a mouse or joystick. *Aesthetic-*

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<sup>20</sup> In 1984, Bodker and Kammersgaardt reviewed different perspectives on HCI and came up with four different but co-existing perspectives on interactions styles, these included system, tool, dialogue partner and media. Petersen et al see aesthetic interaction as the fifth perspective (Petersen et al, 2004).

<sup>21</sup> It differs from the concept of affordance in that it is not a uniform model that tells us how we are to physically interact with a system (i.e. it does not just enhance the user’s tasks).

*interaction* creates an appreciation within itself as well as in what it represents. The author envisions it as ‘*the challenge of creating designs that generate a different view on things, helping perceive the novel in the familiar, discover relationships between seemingly incongruous objects, and relate the unrelatable*’ (Wagner et al, 2002, p.33). In that sense, it takes the semiotic process to a higher level; it is about the user’s ‘*ability/ need to perceive, interpret and influence the context*’ (Fonteyne et al, 2001, line 3) as well as being influenced that results in the shaping of new experiences. *Aesthetic-interaction* aims to promote a relationship between the user and the photorealistic VR environment that encapsulates ‘*a person’s full relationship – sensory, emotional and intellectual*’ (McCarthy & Wright, 2004, p.54) and in doing so, entices an ‘engaged interaction’ which can change the user’s perceptions and interpretations of the photorealistic VR environment.

As Chang (2005) points out, the term interaction can represent everything from passive exchanges with content to active computer-mediated communications. It requires information flowing in both directions (Naimark, 1990, p.455) and as Shedroff describes it involves genuine human engagement. In fact, Shedroff portrays Interaction Design as essentially story-creating and telling (1994b, line 5) where a good storyteller, like a good interaction designer, captures and engages their audience. In this light, *aesthetic-interaction* is also very much intermingled with the concept of engagement (i.e. see Chapter 4) so much so that it has an affect on the user as well as an influence on the experience created (i.e. see Berleant’s aesthetic engagement – participation, continuity and perceptual integration). Indeed, the *aesthetic-interaction* promotes the idea of an active ‘engagement’ where participants ‘*can engage in co-creation [with the artist/ designer], by interpreting content and constructing meaning and by modifying form and content*’ (Chang, 2005, p.5). It is the unpredictability of the user and what they bring to the *aesthetic-interaction* that increases the ‘engagement’. In more detail, each artefact or design (i.e. photorealistic VR environment) is open to a number of possibilities and meanings (i.e. *aesthetic-interactions*) and it is this ambiguity and open-endedness which offers the greatest possibilities for the creation of new, exciting and ‘engaging’ experiences.

As McCarthy and Wright (2004, p.80-89) highlight *experience* has four main threads: 1) the sensory thread (i.e. how the design and overall atmosphere makes us feel), 2) the emotional thread (i.e. those emotions that affect the experience for us), 3) the compositional thread (i.e. how the elements of an experience fit together to form a coherent whole) and 4) the spatio-temporal thread (i.e. the effects of place and time on our experience). The unpredictability lies in the fact that each user has their own personal take on each thread of the experience. This depends significantly on the sense they make of it given their particular history and disposition (McCarthy & Wright, 2004, p.105). In terms

of HCI, this unpredictability of the aesthetic might seem like an alien concept given that HCI spent many of its early years trying to make systems predictable, efficient and reliable (i.e. the GUI interface). However, as the author of this thesis believes, the unpredictability opens up many exciting doors for HCI design and particularly VR design. As Candy & Edmonds (2002, line 83 ) highlight '*the role of the artist [designer] is not so much to construct the artwork but rather to specify and modify the constraints and rules used to govern the relationship between the audience and artwork as it takes place in the world*'.

In the design of *aesthetic-interactions*, it is the designer who plants the important seeds (i.e. sets up the frame for interaction), but it is user who brings them to flower (i.e. who transforms aesthetic qualities into thoughts and feelings by organising it into a meaningful form and then by creating relationships and patterns between it). In *Applied Aesthetics*, Zettl (1999, p.101-102), talks about psychological closure (i.e. proximity, similarity and continuity) and the fact that we all have a tendency to mentally "fill in" the gaps in visual information to arrive at easily manageable and complete patterns.<sup>22</sup> In this research the *aesthetic-interaction* process is envisioned to adopt similar techniques in a framework (i.e. the visual-narrative model) where the user is encouraged to fill in the gaps and build up various narrative patterns. As mentioned these patterns can feed directly into enhancing the functionality of a system but more importantly can exist on their own to provide rich and 'engaging' experiences. Indeed, the *aesthetic-interaction* is an interaction in itself where the user is no longer a passive spectator but instead is an active and perceptually hardworking participant in that they interact with a combination of various aesthetic elements that in turn lead them into specific directions and experiences (Zettl, 1999, p.105-106).

### 2.3.1 HCI and Information Visualisation

The author envisions *aesthetic-interaction* as being comfortably rooted within HCI and its new push towards experience design (i.e. creating 'engaging' experiences for people who are interacting with new technologies). She also sees it as having a strong 'aesthetic' presence and feeding off the ideas of the 'engaged interaction' that were discussed at the

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<sup>22</sup>The pattern that results from closure is often called a gestalt (German for form, configuration, and shape) a gestalt is a perceptual whole that transcends its parts (Zettl, 1999, p.102). The three main principles of psychological closure are as follows: 1) Proximity is when similar elements lie in close proximity to one another and we tend to see them together. 2) Similarity is when similar shapes are seen together. 3) Continuity concerns a visual rhythm, it is when once a dominant line is established, and its direction is not easily disturbed by other lines cutting across it. (Zettl,1999, p.105) This is discussed further in Chapter four.

start of this chapter. Indeed, *Aesthetic-interaction* is perceived as not only about enhancing the functionality of a system, not only about affording the pressing of a button or the clicking of a mouse etc. but more importantly the author sees *aesthetic-interaction* as the interaction itself. In this thesis, the focus is on the visual content and the participant's visual interaction with this content (see Chapter 3). In that sense, the *aesthetic-interaction* that the author has described holds many similarities to the field of data graphics (particularly information visualisation).<sup>23</sup>

HCI and information visualisation (I.V.) have many crossovers in that I.V. uses visuals to enhance the user's interaction with information. It is seen as a particular type of visual which aims to amplify cognition. As Card et al. (1999, p.7) suggest, it is '*the use of computer-supported, interactive, visual representations of abstract data to amplify cognition*' and one of its big challenges is the '*development of appropriate and comprehensible modes of abstracting and representing the complexity of information structures*' (Judelman, 2004, p.1). In fact, information visualisation strives to overcome the complexity of data by increasing resources to the human in the form of memory and processing resources.<sup>24</sup> As Card says '*visualisation helps the user by making the world outside the mind a resource for thought in fairly specific ways*' (cited in Jacko & Sears, 2003, p.551). Information visualisation (similar to the *aesthetic-interaction* process) is about being enticed to engage with visual content (i.e. information); it is about understanding and interpreting, about creating something new and then possibly acting upon it. The important outcome is that the user has visually interacted with the content and has formed a convincing interpretation of it. However unlike the author's idea of the *aesthetic-interaction* process, information visualisation disregards anything to do with the senses: '*there is a big gap in visualisation discourse between science, art, technology and design*' (Judelman, 2004, p.1). As Card emphasises, to be a good information visualisation, the mappings are cognitive and must encode all of the data relations intended and no other data relations.<sup>25</sup> The outcomes of information visualisation are defined: they depend on a certain amount of control to address the problem of how to use the visualisation to create an efficient and useful tool for information exploration. With *aesthetic-interactions*, a little more leeway will be proposed in that every user has their own

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<sup>23</sup> Data graphics is the use of abstract, non-representational visual representations for amplifying cognition (Card cited in Jacko & Sears, 2003, p.551).

<sup>24</sup> Information visualisation reduces the search for information, enhances the detection of patterns, it enables perceptual inference operations and perception monitoring and encodes information in a manipulable and interactive medium.

<sup>25</sup> In terms of encoding the data, recent visualisation research (Chen & Carr, 1999) has looked to semiotic approaches particularly the semantic field (i.e. the range of possible meanings that are associated with any particular sign) as a way of exploring intrinsic connectivity in an information space.

way of getting to the end outcome; it is more experiential where the user applies a combination of their senses, their intuitions, past experiences and intellect to solve the problem or tell the story.

In summary, *aesthetic-interaction* is seen to sit firmly within the field of HCI though at the same time, has strong leanings towards information visualisation in that the author is interested in the use of visuals (particularly its aesthetics) to create ‘engaged interactions’ with the technology. In contrast to Skog et al. (2003, p.239) who believe that ‘*in information visualisation, aesthetics can almost be considered an added bonus, or at least a bi-product when striving for readability and effectiveness*’, the author of this thesis, feels that aesthetics can play an integral role. The author, like Judelman (2004, p.6) agrees that ‘*the challenges facing information visualisation researchers [and HCI researchers] often involve finding innovative graphic and interactive techniques to represent the complexity of information structures.*’ *Aesthetic-interaction* is not an added bonus or bi-product, it is an interaction in itself and is seen as a process of interaction which promotes a richer and more flexible means of communication, storytelling and problem solving.

### 2.3.2 Discussion

*‘The screen provides us with a new, concentrated living space, a new field for aesthetic expression’* (Zettl, 1999, p.73)

*Aesthetic-interaction* embraces the experiential side of HCI technology; it is about designing ‘engaged interactions’ which, in turn, go on to create ‘engaging’ experiences. As the discussions in this chapter have shown, *Aesthetic-interaction* goes beyond the traditional cognitive approach to HCI design by involving the patterning of aesthetic elements to ‘engage’ the senses, intuition, past experience as well as the intellect. In doing so, it takes one’s interaction with technology to a new experiential level in that it is about flexibility and control, about a perceptually hard working participant creating their own experiences. In terms of HCI, *aesthetic-interaction* offers a new type of interaction which encourages an ‘engaged interaction’ between the user and the interface that has the power to create new enriching experiences.

## 2.4 Conclusion

This chapter has explored pragmatic aesthetics in conjunction with theories from psychology and the visual arts. In doing so, it has presented a practical insight into the concept of the aesthetic experience as it exists today. In parallel with this, the chapter has

highlighted the slow shift in HCI from efficiency and performance considerations to now a growing concern for the design of a more holistic experience. The main drive of the chapter has been to expose the growing overlap between the fields of HCI and aesthetics. It has revealed the potential of aesthetics for the creation of ‘engaging’ experiences in HCI design while at the same time, the broadening of aesthetics to meet the needs of the different disciplines and new technologies. Emerging from this, the author has presented the *aesthetic-interaction* as a process of interaction which through the use of aesthetics, ‘engages’ the user in the technology and then influences the way that they experience it. In exploring this, the chapter has aimed to set the scene for the rest of the thesis, particularly the following chapter, which looks specifically at the possibilities of this new kind of interaction in photorealistic VR.

# 3: PHOTOREALISTIC VR

In today's world VR systems are reaching a certain maturity in that they are beginning to be seen and used more regularly in aspects of everyday life such as training, education, entertainment, health, communication and the military. As Gazzard (2007a) says '*they [virtual worlds] have become increasingly common and diverse in their forms*', however, '*in our everyday lives [she still feels] the main form of virtual worlds is the computer game*'. It is very true that quite a number of people would associate VR primarily with game playing. Therefore, from the onset of this chapter, it is important to clarify that the main emphasis of this research is on the VR artefact – i.e. the photorealistic VR 'explorable' environment – as opposed to the photorealistic VR game. Establishing that, the author is primarily concerned with the design of photorealistic VR environments as opposed to the actual building of new, faster and more efficient systems. As Livingston et al. (2006, p.301) point out, '*there are limitations that have prevented many [VR] systems from being truly useful for participants. One reason is the need to overcome human factor issues*'. With regards to this, the author of this research is interested in exploring the more experiential side of photorealistic VR environments as a means of enhancing user experiences in VR (see Chapter 2). She is keen to challenge why the emotional aspects of the virtual experience have generally been ignored (Lee, 2007, p.392) and why '*the actual nature of the content of virtual environment is [still] rarely considered*' (Fencott, 1999a, line 30).

Prior to this, it should be noted that there are some exceptions, for example: the project DESARTE (1998 to 2001) was concerned with the design of computer-based systems to support the work of architects and landscape architects. This project funded by the European Commission and Austrian Ministry for Science and Transport, explored the potential of electronic visualisation and communication and in particular aesthetic pleasure and engagement in electronic spaces (Büscher et al., 1999). Also, the project EMMA

(2002-2005) which was part of the ‘Presence’ Research initiative (EC IST FET), explored the creation of ‘mood devices’ (i.e. VR environments etc.) that would induce different forms of moods amongst clinical and non clinical sample groups. The project investigated the correlation between people’s emotional responses and their sense of presence in Virtual Reality (VR) applications. Finally, it is also important to mention that researchers, artists and scientists such as Monika Fleischmann and Wolfgang Strauss (i.e. *Liquid Views* – 1993), Jeffrey Shaw (*Place-Ruhr* – 2000), Christa Sommerer and Laurent Mignonneau (i.e. *The Living Room* – 2001), Andrea Zapp (*The Imaginary Hotel* – 2002), Victoria Vesna (*Mood Swings* – 2004) are all actively exploring and developing new interfaces, new modes of interaction and new ways to be innovative in VR.

However, despite this work, even today, with specific movements in HCI towards experience design, the author feels that VR (and particularly the photorealistic VR ‘explorable’ environment) is being quickly left behind as it is still caught in the limbo of the early nineties, when Kalawsky (1993, p. 346) felt much more research needed to be undertaken, particularly in the field of human factors. To address this, the chapter aims to probe the notion of *aesthetic-interaction* (introduced in Chapter 2) with specific emphasis on the design and creation of ‘engaging’ experiences for photorealistic VR environments. To give the reader more insight into the VR medium, the author proposes to build a fully rounded understanding of VR and how one might interact with it. In particular the author will be drawn to existing research which has explored engagement through the role of narratives in VR and will then explore how this work might be further developed to incorporate and structure the aesthetic process of interaction (discussed in Chapter 2). Indeed, the overall aim of this chapter is to explore the narrative potential of VR while at the same time demonstrating how one might cut loose from the informational aspects of this narrative to explore its aesthetic potential. The focus is therefore on the experiential side of photorealistic VR, and the author is interested in what it actually means to ‘*create a full sensory experience with control of view and narrative development*’ (Isdale et al., 2002, line 10). As Liu (2004, p.1) would say, the aim is to cast aside ‘*the pollutive backtext which endangers the aesthetic power of storytelling*’ and in doing so, try to expose its potential for the creation of ‘engaging’ VR environments.<sup>26</sup>

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<sup>26</sup> Liu (2004, p.1) sees the pollutive backtext as all the caricatures of known narrative forms and techniques drawn from the media of music, film, television and news. He believes that narratives can be read not only objectively but also aesthetically. He says ‘*an aesthetic reading of text engages not only the agency of thought but also intuition, sensation and sentiment, and cultural interpretation*’ (Liu & Maes, 2005, p.1).

### 3.1 Virtual reality: a definition

*'A painting by the seventeenth century artist Pieter Saenredam, a photograph by Edward Weston and a computer system for virtual reality are different in many important ways, but they are all attempts to achieve immediacy by ignoring or denying the presence of the medium and the act of mediation... All of them seek to put the viewer in the same space as the objects viewed'* (Bolter & Grushin, 2000, p.11).

The concept of virtual reality has a long history; the search for illusionary visual space can be traced back to antiquity (Grau, 2003). However, the actual VR technology (as recognised today) only dates back about forty years when researchers first started to consider the computer as a tool for visual display.<sup>27</sup> It is highly probable that this spurt of VR development grew from the successful medium of cinema, whose origins, like VR, *'based itself on its ability to show something, it solicits spectator attention, inciting visual curiosity and supplying pleasure through an exciting spectacle'* (Elsaesser, 1990, p.58). In fact, when one looks carefully, one can begin to see *'the clarity and seduction of cinema's visual imagery and the immersion of its viewers against which emerging and potential virtual reality experiences are measured... cinema is a key factor in virtual reality's remediation'* (Lister, 1995, P.136). While VR has much in common with other media, particularly film, it does also have many of its own unique and exciting characteristics.

VR is seen as *'a computer generated three dimensional landscape in which we would experience an expansion of our physical and sensory powers'* (Ryan, 2001, p.1). This expansion has the ability to immerse the participant within a computer-generated, virtual environment (Lok & Hodges, 2004, p.1) and to provide them with the illusion that the virtual environment is real (Brown et al., 2002, p.4). Through the use of real time network communications, interactive spaces, multi user interaction spaces, avatars and multi modal interfaces (Isdale et al., 2002, p.1), VR has the potential to offer an immersive, illusive, interactive and self controlling/ creating experience which appeals to all the senses simultaneously. VR primarily privileges the visual, although the aural and tactile senses (as well as smell and taste) can also be engaged (Boyd-Davis, 1998, p.4). As Grau (2003, p. 7) describes, it is like immersing/ entering oneself in the image space similar to jumping into a television or passing through the cinema screen into the image.

Everything in virtual reality is in real time, the images are in motion but their sequence is in the control of the user who has the role of both the user in the environment

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<sup>27</sup> It was about forty years ago when researchers started to consider immersing human participants in visually coupled teleoperated environments (a teleoperated system is one that operates on an environment and is controlled by a human operator who is at a remote location from that environment) (Kalawsky, 1993, p.2).

as well as the creator of what happens. As Morse (1998, p.182) aptly describes: *'I was fascinated with being both in the picture and having control over it... my role lay between that of a character inside the virtual world and that of a narrator outside the virtual space'*. In more detail, the overall structure of the experience depends on the choices of the user inside the environment and hence by making certain choices he or she plays an important role in how the experience is both received and delivered. It is this type of experience which leads to a new kind of relationship between the user and the environment. VR gives us a new visual perspective with spatial depth and temporal continuity; it holds perceptual opportunities which have the potential to give the user a set of convincing experiences (Fencott, 1999b). As Marsh (2001, p.1) states: *'performing activities within three dimensional virtual space has the potential to induce a unique experience in participants'*. It is not about looking through something anymore, it is about being immersed in a new environment and not about staring or gazing, instead, it is about glancing around at various manifestations of the media (Bolter & Grushin, 2000, p.81). As Morse (1998, p.182) says: *'the allure of this cyberspace was the impression that it was responsive to me, as if my gaze itself were creating (or performing) this world'*. It is all about the allure, creating an environment that the user feels the need and want to gaze around and 'engage' in.

### **3.1.1 Photorealistic VR – The BENOGO Project**

This research focuses on photorealistic VR which aims to provide realistic looking VR environments.<sup>28</sup> It emerged from the BENOGO project (2002-2005) which was mainly concerned with the creation of photorealistic VR environments that would enable people to feel a sense of "Presence" in real places without having to actually travel to these places. As mentioned, it was part of a European Union initiative for researching "Presence" and involved five different partners from universities in Denmark, the Czech Republic, Edinburgh, Germany and Israel. The main focus of BENOGO was on the building and development of the photorealistic VR technology (i.e. particularly an Image Based Rendering – IBR – technology) and then, being a "Presence" research project, the measurement of how well this technology could create a sense of "Presence". The author of this thesis was part of the measurement team at Napier University, Edinburgh that not only tested people's sense of "presence" in each new development of this technology but also researched different methods for measuring "presence" in the BENOGO environments.

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<sup>28</sup> This differs to non photorealistic VR which tends to provide stylized and artificially looking VR environments

In detail, this position involved the study of people's experiences in both real and VR environments (i.e. the probing out of real places that would lend themselves successfully to VR) as well as the development of tools to measure and compare people's sense of presence in both environments. This work had a lot of creative potential, however, being a predominantly technical partnership, the BENOGO Project centred on the development of the IBR technology. It evolved from the notion that the more accurate the technology (i.e. in terms of representation and visual experience) the more participants would be inclined to engage, become immersed and feel present. Therefore, it was the Edinburgh team's (i.e. including the author) responsibility to measure if this was so, and if not to feed back to the technologists on what went wrong and how to improve the technology. From a design perspective, the majority of the VR environments were from locations in Prague, and were primarily chosen to enhance the abilities or hide the flaws of the developing IBR technology. The early environments included the Botanic Gardens in Prague, a staircase and an office in the city's university (see fig.2); the later environments included the technical museum and an outdoor viewpoint environment over the city. All these environments were non narrative and ranged from the spectacular to VR environments that were seen to entice visual exploration.



Fig. 2: Benogo Office Environment

IBR Technology loosely refers to techniques that generate new images from other images instead of from geometric forms (see Chapter 5). Therefore the main activity supported by the BENOGO IBR environments was the ability to look behind the objects in the environment (i.e. as well as the standard 360 degrees around and up and down the environment). In terms of VR research, this shifted the emphasis from physical interaction to visual interactions. Indeed, the BENOGO environments thrived on this idea of visual

interaction and the user's ability to become involved in the visual exploration of their surroundings. It can be said that this alone (i.e. the possibility of looking behind objects in VR environments) opened up lots of new exciting doors for the development of photorealistic VR. The BENOGO Project brought a new insight into "Presence" research and introduced the place probe as a new means of "Presence" measurement. In relation to this thesis, the technologically driven BENOGO Project triggered within the author a curiosity to explore the aesthetic potential of this visual interaction as a means of further 'engaging' users in photorealistic VR.

## 3.2 Interacting with VR

*'Virtual reality, or virtual environment techniques, will change the way in which man interacts with computer systems'* (Kalawsky, 1993, p.2).

It is true that virtual reality changes the way one interacts with computer systems in that head mounted displays (HMD), data gloves, space balls, data suits etc. all aim to make the user part of the virtual environment. A head mounted display (HMD) or cave *'provides the wearer with a first person view of the virtual scene and effectively places the user next to or inside the virtual object'* (Vince, 1998, p.10) while the data gloves, space balls, data suits etc. all enable the participant to physically interact within this virtual object. Like the Sensorama (1955) or the *experience theatre* as it was called, VR can also provide a very broad palette of sensory stimulation which can include a full peripheral (wide-field) colour images in 3D, directional sound, aromas, wind, vibration, body tilting and temperature variations.<sup>29</sup> Each of these stimulations has the power to not only enhance the physical interaction within the VR environment but also, to create interactions and experiences within themselves.

This research is primarily concerned with visual interaction in photorealistic VR where participants wear specialized equipment (i.e. HMD – tracked displays) as an extension of their visual sense to explore the virtual environment.<sup>30</sup> The HMD and head tracker monitor the participant's position and orientation while the stereo imagery provides different views of the virtual environment for each eye (Lok & Hodges, 2004). The interest

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<sup>29</sup> The Sensorama was designed by Heilig (1955); its objective was to create a multi sensory film experience that included tactile-feedback handlebars, 3-D stereoscopic views, and wafting aromas (Fisher, 1990, Pp.423-424)

<sup>30</sup> The HMD simulates as close as possible the real world by providing a rich 3-D photorealistic display (Kalawsky, 1993, p.84)

lies in how the participant experiences the photorealistic content as they move around the environment (more so than the physical interactions or how the actual VR technology works). Lund & Waterworth (1998, line 177) suggest '*a key difference between more tool-like applications (word processors, spreadsheets, etc.) and virtual environments is that users will need more than a functional understanding to interact with virtual environments*'. Virtual environments need to make sense to those who inhabit them; they need to provide meaningful experiences for their inhabitants (Lund & Waterworth, 1998, conclusion). As '*print and radio tell; stage and film show, cyberspace embodies... a space maker sets up a world for an audience to act directly within and not just so the audience can imagine they are experiencing an interesting reality but so they can experience it directly*' (Walser cited in Bolter & Grushin, 2000, p.162).

In terms of HCI, VR environments offer a unique medium that allows users '*egocentric perspectives on three dimensional digital worlds*' (Stanney, 2003, p.622). One of its big attractions is that it can provide many opportunities for new kinds of experiences (Scaife & Rogers, 2001, p.1). Indeed, it is the perfect medium for the *experience design* driven HCI (discussed in Chapter 2) in that it encourages a visual interaction on many different levels (i.e. sensually, intellectually, intuitively etc.). When one examines the design of virtual environments, one sees two distinct forms: there is the aesthetic notion of designing the desired perceptual responses; and there is the engineering notion of design which involves the creation of plans and models from which to test and build the desired effects (Fencott, 1999b, p.1). However, as Fencott (1999b, p.1) says '*both forms of design are intrinsic to the process of designing effective virtual environments (VEs)*' even though at times, the aesthetic tends to be pushed into second place behind the engineering. The goal of this research is to examine the more experiential side of the visual content as opposed to the technical issues of how it is made and works etc. Like many artists and researchers (Gromala, 2007), (Davies, 2004), (Packer, 2001), (Holtzman, 1998) and (Jacobson, 1992) have started to do (and are still doing), this chapter aims to probe the *aesthetic opportunities* of VR as opposed to looking solely at the science of how it was made.

In many ways this work follows on from the perceptual modelling section of Fencott's (1999b, pp. 3-4) design methodology for virtual environments (see fig. 3) which involves the act of building up a model of the nature of the perceptual opportunities and their inter-relationships.<sup>31</sup> As he shows, it is particularly concerned with '*attracting visitors*

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<sup>31</sup> This model includes requirements modelling, conceptual modelling, perceptual modelling, building, and structural modelling. The Perceptual Opportunities are part of the perceptual modelling section and are made up of a set of syntactic categories (Fencott, 1999b), which in turn can be seen as attributes of an object in a

attention through patterns of mediated stimuli which will achieve purpose if the visitor perceives and responds to them as the designer intended' (Fencott, 1999a, line 94).

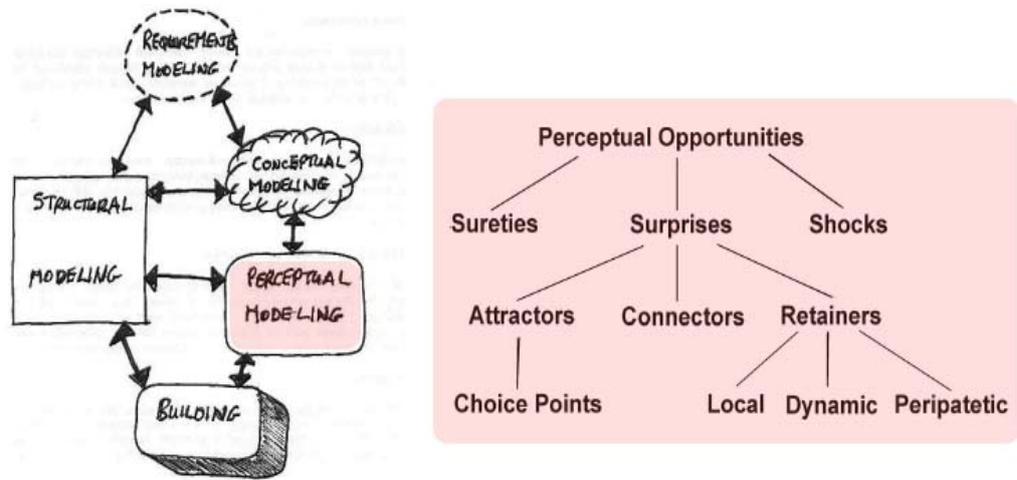


Fig. 3: Fencott's Design Methodology for Virtual Environments

One of the most important yet exciting differences between VR and other communications media is that virtual environments can create artificial stimuli for the perceptual systems to interpret rather than making the interpretations for the spectators, as is the case with films and novels (Fencott, 1999a). Marsh et al. (2001, p.2) describe it as a transparent or *invisible style* of interaction which keeps them in the flow of their activities and consequently enhances the experiences of participants. Instead of passively interacting and receiving information like readers of a book or participants of a film, participants in a VR environment create their own experiences and narratives. It is their interactive contribution that determines the outcome (Marsh & Wright, 2000). It is this notion of the *invisible style* of interaction that is driving our work in photorealistic VR design; how to design an 'engaged interaction' which has the power to manipulate the thoughts and feelings of the user to whatever the desired effect.

### 3.3 VR Environmental Aesthetic Experience

*Media artists represent a new type of artist, who not only sounds out the aesthetic potential of advanced methods of creating images and formulates new options of perception and artistic positions in this media revolution, but also specifically researches innovative forms of*

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VR environment. These attributes stipulate the way in which the object is intended to be received/experienced (i.e. in terms of both simulation and symbolic communication).

*interaction and interface design, thus contributing to the development of the medium in key areas, both as artists and scientists*'. (Grau, 2003b, p.3)

Virtual environments are manmade environments and, rather like both artefacts and natural environments (discussed in Chapter 2), they can be aesthetically appreciated. In fact, many virtual environments are representations of the real world, and can create an experience that combines both the immersive and unpredictable qualities of the natural environment with the more contrived qualities of an art or design work. This research is concerned with the development of 'engaging' photorealistic VR environments and, like what Davies (2002) explored in her immersive virtual environment *Osmose* (1994-1995), this thesis is interested in investigating the aesthetic to probe the interior qualities rather than the outward appearances.<sup>32</sup>

In general, photorealistic VR takes on the illusion theory of pictorial representation because the participants feel that they are immersed and part of the scene surrounding them. They are deceived into believing that the objects in the picture are real and are before them.<sup>33</sup> Saying that, like photography, it is felt that the aesthetic qualities of photorealistic virtual reality are not only '*to be sought in its power to lay bare the realities*' (Bazin cited in Graham, 1997, p.102); its aesthetic powers also include its capacity to represent objects in a way that is exclusive to VR (i.e. visually, tactile, auditory etc.) as well as its ability to impose other layers of meaning through choice, technical treatment, framing and layout (i.e. through special effects, pose, photogenia and aestheticism) (Barthes, 1977, p.20/21). However as Friday (2002, P.68) notes, there are sceptics who argue that it is impossible to have an aesthetic interest in photographs (or photorealistic VR) because they represent transparently. These sceptics see photographs solely as a way of acquiring visual information about objects and the world. Like the author, Friday (2002) disagrees and argues that representation is not the only aesthetically significant property that artists employ in the production of aesthetically interesting works of art. He emphasises that '*a causal relation with its subject matter may be at the heart of photography [VR], but the photographer [VR designer] has available many means of manipulating and controlling the effects of that causal relation*' (Friday, 2002, p.72).

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<sup>32</sup> In *Osmose*, Davies (2002, line6) set out to create a work which not only communicated her own particular idea of the world, but which demonstrated the medium's potential to enable us, the user, to experience our own place in that world afresh.

<sup>33</sup> There are two traditional theories of pictorial representation which are the resemblance and illusion theory (p.34, Carroll, 1999); the resemblance theory of representation states that x represents y just in case x resembles y and the illusionary theory of representation maintains that x represents y just in case x causes the illusion of y in spectators.

Photographers as well as photorealistic VR designers can choose and employ techniques and materials of various types in order to create pictures that draw attention to themselves. As Scruton (1983, p.117) points out *‘the photographer who aims for an aesthetically significant representation must also aim to control detail: detail being here understood in the wide sense of “any observable fact or feature”*. When a photograph or photorealistic VR environment attracts and captures our attention, it does more than merely satisfying our need for visual information: it is the creative use of the medium that attracts our aesthetic interest and ‘engages’ us. A photorealistic VR environment like a photograph can be designed to encourage the viewer to participate in and perceptually integrate with the content. It can show its subject in a particular light and from a particular viewpoint and subsequently it might reveal things about it that one does not normally observe and, perhaps, that one might not have observed but for the photograph (Scruton, 1983, p.119). It is true, like what was discussed in the previous chapter, the aesthetic elements of photorealistic VR environments can be patterned to encourage a ‘continuity’ (see Berleant in Chapter 2) between the viewer and the environment and in doing so, ‘engage’ them in specific modes of thinking and feeling. As the following sections will show, this idea of creating engagement in VR environments has already started to be examined through the form of narrative. The goal of this chapter is to tap into and then continue this work on narrative by exploring how it may crossover and work with aesthetics as a way to further the creation of ‘engaging’ photorealistic VR experiences.

### 3.4 VR and Narrative

In the last few years, there has been much research on new media (including virtual reality) and narrative (Anstey et al., 2000), (Carson, 2000), (Laurel, 1993), (Louchart & Aylett, 2004A, 2004b, 2005), (Murray, 2000), (Ryan, 2001), (Rieser & Zapp (eds), 2002) and (Szilas, 1999).<sup>34</sup> So much so, that in 2001, the first international conference on Virtual storytelling was established which entirely devoted itself to the new discipline linking the ancient human art of storytelling to the latest high technologies of the virtual reality era (Balet et al., 2003, preface). Following on from this work, the main aim of this next section is to build a clear idea of how narratives have been structured within the VR medium (i.e.

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<sup>34</sup> Other relevant research include: (Aylett, 1999); (Brown et al., 2002); (Davenport, 1996a, 1996b, 2000); (Falk, 2003); (Gander, 1997); (Grasbon & Braun, 2003), (Jenkins, n.d.); (Pearce, 1997a, 1997b); (Prada, Machado and Paiva, 2000); (Schubert, 2000); (Sherman, 2000); (Stappers, 2001); (Stubblefield, 2000); (Tanney, 1998) and (Young, 2004).

how content has been organised within a VR environment in order to ‘engage’ the user in the creation of a story). To understand this, it will closely examine some early research on narrative (i.e. the semiotic model of stories founded by the Russian formalist Propp and then other later models developed by Todorov and Barthes). It will illustrate how this early work has influenced contemporary computer theorists, designers and researchers in the design and development of their own narratives in virtual reality (i.e. how it has allowed them to build a good understanding of what determines the makeup of a narrative in VR).<sup>35</sup>

### 3.4.1 Narrative Structures

Narratives have been described as ‘*numberless*’ (Barthes, 1977, p.79), they are present in many different forms and are such a pervasive aspect of our environment that they are ‘*present in every age, in every place, in every society*’ (Barthes, 1977, p.79). To tell a story, we need to assemble information into a coherent structure. As Devereaux (2004, p.6) states: ‘*when we read novels, we read them as if the text is organised in a certain way. We read it as organised so as to allow us to ask certain questions*’. This coherent structure that we are talking about is known as the narrative, while the story is the irreducible substance (A meets B, something happens, order returns), the narrative is the way the story is related (once upon a time there was a princess) (O’Sullivan et al., 1994, p.195). Narrative is the means of organising and understanding information... ‘*it is the organisation of experience, which draws together many aspects of our spatial, temporal and causal perception*’ (Branigan, 1992, p.4).

For many, the most fascinating quality of narrative is the idea that it is independent of media and can be moved from one medium to another (Schärfe, 2004, p.20). As Propp (see below) demonstrated certain narrative structures remain consistent, despite the huge diversity of story form and content. So much so, Barthes (1977, p.79) claimed that narratives are ‘*international, transhistorical, transcultural*’, he believed that there must be a universal model to which every story must confer. It was this way of thinking which drove a great deal of investigation into trying to understand how recurring elements and themes can make up a set of universal patterns that in turn determine the form of a narrative. Semiotic theory and structural analysis have been adopted by many narratologists as a way of understanding the different units of a narrative structure and then how these relate to one another (i.e. how signs are combined into codes to transmit messages, how authors encode their texts with distinctive literary qualities). With regards to this thesis, the interest

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<sup>35</sup> In particular it will look at a semiotic and structural analysis approach to narrative. Semiotics is the study of sign systems and structural analysis focuses on the structural relations, (i.e. it involves identifying the constituent units in a semiotic system and the structural relationships between them) (Chandler, 2002, p.79).

lies in understanding these units and structures of the narrative and then how they might be extended further into the realms of aesthetics and the development of visual narrative experiences in VR.

In his *Morphology of the Folktale*, the Russian formalist Propp (1895- 1970) argued that the entire body of Russian folktales can be condensed into a definite number of plots. To draw these conclusions, he compared the structure of over one hundred Russian folktales in which he identified many common themes, which he then isolated into thirty one functions (i.e. basic plot structures), of which twenty five were constant. He established that not all of these functions might appear in the same single tale, though maintained that those that did could be combined and interchanged with one another and were instantly identifiable. From this work, he further went on to suggest the structure of the Russian fairy tale as a seven part model; he compressed the structure of the folktale into simple irreducible narrative elements. For example, he claimed that the tale usually began with some sort of initial situation (Propp, 1968, p.25) and from which a number of sections consecutively resulted. The initial situation/ build up was followed by the preparatory section which provided essential narrative information which in turn was manipulated by the complication section. This section and the following donor section, he suggested, seem to call for deeper understanding and then action. After this action section, the tale continues by either moving into a second move section or into the repeat section. This analysis has often been referred to as the birth of modern narratology (Schärfe, 2004, p.69) and still today, is being applied to the development of narrative in film, television and new media.

Likewise later narratologists, such as Barthes and Todorov, continued to investigate how narratives are constructed... *'the ways in which details of various kinds in a novel are organised to produce effects of suspense, characters, plot sequences and thematic and symbolic patterns'* (Genette, 1980, p.8). Todorov suggested that narrative in its most basic form is a *causal transformation* of a situation through five stages, the first being a state of equilibrium at the onset, then a disruption of equilibrium by some action, followed a recognition that there has been a disruption and an attempt to repair the disruption, then finally a reinstatement of the initial equilibrium (Branigan, 1992, p.4). He claims that narrative was not a linear structure but a circular one and that the narrative was driven by attempts to restore equilibrium.

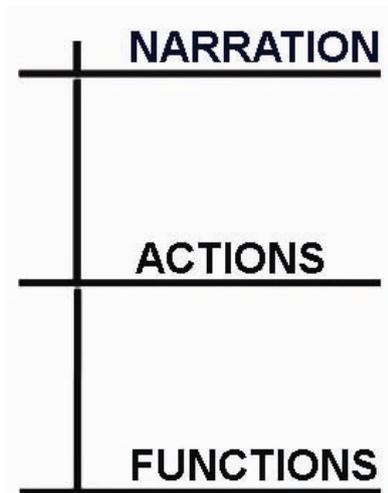


Fig. 4: A Representation of Barthes' Narrative Structure Model

Barthes, on the other hand, proposed a hierarchical approach, he felt that *'to read a narrative is not merely to move from one world to the next, it is also to move from one level to the next'* (1977, p.16/17). In his early work, he described narratives as a hierarchy of instances and he identified three levels – functions, actions and narration: narration on the top level, actions in the middle and functions on the bottom level (see fig.4). He explains a function is the smallest unit of narrative that only holds meaning in so far as it combines with the other units, on the same level or on a higher level.<sup>36</sup> In other words *'the essence of the function is, so to speak, the seed that it sows in the narrative, planting an element that will come to fruition later – either on the same level or elsewhere, or another level'* (Barthes, 1977, p.89).

In his later book *S/Z*, he proposes that in order for us to make sense of the narrative, we pull out narrative codes, which are interwoven within the structure. He describes five narrative codes: the hermeneutic code refers to any element in a story that is not explained, an enigma or gap that enhances interest and curiosity and prolongs the reading experience; the proairetic code applies to any action that implies a further narrative action, that builds the interest or suspense of the spectator/reader; the semantic code creates additional meaning by way of connotation; the symbolic code encourages a deeper additional meaning

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<sup>36</sup> He divides the functions level into two major classes, distributional units (for example functions, basically actions and events which unfold in a horizontal axis) and the integrational units (for example indices which are more vertical and diffuse and provide information about atmosphere, character, time and place). Within these, he subdivides the functions into 'cardinal functions' nuclei and catalyzers. He describes the nuclei as key points, hinge moments in a narrative and catalyzers, which are smaller supporting actions that fill out a narrative. He subdivides the indices into indices and informants which can be described as ready-made knowledge, the indices are open to interpretation while the informants are more concrete. He claimed that all these units could possibly interact together or combine with the higher levels (actions and narration) to form a narrative structure.

to this connotation; and finally the cultural code tends to support a shared cultural knowledge (Barthes, 1974, p.19). Barthes spent many years investigating these codes and their role within the structure of a narrative, and even though the possibility of moving the content of a narrative from one medium to another may not be universally agreed on as a defining characteristic, he remained fascinated by the potential of the transposability of narratives and spent years looking for the universal narrative structure (Schärfe, 2004, p.19).

In terms of VR, the work of these narratologists (as well as others) has provided computer theorists, designers and researchers with a grounded understanding of the different components that make up the narrative. Barthes' hierarchical approach, Todorov's five stages or even Propp's seven part model has exposed them to different processes and patterns, particularly how building blocks of meaning called signs are combined into codes to transmit stories. To name a few, Propp's analysis of the Russian folktales has directly inspired the work of Grasbon & Braun (2001) and TEATRIX by Prada, Machado and Paiva (2000). The work of Cavazza et al. (2002) has been greatly motivated by the findings of Barthes while Propp's functions and Todorov's narrative transformations have stimulated the work on interactive drama by Szilas (1999).

Nevertheless, the overriding goal of this chapter is to drive this existing narrative work further, to go beyond the existing cognitive backdrop from which many VR narratives have emerged. The aim is to expose photorealistic VR environments as an *'amorphous space of meaning'* that is *'a rich tapestry of the sensuous, affective, chimerical and reminiscent existing in every mind, eluding language and escaping the shackles of definition'* (Liu, 2004, p.2). As discussed in Chapter 2, the aim is to take VR beyond the semiotic process of interaction where the user observing the screen makes decisions and takes new measures according to their interpretation of the sign (Nake & Grabowski cited in Fishwick, 2006, p.65). The goal is to consider an aesthetic process. In terms of narrative, this opens the door to many different modes of interpretation such as thought, feeling, sensation, intuition, and culture as a means to *'engage'* in the story. As Liu & Maes (2005, p.1) point out, aesthetic reading is not just about reading for information: *'it is an emotionalised and personal reading whereby the text's primary purpose is to evoke aesthetic rumblings within the reader.'* Indeed, as Liu (2004, p.1) says: *'if a narrative is to be aesthetic... it must challenge the unflattering comparison to known narrative forms and techniques'*. Like the early narratologists, the author of this chapter recognises the benefits in

identifying and using certain narrative structures.<sup>37</sup> Yet at the same time it also acknowledges the need to extend from the sign by considering the aesthetic (i.e. to create structures of aesthetic objects as opposed to those of semiotic signs as a means of creating a narrative environment which is alive with meaning and feeling).

### 3.4.2 Aesthetic Object or Semiotic Sign?

The question arises as to what is the difference between the aesthetic object and the semiotic sign? From what has been seen so far (particularly in the previous chapter), the aesthetic experience originates through the senses. It is about finding something (i.e. a work of art, a computer interface etc.) sensually attractive/ arousing in itself and then using these feelings to inform a greater sense of what the work is about and means. The aesthetic object exists in itself (i.e. the colour white gives cool, peaceful and secure feelings) but also through the senses informs the meaning (i.e. a white room is cool and secure might represent a hospital room etc). As Walsh (1974, p.7) says *'being an aesthetic object means functioning as an aesthetic object and any object so functions if and when it is an object of aesthetic attitude, interest or point of view'*. She goes on to say that an aesthetic object must be an object in its own right, and its existence must be independent of our manner of considering it or of the attitude we adopt towards it.

A sign on the other hand is an event or thing that directs attention or is indicative of other events or things. Semiotics is about the *other*; it is about everything that can be taken as a sign (Eco, 1976, p.7). As Chandler says *'semiotics involves how meanings are made and how reality is represented.'* It is anything which stands for something else and can be words, sounds, images, gestures, and objects (Chandler, 2002, p.2). Dewey (1934, p.87) says *'words are symbols which represent objects and actions in the sense of standing for them; in that sense they have meaning'*. He highlights that these words don't have meanings of their own right, but that they have meaning because they stand for something else. He takes this further by saying there are *'other meanings that present themselves directly as possessions of objects which are experienced. Here there is no need for a code or interpretation; the meaning is as inherent in immediate experience as that of a flower garden'* (Dewey, 1934, p.87). Dewey makes the distinction between science and art (i.e. the word and the image), in that science

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<sup>37</sup> Structuralism is fundamentally a way of thinking about the world which is predominantly concerned with the perception and description of structures (Hawkes, 1977, p.17). Jean Piaget argued that structure embodies: a) the idea of wholeness – the sense of internal coherence b) the idea of transformation – material can be constantly processed by and through it c) the idea of self regulation – the sense that it makes no appeals beyond itself (Hawkes, 1977, p.16).

states meanings while art expresses them, science directs ones course to a new meaning while art supplies experience of that meaning (Dewey, 1934, p.87).

However, there are those, like Rudner (1951, p.2) who believe that '*any semiotic theory that holds that the aesthetic experience is immediate, the aesthetic object is valued in and for itself and is immediately and immanently consummatory is systematically defective*'. It has been argued that colour is a sign in that it represents something else (i.e. the colour white can symbolise peace). The author of this thesis is claiming that it does more than just represent something else, it exists and is valued in itself. It embodies and supplies feelings and sensations which then play an intrinsic part in the creation of the experience. Even as Morris (1964, p.73) says '*what is perceived aesthetically may, but need not, be a sign. The signs that do occur in aesthetic perception need not be iconic, need not be limited to any single dimension of significance (such as appraisal) and need not be given some primary use (such as valuative)*'.<sup>38</sup> Colour can be a sign. It can direct us to other meanings but it is much more powerful than that. As one of the most celebrated semioticians realised '*in order to arrive at this essence or to experience the aesthetic moment Barthes finds that he must reject all means of classifying the image and all theoretical disciplines, including semiology which he was so central in establishing*' (Kember, 2004, p.212). Kember highlights that Barthes experiences the power of the effect in his being, more in his body than mind, more in emotion than thought. As Dewey concludes the aesthetic as distinct from the scientific (sign as distinct from the aesthetic object) '*does something different from leading to an experience, it constitutes one*' (Dewey, 1934, p.88). In that sense, this chapter is looking to create a VR narrative experience, that emerges, exists and is valued in itself that is 'engaging' and unique.

### 3.4.3 Emergent Narrative

*'VR offers a new way for experiencing fiction. Someone reading a book or viewing a film or video may identify with the protagonist but in VR the relationship is more direct; the user is the protagonist'* (Anstey et al., 2000, p.1).

Photorealistic VR encourages narratives which not only have emerged from human life experience (Aylett, 1999, line 57) but from human life experiences in realistic surroundings. In that sense, the narratives can be compared to those created in real life, in that they are emergent; the viewer becomes the protagonist of the story and moves through the space, changing his or her point-of-view and hence the storyline as he or she pleases. As Brown et al. (2002, p.5) note VR users have a great deal more control over what they see

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<sup>38</sup> Morris is an American semiotician and philosopher who brought aesthetics under the study of semiotics

and experience (i.e. their choices are what drives the narrative). However, as the previous sections have discussed, photorealistic VR designers have the power (through the use of aesthetics) to influence these choices made by the user and hence to arouse them into the sharing of certain information and certain ‘engaged interactions’ which in turn drive the creation of certain types of stories.

However, like most narratives, a structure is needed which encourages the viewer to aesthetically interact and pick up the relevant narrative cues. Yet, unlike film or the novel, the content of photorealistic VR doesn’t exist as a linear storyline but rather as a space to be explored. Ryan claims that VR narratives are not very different from traditional narrative patterns in that one fixed story could emerge in many different ways, depending on how the participant interacts (i.e. aesthetically interacts) and what path is chosen through the environment (Ryan, 2001, line 112).

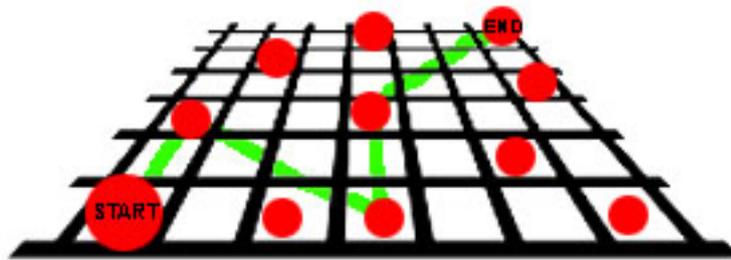


Fig. 5: A Representation of Murray’s Grid Like Structure

Addressing that Murray (2000, p.170) suggests that a kaleidoscopic structure has many possibilities for narrative in a VR environment (e.g. a grid-like structure where the user freely navigates and randomly links elements to form a story). Using this structure each user experiences the same environment but creates a different story depending on the choices they make and the paths they take in the environment (see fig. 5). As Murray claims this gives us the best of both worlds: it allows us the expansiveness of a book where the simultaneous actions are presented consecutively and also the rapid intercutting of the film. It gives us the ability to present simultaneous actions in multiple ways (Murray, 2000, p.157). Indeed, this opens many exciting doors for the creation of narratives and especially aesthetic driven narratives in photorealistic VR environments. However, in terms of further building these narrative experiences, as Louchart & Aylett (2004a, p.4) point out, a certain amount of specific requirements are needed. These include the character design, the world and environment designs, the interaction considerations and finally the user roles and different involvements.

### 3.4.4 Discussion

Like the early narratologists this research supports the need to consider the structure of a narrative in photorealistic VR. Similar to Murray (2000) it favours structures that work with the versatility of the VR medium (i.e. flexible structures that still retain certain control over the paths and choices the participant makes in the VR environment). Also, in terms of building the narrative, it also recognises the necessity to consider the whole picture and to carefully reflect on the design of the environment and the different interactions, experiences and user roles that can occur. In view of that, this chapter strongly supports the need to go beyond the semiotic approach to VR narrative design (used by many contemporary computer theorists, designers and researchers) and to focus on an aesthetic process of interaction and the aesthetic object as a means of broadening the narrative experience in VR. The main drive throughout this chapter is to expose the experiential potential of the photorealistic VR environment. As seen, the previous sections have explored the intermingled relationship between VR, narrative and aesthetics, in doing so, the author has started to tease out how they might all fit together to create narratives that are alive with both meaning and feelings and '*spaces with qualities that call forth active imagination*' (Laurel et al., 1994, line 244).

## 3.5 Conclusion

*'VR offers the artist a brave new world for the imagination; a tantalising mix of absolute freedom and niggling limitations'* (Anstey et al., 2000, line 10). Continuing on from the previous chapter's notion of *aesthetic-interaction*, this chapter has explored the idea of how one might be enticed to aesthetically interact within a photorealistic VR environment. In particular, it has looked at narrative development in VR. It has suggested pushing the boundaries of traditional narrative structures by replacing the semiotic sign with the aesthetic object to include the senses, intuition and intellect in the narrative experience. Indeed, the chapter has exposed a common ground between the aesthetic experience and the narrative experience which within the photorealistic VR medium has started to highlight many opportunities for the creation of 'engaging' experiences. In terms of HCI, this has incited our interaction with photorealistic VR to a new experiential level, in that aesthetics is beginning to be seen to have the power to influence the way one experiences the VR environment. The next step of this thesis is then to establish how exactly the aesthetic objects of the photorealistic VR environment can be patterned into a narrative structure to generate 'engagement'. In fact, as virtual reality '*rests firmly on historical art*

*traditions*' (Grau, 2003, p.339), it will be crucial to look at how other visual media have mastered this, and how their approaches and techniques might be applied and even manipulated to suit photorealistic VR. As Chapter 4 will show, the visual-narrative (i.e. from cave paintings to computer art) has used aesthetics to create enriching narratives and 'engaging' experiences. The goal of this next chapter is to investigate how these techniques and approaches might be further adopted to the medium of photorealistic VR.

# 4: THE VISUAL- NARRATIVE

Many forms of knowledge and entertainment are now visually constructed and after centuries of *word* dominance, it is finally being realized that '*what we see is as important, if not more so than what we hear or read*' (Rose, 2001, p.1). In fact, one is constantly surrounded by different sorts of images, visualising technologies and media which are steadily taking the place of written texts as a new exciting means of communicating and storytelling. Photorealistic VR is one of these fascinating visual media and in terms of this particular research, the interest lies in how it can be visually constructed (i.e. strategically patterned) to 'engage' people in stories. To understand more, this chapter will look at other visual media and how they have told stories through history. In particular, it will look at the aesthetic reading of these visual media (i.e. how colours were strategically patterned to 'engage' the reader sensuously, intellectually, culturally and intuitively in the creation of a story). In doing so, the chapter aims to probe the relationship between the aesthetic and the narrative (see Chapter 3), to explore the *aesthetic-interactions* (see Chapter 2) and how we, as individuals, aesthetically interact with the content in order to generate a story.

## 4.1 Visual-narratives

A visual-narrative can be defined as pictures that tell a story. These pictures do not depend on a literary component, but are made up of an image or a set of visual elements, which are interwoven with a narrative intent (Coulter-Smith, 2000, p105). Visual-narratives are driven by the content, style and composition, which, are very much influenced by the materials and media that have created them and by the viewer (i.e. it is the artist who strategically patterns the story in a space, but it is the viewer, through their

own experience, who recreates it). Visual-narratives have been in existence since prehistoric times and as Lynton et al. (1985, p.32) discuss it is often useful to think of narrative painting (i.e. visual-narratives) as a form of drama with which one ‘engages’. Indeed, the visual-narrative is strategically patterned to give the viewer that sense of being a part of the unfolding narrative (i.e. it is the viewer’s interaction with the content that encourages them to become involved in the painting).

Engagement is a term that has often been associated with the idea of flow, which is suggested by Csikszentmihalyi & Robinson (1990, pg.7) as *‘the deep involvement in and effortless progression of the activity’*. Lessiter et al. (2001) elaborate further in their ITC-Sense of Presence Inventory (SOPI) when they use words like ‘drawn in’, ‘involved’, and ‘enjoyed’ to describe one’s sense of engagement.<sup>39</sup> In terms of the visual-narrative, it is about drawing in and then involving participants in the creation of certain thoughts, feelings and narrative interpretations. Csikszentmihalyi & Robinson state: *‘artists have found many ways to use visual media to code pleasurable formal patterns, complex events, and subtle emotions’* (1990, Pg 2); they feel that by decoding such information viewers can share engaging experiences that would otherwise not be accessible to them. However, in terms of this research, the visual-narrative is seen to be more about the images and their aesthetic elements ‘evolving’ as narrative cues (i.e. when strategically patterned within the picture space, the aesthetic elements can draw in and guide the viewer, through their own experience, to create their own story). In fact, the visual-narrative offers much more than objective reading (i.e. encoding stories): it offers an aesthetic reading and the possibility to ‘engage’ the agency of intuition, sensation, sentiment and cultural interpretation of the viewer. In that sense, the author sees the concept of engagement as moving towards the ‘engaged interaction’ where the visual-narrative has the potential to ‘engage’ the intellect, the senses and intuitions and as a result encourage the viewer to aesthetically interact in the creation of a narration.

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<sup>39</sup> Other dimensions of engagement explored in this cross-media presence questionnaire are: I lost track of time; I responded emotionally; the content appealed to me; my experience was intense; I paid more attention to the displayed environment than I did to my own thoughts; I felt sad that my experience was over; I had a sense that I had returned from a journey; I would like the experience to continue; I vividly remember some parts of the experience; I’d recommend the experience to my friends

## 4.2 Aesthetic Reading

For many people, an understanding of the world is achieved through the reading of images as opposed to the reading of words. As a result it is very important for us to be able to read images. Visual literacy is the ability to see, to understand, and ultimately to think, create, and communicate graphically (Thibault, 2003, p.1). It is all about having the ability to differentiate and then interpret the visible actions, objects and/ or symbols, natural or man made, that are (encountered) in the environment (Avgerinou, 1997, line 4). As Kress and Leeuwen (1996, p.1) point out it is understanding a visual grammar which '*describes the way in which depicted people, places and things combine in visual statements of greater or lesser complexity and extension*'. In more detail, this grammar is made up of a number of basic elements (i.e. the dot, the line, shape, form, tone, texture and colour) and it is the readers' interaction with these basic elements in conjunction with the medium and the context that results in an effective reading and understanding. Indeed, the key focus in this research is how these basic elements particularly colour can be patterned in a photorealistic VR environment so that the reader is not only attracted to certain areas and into certain thoughts but also into feeling certain feelings, intuitions and remembering certain memories. The author of this thesis is particularly interested in exploring how these feelings, memories and thoughts then evolve into a visual-narrative and hence an 'engaging' experience.<sup>40</sup>

Looking closely, the author believes that the essence of the visual-narrative experience emerges from the viewer aesthetically interacting with the content (see *aesthetic-interaction* in Chapter 2). In that sense, the visual-narrative and the *aesthetic-interaction* are seen to have a reciprocal relationship in that the viewer's *aesthetic-interactions* feed the visual-narrative while at the same time, the visual-narrative provides a pattern to articulate the viewer's *aesthetic-interactions*. This *give-and-take* relationship between the visual-narrative and the *aesthetic-interaction* process allows for what the author calls, the aesthetic reading (as opposed to the objective reading) of the visual-narrative. As Liu & Maes (2005, p.1) describe an aesthetic reading evolves from the senses, intellect, intuition and cultural interpretation to tell the story. Indeed, for the 'aesthetic reading' to be effective it must have both *strength* and *clarity* (Altengarten in reference to visual communication, 2002, line3). The term *strength* concerns the ability of the aesthetic element to attract the viewer's

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<sup>40</sup> This differs from the semiotic process of communication which stresses the idea that images are collection of signs that are linked together in some way (Bulut & Yurdaisik, 2005). The aesthetic process is encouraging the evolution of the narrative (as opposed to a bare representation) through the participant's senses, memories, intuitions and thoughts.

attention and the term *clarity* refers to the ability of the aesthetic element to keep the viewers interest. According to Csikszentmihalyi & Robinson (1990, p.18 –19), for attention to be attracted to the object, a set of conditions are needed, in the sense that the object must contain a set of visual challenges that engage the interpretative skills of the beholder and the environment must encourage a centring of attention on the object and a screening out of distractions. For example, when we look at literature, when one reads a book for pleasure one experiences an unforced concentration that transports them to another place (Nell, 1988, p.1). The reader is drawn into the world of the book with its own sense of time that in many ways screens out the real world and its distractions.

In the visual experience, there is a difference between passive reception and active perceiving (Arnheim, 1969, p.14). As we look around a room, everything we see is there without having to do anything to produce it. We receive this information passively. It just exists, but when we start to be attracted to certain objects, to feel certain emotions and intuitions, to want more information, then we start to aesthetically interact and become actively involved. Berger claims that '*we never look at just one thing; we are always looking at the relation between things and ourselves*' (1977, p.9). As the Gestalt psychologists outlined, there are several universal principles of perceptual organisation (i.e. proximity, similarity, good continuation, closure, smallness, surroundedness, symmetry and prägnanz) (Bruce & Green & Georgeson, 1996, p.107-110).<sup>41</sup> They believe that whenever one tries to make sense of information visually, one associates features that are close together; that look similar; that follow a smooth continuity rather than abrupt change; one favours closed rather than open figures; one sees small areas as figures on a larger background; symmetrical areas as figures against asymmetrical backgrounds and one perceives areas seen as surrounded by others as figures.

In line with this, aesthetic reading is about attracting the viewer's attention and then keeping their interest. It is all about the construction of associations and meanings through feelings, intuitions, thoughts, memories etc. which one can then stitch together to form a deeper understanding of what they are seeing (i.e. a narrative). As Coulter Smith (2000, p.105) points out: '*visual narrative does not depend upon art incorporating a literary component, but that the rhetoric of visibility offers a complexity and sophistication that can inform literature*'. In other words, the image has a vocabulary and grammar that is quite different from that of literature, it can inform literature but it is never fully explicable or dependent on it.

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<sup>41</sup> Gestalt theory is closely associated with the work of three men: Wertheimer (1880-1943), Köhler (1887-1967) and Koffka (1886-1941). (Gordon, 2004, p.7)

### 4.2.1 Composition

When one looks at any work of art, whether it is a painting, a sculpture, a digital installation or a building, one is, in fact, looking at different ways that an artist has strategically patterned elements in a space. According to Andrews (1995, p.117), when they look at a painting (Renaissance), *'it is possible to imagine ourselves within a picture space moving throughout it over time, as if it were the real world, where several moments or episodes all remain in view, even as we concentrate our attention on the first one and then the next'*. As mentioned every picture, whether painted, photographic, digital etc. has a grammar, it is a collection of elements (dots, lines, shapes, forms, tones, textures, colours etc.) patterned in a carefully planned composition. It is this strategic arrangement and composition of elements that allows us to express, to communicate, or even to tell a story. As O'Toole (1994, p.7-12) (talking about painting) shows, the visual units, the characters, and the objects in a painting, as well as their actions, gestures, and stance, all have the potential to carry important clues about what the people portrayed are doing and what stories they are creating by doing so. By perceiving the visual units in a carefully arranged and organised picture space, the viewer is able to piece together the whole story.

According to Boyd Davis (2004, p.65), most graphics may be considered as planar images and there are roughly two contrasting strategies of organising elements in the planar graphical space: the configurational and the pictorial. In the configurational, he states, the elements are combined in the two-dimensional space of the composition itself (e.g. early Christian, Romanesque and Byzantine art). In the pictorial, meanwhile, they are combined in an assumed world space, real or imaginary, which is then depicted (e.g. Renaissance art, Baroque art, photorealistic VR etc.). This chapter looks at both of these graphical representations and how they have been patterned to create effective visual-narratives. In particular, it will consider the different use of visual relationships (i.e. see above the Gestalt theories) and weight in the visual spaces to add and subtract to the narrative movement through the whole picture. Visual weight can be measured by the extent to which a visual element demands our attention or maintains our interest (i.e. colour can be used to draw and hold our attention on certain areas etc). When a visual is weighted it can become a focal point and by creating focal points the artist and designer has the power to draw the viewer into the space and compel them to look at certain things, which in turn, can help glue the story together.

By looking at different visual-narratives through history, the aim is to identify different techniques and structures used to draw the viewer into the narrative space and keep them there. What will be interesting is that each visual media adds its own

uniqueness, as Hugo (1996, p.4) once said *'a better understanding and mastery of visual communication requires not only this ability to read images but also a thorough understanding of the nature of these new visual technologies and media and their codes and conventions'*.

## 4.2.2 Colour

*'Colour is one of the most obvious and pervasive qualities in our environment. We interact with it every time we note the colour of a traffic light, choose clothes that are colour coordinated or appreciate the colours of a painting. We pick favourite colours, we react emotionally to colours and we imbue colours with special meanings'* (Goldstein, 2002, p.185).

Colour plays an intrinsic role in the reading of visual-narratives, as Zettl says *'colour adds a new dimension to everything'* (1999, p.47); it is the first thing that someone notices about an object or environment *'the colour of an object is perceived before the details imparted by its shapes and lines'* (Anderson Feisner, 2000, p.2). Colour provides visual and psychological information and can control and influence viewer's responses and reactions (Anderson Feisner, 2000, p.117); it can affect people in different ways depending on their memories, experiences, intelligence and cultural background. Within itself, the energy and impact of a colour *'depends on the hue, saturation and brightness attributes of a colour, the size of the coloured area and the relative contrast between foreground and background colours when looking at hues'* (Zettl, 1999, p.58). For example red, orange, yellow and brown hues are used to induce emotions such as excitement, cheerfulness, stimulation and aggression while blue, green, grey are cool, implying security, calm, peace or sadness and melancholy (Anderson Feisner, 2000, p.118). As Vernon (1962, p.67) says *'Colour perception is often associated with feelings of pleasure or displeasure'* and *'most people have preferences for certain colours rather than for others'*.

Colour can be used for a number of different purposes: they can serve *'a very wide range of aesthetic and symbolic purposes'* (Gage, 2000, p.34). As well as helping us to identify and tell us more about things *'colours not only make the event more realistic but they also give us specific information about its conditions'* (Zettl, 1999, p.63). As Goldstein (2002, p.186) notes: *'Colour adds beauty to our lives, but it is more than that colour serves important signalling functions, both natural and contrived by humans (i.e. traffic light) in addition to its signalling function, colour helps facilitate perceptual organisation, the ability to tell one object from another'*. Colour is the *'primary method of conveying one's message. Colour can reflect mood, emotion and time frame and provide the symbolism'* (Anderson Feisner, 2000, p.66). However to use colour to its full potential, one needs to understand the compositional and expressive functions of colour. As Zettl says, rather than trying to identify hues that match

and go well together *'you will do much better by translating colours into colour energies and then bringing the various energies into either balance or purposeful conflict'* (1999, p.65). When objects have an unexpected colour, the eye gravitates to it and makes it the focal point while the other colours are deemphasised. This relationship between the colours can produce many different energy levels and feelings; the wider the contrast between the colours, the greater the impact.

In digital media, as in painting, colours play an important part in the *aesthetic-interaction* process (see Chapter 2). They are not only used to draw importance to certain objects and areas of a picture (Knoppel, 2005, p.2); but also they are used to express the essential quality of an object and to add excitement and drama as well as a specific mood (Zettl, 1999, p.66).<sup>42</sup> In fact, colours can guide the viewer to make certain decisions: *'our surroundings, our experiences, and even our memories influence the associations we have with colours and affect our predispositions and the choices we make'* (Tan & Zeng, 2004, p.235). Colour has the power to create an absorbed interplay of cognitive and non cognitive faculties on an object that in turn can cause an 'engaged' attention and a kind of pleasure (Friday, 2002, p.28). However to successfully create 'engaging' experiences (particularly in VR), colour needs to work within *'a form and content, which catches and holds the user's attention and absorbs the user in the illusion of interacting in the three dimensional space...'* (Marsh & Wright, 2000, p.1). VR designers need to organise the elements (i.e. colours) or the sets of elements to maintain the users attention while at the same time draw him or her away from the artificiality of the system: *'Without the artworks prompting, we could not start or maintain the process; without our playing along and picking up the cues [colours], the artwork remains only an artefact'* (Bordwell, 1990, p.34). Indeed, it is one task to manipulate colours in the VR environment in order to encourage *aesthetic-interactions*, but it is another to strategically pattern these colours so that the user is attentive and 'engaged' for a substantial period of time. The next section of this chapter will look specifically at the development of the visual-narrative through history, specifically, the colours, the techniques and the patterns used to *'balance the interaction [exploration] with an ability to guide the user, while at the same time maintaining a sense of pacing or flow through the experience'* (Galyean, 1995, p.103).

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<sup>42</sup> Saturation is the intensity of a colour and be used to control the dominance of a colour

## 4.3 The Visual-narrative: a Brief History

This section is particularly interested in how visual-narratives (through history) have achieved the balance of interaction which guides the reader through the narrative while maintaining the flow of the experience. Its main interest is in the aesthetic object (especially colour) and how it has been *strategically patterned* within the visual space to tell a story. In particular, it looks at how the aesthetic object and its strategic patterns have developed through time depending on the skill and knowledge of the artist/ creator and the advancements of the media. The following examples (a random selection through time) illustrate how the image as a storytelling tool has adapted to the changing media. By highlighting the various colour techniques applied to different visual spaces, the aim is to explore ways in which the image (and particularly the aesthetic element of colour) can be used to tell a story and create an ‘engaging’ photorealistic VR experience.

### 4.3.1 A Prehistoric Wall Painting

Images and the art of storytelling have a very long and intertwined history. More than 30,000 years ago, humans were using images on cave walls to tell stories and report on their own world and experiences. These have been noted to being images from spiritual trances. They tell us about what these prehistoric people saw and experienced in their trances and through them, they recreate their illusive encounters with the animals (Lewis-Williams cited in Brass, 1999, line 1). These frameless images are generally abstract. They arouse attention straight away as they are well defined and dance out of the rugged cave walls. In many ways, they are the last thing one would expect after travelling deep underground and in that sense, this gives the paintings an element of suspense (suspicion of the unknown). As Bataille (1980, p.15) says: *‘the splendour of the underground halls is incomparable: even when directly before his wealth of animal figures, how is one to avoid a momentary suspicion that it is all a mirage, some deliberate trick?’*

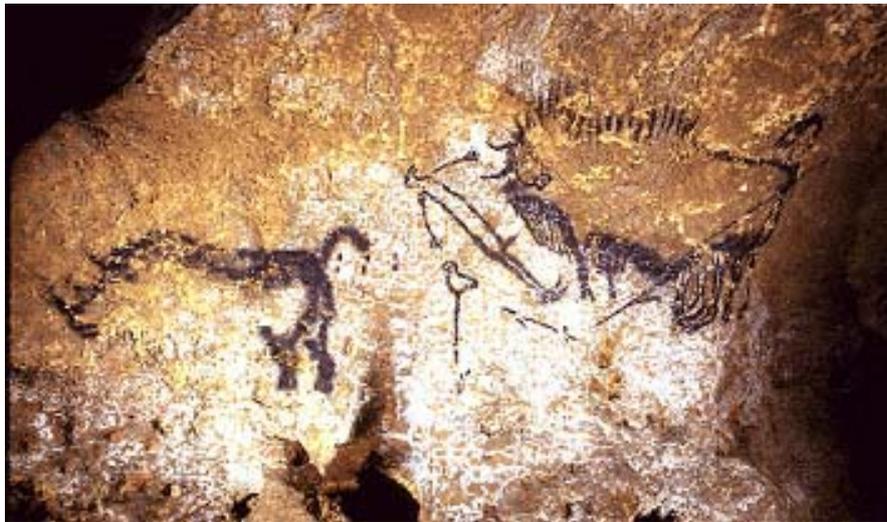


Fig. 6: The *Shaft of the Dead Man* (A Prehistoric Cave Painting)

Figure 6 which has become known as the ‘*well scene*’ or the ‘*shaft of the dead man*’ tells the story (in a cartoon like fashion) of a man with a bird face (perhaps a mask) falling backwards to his death as a bison (some say a woolly rhinoceros) attacks him with his sharp horns. This has been described as ‘*one of humanity’s earliest narrative compositions*’ and has been noted as having ‘*mingled awkwardness and strength of expression*’ (Bataille, 1980, p111). It lies on the uneven surface of the rock wall (amongst many other detailed three dimensional representations) deep inside the vast chambers of Lascaux in France and as a result cannot always be viewed from directly in front like ordinary pictures. This ‘*uneven surface*’ along with the awkward ‘*twisted perspective*’ of the characters (i.e. the bison shows a body in profile but with feet, ears and horns which are twisted) gives us several different viewpoints and allowing each viewer many different impressions of the same painting. As Bataille (1980, unpagged) points out: ‘*at every step things change, almost beyond recognition, a bull looks squat and hunch-necked; shift your position and the same animal acquires an elongated body and the head of the giraffe*’. This shift and change not only creates a certain degree of movement within the painting as characters change accordingly but also ‘*the ingenious use of surfaces in the rock, suggest depth and even a kind of perspective*’ (Johnson, 2003, line 147). As the viewers move through the caves, they can chose which viewpoints they prefer and by doing so build up different stories and impressions of the paintings.

This ‘*uneven surface*’ and ‘*twisted perspective*’ in union with the rocks native yellow/brown ochre adds a warmth and animation to the painting. The bison depicted as being ‘*very much full of life*’, is made up of broad dark strokes and is quite brusque and expressive. ‘*The infuriated bison’s hair literally stands straight on end, it lashes its tail, intestines spill in thick ropes from a gash in its belly*’ (Bataille, 1980, p.110). The man, on the other hand, is drawn in heavy black lines and is seen to be stiff. He is necked, ithyphallic and is

shown to be stabbed by the bison's horns, his arms are flung and his four-fingered hands are open. It is a rigid drawing '*awkward and similar to childlike simplification*' (Bataille, 1980, p.117) when compared to the '*naturalistic*' bison. Through the use of line and colour, the artist for whatever reason presents the bison and the man differently, as Bataille says: '*separation between man and animal seems almost to imply a systematic effort to preserve man from the naturalism*' (1980, p.117)

The intriguing thing about these chambers is that they have been thought by scholars to have been theatres for performance of rituals, as Sanes (2000a, p.2) points out '*the images were lit by flickering lamps, which must have added to the sense that they were in a world apart, a world modelled after their own fears and desires and perceptions.*' Indeed, the whole experience of being deep within these caves and surrounded by these representations of hunting scenes and animals created the illusion of being a part of the stories being portrayed (Sanes, 2000b, p.15). The dots surrounding the Bison and the falling man on the cave wall are described as representing the clouds of dots the people actually saw and experienced when they were just about to go into a trance themselves. This is of interest to us, as the pictorial technique of dotting combined with the flickering of light in the physical cave not only adds to the visual aesthetic of the cave but also helps to recreate the sensation of being in the story and hence in a new and different world. '*If we take into account the freshness of the pigments when the work was just done, and the impact of the lines and colours under the flickering light of primitive oil lamps, or flambeaux, we can imagine the force of the impact which this first artistic experience had on primitive humans, whose innocent eyes were unaccustomed to visual forms outside nature itself*' (Johnson, 2003, line 252). These cave paintings have no frames, but through the impact of lines and colour, they are promoting the idea of an *aesthetic-interaction* where the inside pictorial space melds with the outside surrounding physical space to create an entirely new experience. It is interesting to point out that these prehistoric paintings have been described as '*virtual environments of the earliest known form of human expression*' (Artmuseum, 2000, line 11)

### 4.3.2 A Christian Altarpiece

Somewhat later, during the latter half of the middle ages, we find a world where the written word now existed but where illiteracy ratings were still very high and where many people still depended solely on images as a means of communication and to tell stories. Nevertheless, the picture space and the approach used to tell these stories have changed quite a lot from the cave men years before. For example, the *Maestà* (1308-11) by *Duccio* is a good example of Christian narrative art whose main role was to tell the story of Christ

(see fig. 7). It has been described as an ‘*innovative use of narrative composition, colour and gilding which sums up the Byzantine style so splendidly*’ (Esaak, 2007, line 12).



Fig. 7: *Maestà* (1308-11) by Duccio

It is a very large double-sided altarpiece whose front side, in a stylised and symbolic fashion, mainly depicts Mary, the mother of God, holding her son on her lap. On the back, there were originally forty-three episodes in total: it consists of the central panel, crowning panels and predella. The central section has twenty six scenes from the passion of Christ which contains stories from all four gospels. It is important for us to understand that these paintings appealed to the audience at the time and that their function was primarily to inform and to enhance the peoples understanding of the religious story. Therefore, it is generally agreed that like a book, it was linear narrative and the scenes (framed separately) were to be read sequentially, the cycle beginning at the bottom left and ending at the top right, each scene telling its own story which in turn makes up the larger story of the passion of Christ.

For the reader at the time it was the emotional impact of the content that aroused the reader’s attention and kept them engaged. Duccio uses nine pigments in this altarpiece and as Hall (1992, p.32) says: ‘*it took considerable ingenuity to compose so many scenes with so many figures and to obtain the balance that he did*’. He painstakingly calculated the placement of hues in each panel so as to ensure that the fields of similar colour did not come in contact with one another and that the eye travelled through the story appropriately. For example in the scene where the blind man is healed, the eye first is drawn to Jesus as he is at the centre of the painting and is clad in brilliant ultramarine blue. He is backed by Peter and John in a paler shade of the blue and the crowd of apostles

which are arranged specifically that *'each is differentiated from the others and the whole creates an aesthetically pleasing pattern'* (Hall, 1992, p.35). Each colour is scaled hierarchically and the blind man caught in two different narrative moments wearing brown (which depicts his poverty) balances the panel (both compositionally and colouristically) against the crowd of wealth and holiness on the left of the work. *'Duccio has told his story simply and graphically, pointing up Jesus' compassion by showing with colour that the man he healed was not one of the powerful and wealthy but a pariah of his society'* (Hall, 1992, p.35). Duccio uses isochromatic patterns of colour to animate the lively linear pattern that leads the eye around but also makes use of colour to identify the various patronages and by doing so adds meaning to the painting.<sup>43</sup> *'In ancient Rome, purple was the colour reserved for the emperor (it could only be obtained in small quantities and very expensive) by the same token the deepest blue is appropriate to the most holy and revered and the undyed natural cloth depicts beggars and outcasts'* (Hall, 1992, P.35).

Duccio has been described as the *'first Western artist since antiquity to capture the weight and mass of bodies moving in space, making them three-dimensional with light and shadow'* (Washington National Gallery of Art, 2003, p.1). So in conjunction with the use of colour, Duccio has used light to add to the realism of the painting particularly in the modelling of figures (Washington National Gallery of Art, 2003, p.1). At the same time these are flat paintings which seem to focus more on the inner and more heavenly meaning of the image rather than on any realistic depiction of time and place on earth. Unlike the cave paintings (discussed previously), Duccio frames each scene in an architectural setting to separate the inside image space from the outside, surrounding space which gives the impression of looking into a separate world and we, the viewer, are on the outside looking in. The altarpiece interestingly introduces the idea of two spaces, which unlike the historic cave paintings; it chooses to separate the spaces in order to tell the story of another more transcendent world (Calter, 1998). He uses the frame as a means to separate two worlds but also as a way to identify and link many different narrative scenes within a larger space.

The intriguing thing about Duccio's work is the blending of different styles and traditions *'the formality of the Italo-Byzantine tradition, strengthened by a clearer understanding of its evolution from classical roots, is fused with the new spirituality of the Gothic style'* (Keresey, n.d., line 4). He manages to reconcile *'the Byzantine ideal of power and dignity with the underlying tenderness and mysticism of the Sieneese spirit'* (Keresey, n.d., line 87). He uses Byzantine iconographic schemes and develops them with a deeper concern for their wider narrative significance. In the Nativity scene, Duccio uses a cave setting which is

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<sup>43</sup> Isochromatic pattern is about using the same colour to connect the different parts of the pattern.

Byzantine and adds a manger roof similar to the gothic art of northern Europe. By including a large devotional image of the Virgin with the kind of scene that had usually been painted on church walls, the *Maestà* combines the functions of both icon and narrative art (Washington National Gallery of Art, 2007). What is of real interest is what the author sees as the ‘extension’ of the icon into an aesthetic object (in terms of the visual-narrative a more fully rounded narrative unit). For example, the colour blue is used to attract our attention, but also to inform us that we are looking at a holy person (Wilmer, 2006). Likewise, gold was used to break up the narrative composition and help give the impression of space and realism but also to enhance the iconic meaning of representing the radiance of heaven.

### 4.3.3 An Early Renaissance Fresco

The *picture space* continued to be used to communicate different stories, but after a time, people started to demand images which told stories that they could relate to, that fitted into their own lives. They wanted the stories to be more *real* and in order to achieve this, artists started to make people and objects in the pictures more *real* looking. Frey suggested that a gothic painting must be read rather than seen ‘*it rolls off, as it were, like a film before the observer, except that the successive pictorial impressions do not depend upon the mechanical movement of the film but upon the intellectual movement of the viewer*’ (Frey cited in Andrews, 1995, p.5). We need only to look at *The Tribute Money* (c.1425) by Masaccio which is located in the Brancacci Chapel, Florence, he was among the first to introduce and develop ‘*one point perspective*’, a technique which introduced to painting, a new convincing illusion of depth and continuous space often described as like looking through a window (see fig 8). ‘*Perspective painting immerses a virtual body in an environment that stretches in imagination far beyond the confines of the canvas*’ (Ryan, 2001, p.3). This technique brought with it a form of narration, which is now referred to as continuous (or polyscenic) narrative. This is where a picture has a number of actions occurring at different moments, which are presented, together in a single unified space. Similar to Duccio’s painting it had a religious drive as it contained a biblical moral in the narrative (i.e. God would provide). Though, dissimilar, it consisted of three scenes linked in one space by the figures of St. Peter, Christ and the tax collector.



Fig. 8: *The Tribute Money* (c.1425) by Masaccio

Massaccio moves on from the heavenly space that had been dominant in previous painting (Duccio's *Maestà*) and he starts to use perspective to develop an illusion of space on a flat surface. He achieves this by overlapping separate planes to suggest depth. These planes, known as foreground (i.e. the group of apostles, tax collector and Christ), middleground (i.e. architecture) and background (i.e. hills and sky), lead the viewer's eye from the closest objects in the painting backward to the furthest objects in the painting. The story begins in the slightly off-centre position where our eyes are drawn to Christ's head (i.e. where all the perspective lines running into the picture space meet). Then, they are guided by the gestures of the hands, placing of the feet, expressions of these figures and the eye-catching contrast between the red and green robes (i.e. that move the eye to the left of the painting where St. Peter follows the instructions of Christ and retrieves the coin from the mouth of the fish and then on to the right where St. Peter uses the coin to pay the tax collector).

Gone are the individual frames defining each narrative scene and separating our world with that of the painting, instead we are beginning to feel a little present in the drama. We are beginning to see how the use of perspective, colour and composition can help blend the inside and outside picture space and make us more involved and 'engaged'. Masaccio uses the Renaissance principle of classic colour theory which is founded on the psychological effects of colour (in a painting) on the viewer (No author given, 2007, line 20). The theory follows that warm colours appear to advance and cool colours recede. In *The Tribute Money* Massaccio uses warm colours like the red and orange clothed figures to enhance/ advance the characters and uses cool blue and grey to recede the background. This use of colour not only guides the eye to the main characters but also to the narrative which gives '*a lightness, a vivacity, and a majesty to the picture*' (Fremantle, n.d., line 24).

Instead of contrasting the colours of each of the draperies as Duccio has done, he chose closely related tones in red-purple-orange gamut and didn't use contour lines around the forms to separate them. The result shows a good sense of space, one firstly sees the band of colour made by the Apostles' cloaks across the front of *The Tribute Money* as a coherent whole and then secondarily the individual figures are distinguished. He also makes use of atmospheric perspective (brightness gradient, texture gradient, and colour saturation) to create the illusion of depth. He does this by giving us visual clues to the expanse of faraway objects (i.e. as already mentioned, objects closer to the viewer are brighter, have more colour and more detail than objects in the background). Masaccio has used atmospheric perspective together with linear perspective to create a convincing illusion of the biblical story (West Virginia Wesleyan College, n.d.).

What is interesting about this work is how it addressed the curiosity of the people. By looking closely at the details in the painting one can see the individual aspects of the scene very well (i.e. the worried looks on the men's faces, the richly coloured garments worn by the important figures of the church and the less colourful worn by the commoners, and the single church member on the right with his hand extended giving money to the commoner he is with). But also, to experience an overall interpretation of what's happening, one needs to step back and look at the entire painting. Accordingly, one can piece it all together to understand that the large group is upset and agitated as money is exchanged between a church member and a commoner. There is the overall feeling that another member is performing a seemingly wrong act. The painting can be described as portraying the overall feeling of wrongdoing by the church during the Protestant Reformation. As Lynton et al. (1985, p.36) states: '*the pictorial construction and the intellectual focus are congruent*'. Masaccio successfully integrates the senses and the intellect into the storytelling.

#### **4.3.4 A Flemish Altarpiece**

A few years later (1470), *The Passion of Christ* was painted by Memling (see fig. 9). Again it is a visual-narrative (with a similar theme to Duccio's altarpiece) but this time the altarpiece depicts over twenty two scenes with a topographic view of urban Jerusalem. Memling's style is '*static and spatial, his aesthetic idealised and rational and his message narrative*' (De Vos, 1994, p.52). This particular painting narrates the New Testament story of the *Passion of Christ* by picturing events as a series of scenes. Yet unlike the previous two paintings, the order of these scenes seems more of a *tortuous course* of events (Goodman cited in Van Den Berg, 2001, line 30). As Van Den Berg (2001, line 40) states: it can be described as '*an early modern instance of visual-narrative*'.



Fig. 9: *The Passion of Christ* (1470) by Memling

The painting immediately ‘engages’ spectators, it uses the urban form as a unified narrative frame and envelops out on to a vast imaginary expanse. It is divided randomly into different scenes and each scene is divided into micro scenes, which feed back into the main scenes. For example, the porter figure, lighting the gate torch in the foreground on the left, whose narrative function is to indicate a certain time and place in the city, acts as a link in the overall sequence. Within this frame, the narrative moves symmetrically from the back left to the foreground and through the principal scene in the middle, before culminating on the right (in the distance). It is plotted spatially as a series of scenic settings over the city, colours are used to attract attention and characters are used in the painting to link these sequences (i.e. Christ’s numerous appearances after the resurrection are as De Vos (1994, p.48) points out *‘visual links running into the landscape’*).

In terms of colour, *‘objects seem to have been coloured rather than possessing their own natural colour’* De Vos (1994, p.52). Memling creates a kind of *‘artificial and evenly distributed colour balance that takes over the entire surface of the painting’* (De Vos, 1994, p.52). And the effects of this are magnetic; as we look our eyes are drawn to the bright Mediterranean colours which drag us around the landscape. These not only enhance the narrative by attracting our attention to certain narrative areas but also they enhance the spatial effect as these colours are lightened and darkened by the light source which is located within the painting and is associated visually with the rising sun on the far right.

The overall effect is that of a complex stage set (De Vos, 1994, p.48) with different viewing positions. As Van Den Berg (2001) points out when we read this visual-narrative

we are prompted to appropriate and to alternate between two distinct narrative perspectives. He labels the spectators with two scenic roles, the first as a *prospector* and the other as a *sightseer*. He says *prospecting* viewers adopt an observer's stance towards the expanse and the horizon with a surveying orientation towards the schematic layout of the city map. *Sightseeing* spectators on the other hand are faced with ground level urban experience. What is of interest here is the idea of the spatial plotting of the narrative. We are not looking at the linear but instead we are thrown into a space and left to link the narrative cues (i.e. colours, characters etc) as we explore the space. This painting is about looking at narratives within narratives. It is framed not within the rigid architectural pillars like in Duccio's altarpiece but instead a random arrangement within the overall urban composition.

#### 4.3.5 A Baroque Painting

As Ryan points out, it wasn't until the 17th century that visual immersion reached its climax in the remarkable trompe l'oeil effects of the Baroque age (1600-1750). Here the distinction between the physical and pictorial/ sculptural space is blurred by turning the latter into a continuation of the former. This is why, she believes that Baroque churches offer a better prefiguration of the virtual reality experience than the architecture of any other age (Ryan, 2001, p.3 & p.291).

In the Baroque period (1600 –1750) we see a new concern for complex, dynamic motion and multiple perspectives. Gone is the limit of the frame and, instead, we now have an invasion of space in every direction that combines both multiple viewpoints and narrative perspectives. We see '*a space that illusionistically connects with, and infinitely extends from, our own*' and one that has '*a greater flow between the inside and the outside*' (Ndalianis, 2000, line 33).



Fig. 10: *Las Meninas* (1656) by Velasquez

When we look closely at *Las Meninas* (1656) by Velasquez we can begin to understand why it has been described as one of the best and also most puzzling paintings in the western world (see fig. 10). It is a painting about a representation, where the artist challenges the viewer by making them the model to be viewed and at the same time, part of the audience. The painting uses several visual techniques to grab/ keep our attention (trompe l'oeil techniques – see below) and also raises many questions about reality and the illusion of reality. Simply, it is about a group of people gathered together, and the narrative lies somewhere in determining what is happening. We are confronted with the mystery embodied both in the subject matter of the painting (what is this painting about?), by the artist's canvas (what is on the canvas?) and the mirror (who is in the mirror?). It is then up to us to determine – to solve – these enigmas in the painting. In every sense we are implicated in the picture space, the gaze signals from within the picture that we, the viewer outside are seen. As Huddleston (2001, line 53) states: '*Baroque art unites the painting and the viewer in a single space, creating the illusion that the image is as real as its beholder and that the pictorial space extends infinitely*'.

Using trompe l'oeil devices (i.e. tricks of light and endowing objects with a sense of weight and mass) one not only begins to get the illusion of one space (i.e. a combination of the image, and its surrounding physical space) but also one looks at the visual cues and starts to be drawn around the space. In terms of colour, Velasquez aimed at the '*cool effect of*

*silvery light*, and he preserves an appearance of truth and natural vigour, so much so that *'when you look at both nature and the picture, your eye only seems to pass from one room into another.* (Antiques digest, n.d., line 76). The whole composition and arrangement of visual units leads us to believe that we are all together, we are looking at the little ensemble of people, and also, for some reason, the artist is looking at us. But why? It is that feeling of puzzlement that is important; looking at this painting, we become 'engaged' in trying to figure out what's going on? Why is the artist looking at us? Who is in the mirror? Where are these people? Are they next to us? What is the man at the door doing? It is these questions, which draw us into the painting and extends our world into the world of the painting to create a single space.

### 4.3.6 A Twentieth Century Film

In 1895, however, things began to change. Two brothers, Auguste and Louis Lumiere, were amongst the first to bring this change when they exhibited the moving image system or, as we know it today the cinema. This saw huge developments for the image as it presented us with familiar and realistic images (arranged within a rectangular frame) and offered us all the combined experiences of painting, music, literature, theatre and architecture. For the first time, we were presented with images in illusory motion, engendering a much greater sense of realism. The early films were more of a spectacle, which seemed to cross into the viewer's own space (Elsaesser, 1990, pg.57-59). For example, one of the first films shown by the Lumiere brothers (in Paris in 1895) shows a train entering a station. When this was shown, many people from the audience ran out of the room as they felt the train was going to run them over. They really felt that they shared the same space as the train.

After a time, people began to further explore the potential of film as a storytelling art and they began to realise that it could also offer us a window into a new world, and a new illusionary space. Nowadays, the viewer can experience this new world as a narrative evolving from a chain of cause-and-effect events occurring in time and space (i.e. we watch the moving images, pick up cues, recall information, feel curiosity, suspense and/ or surprise etc. and then anticipate what will follow). *'When we see a film, though we do not engage with only a narrative or a non narrative pattern ... we experience a film – not a painting or a novel ... consequently our understanding of a film must include features of the film medium'* (Bordwell & Thompson, 1990, p.126). In their book *Film Art: An Introduction*, Bordwell & Thompson claim that, in order to appreciate the form of a film, we must understand how the formal system of a film works (i.e. in this case, how the

narrative interacts with the stylistic system-patterned use of techniques, editing, mise-en-scene, sound, cinematography). They believe that the picture space must be filled up in ways that cue the viewer to notice and feel certain things (and, indeed, not to notice and feel others). For example, through the use of visual cues (i.e. which encourage us to look at particular things), sound (i.e. diegetic and non diegetic sound) and editing etc., the film director has the power to make us feel either, on the outside looking into a separate world or in the picture and part of the story.



Fig. 11: *Red Desert* (1964) by Michelangelo Antonioni

The following example, *Red Desert* has been described as one of the most extraordinary and riveting films of Italian film director Michelangelo Antonioni's entire career (see fig.11). Made in 1964, it shows a decisive move away from realism and more towards the aesthetic. In it, he shows '*an interest in aesthetic experiences associated with spatial disorientation*' (Gandy, 2003, p.221). The story is centred on the character of Giuliana who, after a nervous breakdown, finds herself estranged from everyone and everything. The story unfolds in the grey industrial city of Ravenna, where we see Giuliana trying to cope with her situation and those around her. We, the viewer, are on the outside looking into the disconcerting industrial landscape of Ravenna, but through various tricks of the eye (i.e. the flattening of space by telephoto lenses; the strange scale, placement, and colour of objects; out of focus foregrounds and backgrounds (Brown, 2002) we are, at the same time, able to jump into the troubled mind of Giuliana.

The use of colour in the film is quite strong and it is meticulously calculated and arranged to correlate with Giuliana's emotional state. Antonioni uses colour throughout to tease the viewer with higher possibilities and into new spaces. For example, in the film, when Giuliana tells a story to her sick son, the film leaves the iridescent grey real world of

Ravenna and moves entirely into her fantasy of a young girl on a beautiful bright and colourful beach. This is interesting in that Antonioni's visual manipulation not only presents us with a rich aesthetic experience of different landscapes; it also gives us a representation of spatial psychosis. The screen frames these industrial landscapes and separates us from the dull looking streets of Ravenna; but it is the use of colour which captures us and allows us to get inside the interior space of Giuliana's mind: into a space within a space.



Fig. 12: *Hero* (2002) by Zhang Yimou

Another example of how the aesthetic has been used to power the narrative is seen in the film *Hero* (2002) by director Zhang Yimou (see fig. 12). Yimou who has been portrayed as *'quite possibly the most visually astute director alive'* (Ferguson, 2004, line 26) has an artists eye for the screen and thrives on aesthetic challenges. *Hero* is a martial arts film which has been described as *'presenting a bold visual statement with stunning photography, vivid art direction, and meticulously staged swordplay that possesses more dazzling, theatrical dance than screen combat'* (Pollard, 2002, line 5). It is a film about storytelling, it tells the story of how the king of Qin, soon to be the first emperor of China is threatened by three assassins, the story begins with Nameless, a master swordsman recounting to the king how he defeated the three assassins. However, as the film moves on, the flow of the narrative breaks up into different conflicting accounts to how he actually did this. As a result, the success of the film relies on Yimou's ability to reveal each version of the story without seeming too repetitive. He achieves this in differently coloured flashbacks, he uses different primary colours (i.e. red, green, yellow etc.) and colour saturation to tell different

versions of the story and ‘*not only does whole scenes get relit and recoloured but clothes and mood also shifts as well*’ (Nix, 2003, line 41).

As Corliss (2002, line 28) points out ‘*the camera and colour not only told the story, they were the story*’. He describes the colour as the context; each version of the story is dressed in a different hue. Indeed, Yimou makes full use of the power and beauty of colour, the sword fight in the golden leaves, the lovers asleep under the red silk, soldier squatting in a circle, Nameless and Flying Snow versus a blizzard of Qin arrows have all been described as ‘*ecstatically kinetic and as rapturously beautiful*’ (Kraicer, 2003, line 89). Colour is used to build impressions and pull the viewer into the narrative but it is also used to serve a specific purpose. Behind the material content of the fights, colour is used as a code to imply certain messages (i.e. Nameless’s black outfit represents death, the red used in the portrayal of the couple of assassins represents heat and passion, the green colour represents Chinese cultural change and white represents peace). As Pollard (2002, line 8) sums it up ‘*the story is seductively simple yet peels away in colourful layers of complex tapestries woven by the threads of trust, revenge and ultimately sacrifices*’.

#### 4.3.7 A Twenty-first Century Computer Narrative

In the last few decades, the picture space has veered into a more physically interactive zone and as Manovich (2001a, p.325) highlights ‘*The logic of replacement characteristic of cinema, gives way to the logic of addition and co-existence*’. In terms of narrative, it adds the element of choice (i.e. the viewer assembles a version of the story through a series of choices). This is quite evident in the artwork titled *Beyond* by Zoë Beloff who exposes the moving image to a new language of vision (see fig. 13). Indeed, *Beyond* has been described as ‘*a bench mark work in that it extends traditional mediums in a way that cannot be done without a computer and yet retains the evocative qualities associated with those earlier narrative forms*’ (Tomasula, 1997, line 37).



Fig. 13: *Beyond* (1997) by Zoë Beloff

When the participant enters *Beyond*, they are initially faced with ‘a small black and white movie which appears at the centre of the screen with camera shots of the Hindenberg blimp flying above New York city coupled with pages of text being stacked upon one another’ (Thompson, 2004, line 10). Then, they are introduced to a panoramic landscape interface, which they can navigate 360 degrees around using a mouse. In this landscape there are various hotspots which attract ones attention through both their brightness and unusualness. Beloff uses an odd array of different styled and collaged objects (whose white areas shine out of the landscape with immense brightness) to enhance the hotspots in the dark landscape and to attract the participant’s attention. The work uses panoramas of abandoned buildings and empty landscapes which contain eighty QuickTime movies.<sup>44</sup> By clicking on the bright white and odd selection of collaged objects, the participant can choose different routes into the narrative (i.e. each hotspot transports them to various rooms of the abandoned building, and from within these rooms to other parts). With each click of the mouse, the participant gets a glimpse of another existence and experience. In that sense, the potential of the narrative is endless (i.e. many different types of narratives can emerge). Beloff is interested in ‘creating some kind of dialogue with the past’ (Thompson, 2004, line 22) and to do so, she makes use of the many possibilities of interactivity ‘her ominous music and sound’ juxtaposed with her bright white collaged objects attract the participants attention and then act as a guide through their narrative journey.

In terms of the visual-narrative and the development of the twenty first century computer narrative, this section would not be complete without some reference to the computer game. In fact, as the game industry thrives, there is more and more research exploring its visual potential (Innocent, 2005), (Bunt, 2006), (Wenzel, 2006) etc. as well as work and debates on the narrative aspects of computer games (Juul, 2001), (Mallon & Webb, 2005), (Jonsson, 2006), (Wilhelmsson, 2006). Therefore, within the realm of this research, it is quite important to look at how these two areas (i.e. visual and narrative) might work together.

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<sup>44</sup> These QuickTime VR panoramas are basically technological developments of the panoramas that we have already discussed. They are virtual 360 degree spaces that one can explore by dragging the mouse around the space. They are constructed by ‘stitching’ together in the computer twelve (or more) still photographs taken in rotation



Fig. 14: *Metal Gear Solid* (1998) by Hideo Kojima

*Metal Gear Solid* is ‘one of the most important and most distinctive titles in video game history’ (Moyles, 2002, line 1).<sup>45</sup> It was first released in 1998 and has since been the source of much discussion on whether or not the creator Hideo Kojima used too much story and not enough game play (see fig.14). Nevertheless, what is of interest to this research is how he challenges the way people experience computer games, how he pursues enjoyment and expression. The story has been described as a fairly standard action/espionage type, to which Kojima has skilfully added numerous methods of presenting the narrative from the world of film (i.e. cut scenes, fixed camera and first person mode etc).

In the first part of the game, a player can find themselves in control of the retired agent Solid Snake and it is their job to single handedly break into a tanker under enemy control and to find out more about a new prototype Metal Gear. In terms of the visual-narrative, the player is positioned inside the picture space (i.e. inside the world of Solid Snake) which Kojima cleverly makes realistic by using graphic details (e.g. textures on the characters which add more information to the story line). As Lafferty (2003, line 9) says ‘*what makes the game so strong are the graphical elements and the way the game pulls players into the tension of the situation*’. Kojima also subtly uses colour (i.e. the mustard yellow jumpsuits of the enemies, the bright green target pillars, and the glowing fire from the guns) to prompt interaction and gameplay as well as pull the player into the urgency within

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<sup>45</sup> This research looks specifically at *Metal Gear Solid 2: Substance* which was designed for the computer and is composed of the original game *Metal Gear Solid 2: Sons of Liberty*, a mission’s pack featuring new stages to play and five other playable stories.

the narrative. Of particular interest is how he subtly creates the illusion of other places and, in doing so, encourages the player's suspension of disbelief; this is done by placing the action in a real world location by using a radio device 'codec' to communicate with contacts in other places. This gives the player the illusion of another place, a place apart from the earthy coloured one they are in. In narrative film, space is usually an important factor '*...the place of a story is usually that of plot, but sometimes the plot leads us to infer other locales as part of the story*', thus as Kojima achieves with the radio device, '*the narrative may ask us to imagine spaces and actions that are never shown*' (Bordwell & Thompson, 1990, p.61).

Similar to *Las Meninas* (previously discussed), the player is in the picture space and is presented with the defined role of game player but also a more subtle role of storyteller. In this role, the player is confronted with many different situations and choices and, like the open structure and spatial narrative in *The Passion of Christ* by Memling, there is more than one way the game and story can advance. By incorporating subtle colour techniques and close attention to graphic detail, Kojima successfully adds to the standard game and in doing so, he also adds to the story being told. As Lafferty (2003, line 62) says '*From the special effects to the dynamic lighting and shadowing, the attention to detail makes this one of the best looking games in its genre*'. Indeed, whether one is experiencing the latest computer game, virtual reality environment or art installation, the computer poses many new challenges for the visual-narrative. It adds a new versatility and as Kojima successfully has achieved new exciting ways of storytelling.

## 4.4 Discussion

Looking back through the centuries has not only given us a greater understanding of the visual-narrative process but also enabled us to identify a number of visual-narrative techniques which might possibly play an important role in the development of a visual-narrative VR environment. For example, in the prehistoric cave paintings, the use of bold black expressive strokes (on the rocks native yellow/ brown ochre) in contrast to black stiff lines shows how easily different impressions of the characters in the story can be created (i.e. the vibrant, full of life bison versus the stiff man). Also of interest is the technique of dotting colours on the uneven cave walls (combined with the lighting in the physical cave) to enhance the feeling of being immersed in the story (i.e. using colour and light to merge the picture space and physical space together). Following that, in the *Maestà*, Duccio's use of contrasting colours to 'engage' the reader in the narrative is also of interest. Particularly how he has used an isochromatic pattern of colour to attract and then direct the eye

through the linear narrative pattern of the altar piece. These colours are seen to be carefully arranged throughout the altarpiece; they feed into the narrative by not only capturing the reader's attention but also giving them more meaning in that the colours represent the various patronages. On the other hand, Massacio, in *The Tribute Money*, has applied more closely related tones which firstly appear as one large narrative unit and then secondly appear as individual narrative units. Again of interest to this research is how he has employed a more psychologically orientated colour technique which uses warm colours like the red and orange clothed figures to enhance and also advance the characters in the narrative and uses cool blue and grey to recede the background.

A few years later, Memling in his *Passion of Christ* has started to artificially apply colour to the objects. In his spatial organisation of the narrative he has used colour to magnetically attract the eye to narrative cues. The eye is drawn to the bright Mediterranean colours which in turn drag the reader around the landscape and hence around the story. In contrast, Velasquez's in his *Las Meninas* has used a more blended approach. He has used a silvery grey effect to blend the colour from one space to another (i.e. the narrative emerges from the feeling of being part of the scene and trying to figure out what is going on). In the film *Red Desert* Antonioni's approach is somewhat on par with Memling, his use of colour is quite strong and at times quite artificial. However, he has taken things a step further by carefully calculating the colour so that it correlates with Guiliana's emotional state. He has applied colour throughout the film to tease the viewer with higher possibilities and into new spaces (i.e. spatial psychosis). Yimou in his masterpiece *Hero* has taken a slightly different approach to Antonioni's muted backgrounds by using dazzling colour schemes as well as colour saturation to highlight the different versions of the multi linear narrative. Unlike, Antonioni, he works with a rich and colourful canvas. It is the immense beauty as well as the underlining meanings attached to the beauty (i.e. particularly the colours) which drives the narrative and powers the film. Finally, the computer narrative, Beloff's *Beyond* brings the visual-narrative into a more interactive zone and opens the door to many exciting possibilities for the traditional visual-narrative. It shows how the brightness of the 'white' in conjunction with a conflicting style and odd objects can attract the participant to certain areas of a VR panorama and in doing so guide them into the creation of certain narratives. Similarly, Kojima's *Metal Gear Solid 2* demonstrates the power of colour to align the story and the game, he uses colour to feed into the tension of the narrative as well as to highlight a game move (i.e. the mustard yellow jumpsuits of the enemies attracts attention and 'engages' the user in the danger of the situation as well as affording a physical interaction – shooting the enemy).

Examining these visual-narratives especially the different techniques, structures and patterns that have been applied to the various visual spaces, one begins to understand just how many possibilities there are. The whole act of being attracted to certain colours, building impressions, making sense of and forming narratives embodies the whole process of *aesthetic-interaction* that was discussed in Chapter 2. In terms of the photorealistic VR medium, this holds many opportunities in that it not only allows us to employ and tailor some of the above techniques and patterns but also to create new ways of getting the user aesthetically interacting, ‘engaging’ and telling a story.

## 4.5 Conclusion

Manovich (2001b, p.2) talks about combining ‘*informationally dense visual narratives of Renaissance and Baroque painters with “attention demanding” shot juxtapositions of twentieth century film directors*’. As this thesis is suggesting, photorealistic VR has the potential to do this and much more. However, in order to build a greater understanding of the visual-narrative and how it might work in VR, this chapter has explored the development of the visual-narrative through history. Indeed, it has closely examined how colour has been strategically patterned within the various different visual media to ‘engage’ viewers in a storytelling process. In doing so, it has enabled the author to identify a number of techniques which could possibly be adapted for the creation of visual-narratives in photorealistic VR. Of particular interest is the use of colour to attract the participant’s attention, to enrapt them in certain emotions, thoughts and memories, while at the same time guide them into the creation of the narrative. As mentioned, this embodies the notion of the *aesthetic-interaction* (discussed in Chapter 2), in that, it is about using aesthetics to entice a visual interaction which in turn feeds into the creation of a narrative and hence, an ‘engaging’ photorealistic VR experience. However, it is not only about combining the continuous narrative forms of early Renaissance and Baroque paintings with the exciting traits of film but also about looking to incorporate the full immersive, illusive and experiential potential of photorealistic VR. In the following chapters, the research will look specifically at photorealistic VR and how visual-narratives might be further developed and adapted within photorealistic virtual environments to articulate an aesthetic process of interaction which in turn will create ‘engaging’ VR experiences.

# 5: EXPERIENTIAL DESIGN PROCESS

This chapter acts as the bridge between the theoretically driven chapters just read and the practical and experimental chapters yet to come. It is the hinging point of the thesis where connections are starting to emerge between the *aesthetic-interaction* process discussed in Chapter 2, the photorealistic VR environments described in Chapter 3 and the visual-narrative explored in Chapter 4. It is the chapter where the author actively starts to contemplate the possibilities of creating a visual-narrative in a photorealistic VR environment to entice *aesthetic-interactions* and hence ‘engagement’ amongst her users. Indeed, to achieve this, the chapter is divided into three sections: Firstly, it investigates the potential role of the visual-narrative in photorealistic VR; it moves from the non-narrative BENOGO environments to various outdoor environments in Edinburgh before finally settling on the more personal interior VR environment. The chapter discusses the autobiographical work of Tracey Emin and the photo narratives of Jeff Wall whilst concurrently moving towards VR and how the aesthetic elements of photorealistic VR environments might be designed to ‘engage’ and tell a visual story.

The second section of this chapter focuses specifically on the design process, particularly, the development of a visual-narrative model to guide the design of an ‘engaging’ photorealistic VR environment. To pursue this, the section draws from aspects of the previous chapters (i.e. Barthes’ narrative structure and Murray’s grid in Chapter 3, and the visual-narrative process discussed in Chapter 4) to devise a theoretical visual-narrative structure. This proposed structure embraces an iterative design process in that it prompts a number of studies (Study A) which aim to elicit ‘design requirements’ for the development of the visual-narrative model and in turn the design of ‘engaging’ photorealistic VR environments (Study B).

Following on, the final section of this chapter examines the methodologies that will be used to draw out these design requirements as well as the data needed to determine which photorealistic VR environment is more ‘engaging’. In more detail, this section will discuss the Place probe, the talk aloud method, the semi-structured interview, it will talk about the sample groups used and the methods of analysis employed in both studies. By doing so, the aim of this section, in conjunction with the preceding sections, is to fill in the gaps and pave the path for the remainder of the thesis.

## **5.1 The Photorealistic VR Environment**

This PhD research was greatly inspired the author’s work on the BENOGO project, in particular the unexplored narrative potential of the BENOGO VR environments. So much so, this section of the chapter aims to trace the author’s journey (i.e. both creative and technical) from BENOGO to the creation of a more narrative ‘evoking’ photorealistic VR environment. The objective is to relay the effort dedicated to the choosing of a suitable environment; to selecting an environment that would comfortably provide a balance between the technical and creative aspects of the medium and in doing so, lend itself effectively to the creation of ‘engaging’ narratives.

### **5.1.1 BENOGO VR Environments**

The BENOGO VR environments were designed to give the user the sense of being ‘present’ as if in the real world (see Chapter 3). These environments consisted of photorealistic representations of real places (i.e. the botanic gardens in Prague, the technical museum in Prague, an outdoor viewpoint in Prague, and a stairwell in the Czech university in Prague). They were non-narrative in that there was no planned narrative framework embedded in them. The BENOGO environments can almost be described as monstrations as opposed to narrations. Monstration is a word used by Elsaesser (1990, p.59) to describe early films where the emphasis was more on inciting a visual curiosity through an exciting spectacle – a unique event as opposed to a number of different events structured into a story. Each environment aimed to enable the user to experience a sense of ‘presence’ at real and possibly known places without having to physically go to these places.



Fig. 15: The Botanic Gardens in Prague

### 5.1.2 IBR Technology

To achieve this sense of ‘presence’ the BENOGO environment consisted of true to life visual and auditorial sensory information presented in real time. The earlier BENOGO environments were static mosaics (i.e. the botanic garden [see fig. 15]) which allowed the user to look 360 degrees around, up and down the photorealistic garden. The later BENOGO environments introduced a technique called Image Based Rendering (IBR) which explored a rendering method that basically generates new images from other images (see Chapter 3). The main advantage of IBR and particularly BENOGO IBR was the realistic nature of the resulting images without any need for three dimensional computing. It added mobility (ego motion) and appropriate sensory responses to an experience in that users could look 360 degrees around the environment, up and down but also around the actual objects in the environment itself. In addition, the IBR technology also allowed for augmentation, which attracted the user’s attention by adding, hiding or occluding objects in the environment. The ultimate goal of BENOGO was to develop the technologies so that the visual display matched as closely as possible to the users cognitive and sensory capabilities (i.e. in more technical terms, the ability to change their position in a region of exploration (REX) and to pan and tilt, to explore the field of view (FOV) available at any chosen position).

### 5.1.3 Edinburgh Environments

Inspired by the technical achievements of the BENOGO VR environments yet disappointed by the lack of creative content and narrative development, the author of this

thesis started to look to different environments (particularly those around her local Edinburgh). Being familiar with the city, the author felt confident in identifying everyday locations that would naturally imbue a curiosity or would easily lend themselves to narrative and storytelling (e.g. post office on a busy square, a park area with paths leading to different places etc.) (see fig.16 &17). In exploring these locations, the author not only examined the content but also experimented with different ways of capturing and presenting the environments.



Fig. 16: Bruntsfield Post Office and Square



Fig. 17: The 'Links' Park Area

In fact, a lot of time was spent experimenting with QuickTime VR software (QTVR), and carefully considering ways of enabling users to navigate around these QTVR environments (i.e. optical sensors and wireless mice).<sup>46</sup> However, after several months weighing up its immersive and creative potential, the author abandoned the QTVR software to return to the existing BENOGO environments. Indeed, the author revisited and explored the basic static mosaic environments which were implemented at the start of the BENOGO Project. These were simply photographic panoramas presented through the HMD and on reflection, the author was confident that they offered the perfect platform for the creative exploration and the narrative development that was necessary to produce an 'engaging' photorealistic VR environment.

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<sup>46</sup> QuickTime VR software supports the easy creation of an immersive experience. It enables spectators to explore virtual worlds using nothing more than a computer and mouse. (see <http://www.apple.com/quicktime/technologies/qtvr/>)

## 5.1.4 Biographical VR Environments

The “post office on the busy square” and the “linking park area” naturally imbued a curiosity and hence the possibility for different types of narratives. However, they both lacked the depth, substance and in many ways ‘intimacy’ that the author felt was necessary for her to create a visual-narrative. To overcome this, the author started to look at environments that were both physically and mentally closer to her (i.e. environments that held a lot of personal feelings and meanings for her). A natural progression from these outdoor environments was to look at her own personal space. At this time the work of Tracey Emin and Jeff wall greatly inspired the author particularly in terms of narrative and substance.

### 5.1.4.1 “My Bed” by Tracey Emin

“My Bed” is an autobiographical work which exposes the intimate and convulsive life of the artist *Tracey Emin* while living in Berlin in the early nineties (see fig. 18). It is an installation piece comprising an unmade bed with urine stains, tossed sheets, dirty underwear, full ashtrays, worn tights, vodka bottles, condoms and other paraphernalia.



Fig. 18: “My Bed” by Tracey Emin

To the dismissive eye it is just a regular bed with familiar content, however, to the more curious eye, it is a rendering of a difficult time in the artist’s life. Emin uses raw materials and like a jigsaw entices her viewer to piece together her story. The raw materials,

that she uses, trigger strong feelings and emotions which in turn ‘*scratch away the surfaces to what lies below*’ (Akbar, 2006, line11) and in doing so create shocking yet powerful narratives. As Gargett (2001, line 84) describes ‘*she makes tactile contact with the emotion of her audience rather than a purely intellectual one. It is an art, primarily visual, but ultimately of the interior life into which vision leads*’. In terms of this research, “My Bed” inspires a sense of ‘*unedited and unpolished immediacy*’ (Smith & Watson , 2001, line 65), the viewer walks around the real bed, ‘engaging’ freely with the content that in turn result in certain emotions and the creation of certain narratives.

#### 5.1.4.2 “View from an Apartment” by Jeff Wall

Canadian photographer Jeff Wall also uses visuals to ‘engage’ the viewer in narratives; he creates large scale photographs and with these, he ‘*meticulously creates these elaborate narratives, using actors, lighting and digital manipulation*’ (Holmes, 2006, line 2). In his photograph “View from an apartment” we are exposed to the everyday existence of a woman in her apartment (see fig.19).



Fig. 19: “View from an Apartment” by Jeff Wall

As Wagstaff (2005, line 68) points out ‘*The room offers a muted mix of styles, colours and textures, evocative of the living quarters of a young woman in a nascent stage of determining her own taste*’. What is of interest to this research is how the artist entices us to build and imagine the story of the young woman. He uses two pictorial worlds ‘*one within*

*the other, one inside and one outside, each framing a reconstruction of the world, each representing a different reality, each with its own logic of illumination*' (Wagstaff, 2005, line 96). The breathtaking view out the window grabs the viewer's attention and in contrast to the interior space, feeds our curiosity to piece the story together. We find ourselves asking: Who is she? Where is she? What does she do? What does she like? Who does she love? Like in the previous example, the viewer is 'engaged' in figuring out the narrative. The photograph '*depicts something in a way that the viewer feels he or she is really seeing but at the same time suggests that something significant isn't being seen*' (Wagstaff, 2005, line 107). It is that unseen that interests this research, it is that something extra which feeds the imagination and emotions and powers the narrative.

### 5.1.5 Edinburgh Flat

After exploring the potential of the different rooms in her Victorian Edinburgh flat the author chose the *sitting room*. On making that decision, she was confronted with the task of making the sitting room environment tell her story, this in itself, required the careful balancing of the technical and creative aspects of the technology.

In technical terms, the idea was simple in that the environment was to be captured as a panorama image using a standard digital camera (Olympus-D-540 Zoom) and then imported into an existing BENOGO VR++ program to allow it to be viewed via the HMD. However, in order to accurately display the sitting room environment via the HMD, it was necessary to create a photographic panorama 36.12cm by 72.25cm (2048 by 1024 pixels). This width to height proportion created many problems in the actual capturing and stitching of the images as the ratio proved too unrealistic when compared to the amount of detail required (see fig. 20). After several weeks of trying to resolve these issues (i.e. experimenting with different cameras, lens and capturing methods – linear and rotational), a system was adopted which sacrificed some detail in order to allow for accurate stitching and acceptable realism. It basically meant calculating a distance (between the camera and the chosen wall), which allowed the author to capture each wall of the environment in three photos as opposed to twelve photos. This lessened the amount of detail achieved but on the positive side, also reduced the amount of stitching which gave a smoother and more realistic rendering the room (see fig. 21).



Fig. 20: Capturing the *Sitting Room* Environment with Several Photographs



Fig. 21: Capturing the *Sitting Room* Environment with Fewer Photographs

In parallel, the development of the visual-narrative and its successful embedment in the sitting room environment were being considered. In fact, prior to the capture of the images, it was necessary to sketch out a rough plan of the proposed narrative:

*Mary is in her twenties. She lives with her boyfriend in a flat in Edinburgh. She is Irish though she is reasonably settled and very happy living in Scotland. She has a busy life. She likes going out and dancing. She likes sport particularly rugby, she is learning to play golf and she likes keeping in shape with her dumbbells. She has a passion for travelling and collecting artefacts; she has recently been to Africa, Thailand and India. She leads a healthy and natural life and her favourite food is apples. She likes animals particularly cats. She comes from a design background and works regularly on an Apple MAC.*

In sketching this narrative, it was also important to simultaneously consider its structure and how it will be visually recreated in the photorealistic VR environment. In fact, a clear understanding of how the visuals might work together (i.e. in terms of what feelings and impressions they might elicit) as well as how they might evolve into the above narrative is required. Indeed, a design process is needed that will give a clear outline of the visual-narrative content and then, a framework to how it will be orchestrated. To achieve this, a visual-narrative model is proposed; this model aims to identify the objects and their colours (narrative cues) that need to be strategically organised in the actual environment before the photo capture (see fig. 22) but also, the patterns of colour which are required to

feed the narrative after the images are taken. As the next section will show in more detail, this visual-narrative model entails the careful planning before and after the photo capture.



Fig. 22: Organising the Narrative Cues in the *Sitting Room* Environment

### 5.1.6 Discussion

In terms of narrative potential, one can see a clear progression from the non-narrative BENOGO environment to the *sitting room* environment. By picking her own Edinburgh flat, the author has chosen a very familiar space with a story that provides both depth and substance (i.e. the factors that were lacking in the previous environments). However, as with all storytelling, it is one thing knowing the story and another telling it. The following sections of this chapter will discuss the design process and methodologies needed to be put in place to ensure the creation of an ‘engaging’ visual-narrative environment.

## 5.2 The Design Process

This section focuses on the development of a visual-narrative model which will entice *aesthetic-interactions* and in doing so guide the design of an ‘engaging’ photorealistic VR environment. To successfully implement this, it proposes a theoretical visual-narrative structure based on Barthes’ narrative structure (Chapter 3), Murray’s VR grid (Chapter 3) and the visual-narrative (Chapter 4). It aims to use this structure to devise a set of studies (Study A) which in turn, will elicit a number of design requirements (specific to photorealistic VR) to be incorporated into the design of a visual-narrative model. As mentioned, the goal of the visual-narrative model is to provide a framework to support *aesthetic-interactions* and hence the design of an ‘engaging’ photorealistic VR environment. The next section of this chapter recounts the rationale behind the visual-narrative structure

while also demonstrating its central role in the design of the visual-narrative model and hence, the overall process of creating ‘engaging’ environments.

### 5.2.1 Designing the Theoretical Visual-narrative Structure

*‘Stories live in and are influenced by their container, the medium of their telling’* (Barry, 2000, p.2).

When one follows Barry’s train of thought, the photorealistic VR environment can be seen as the container that influences the reading of the content. The content then consists of photorealistic images of the sitting room environment. Like in the previous visual-narratives (see Chapter 4), it is important to ensure that this content and container relationship has a coherent and balanced structure. By this we mean a balance between the user’s exploration of the content and then the container’s ability to support this exploration and to provide guidance without breaking a sense of ‘flow’ through the experience.

To do this, O’Toole (1994, pp. 5-31) turns to semiotics (i.e. the study of sign systems) as a way to help us explain how one experiences a painting. He sees a painting as having three main functions, the modal function (to engage our attention and interest), the representational function (to convey some information about reality) and the compositional function (to structure these into a coherent textual form). He believes that *‘an artist has at his or her disposal various devices for engaging our attention, drawing us in to the world of the painting and colouring our view of that world’* (O’Toole, 1994, p.5). This research is pursuing a similar idea, however unlike O’Toole, the author of this thesis sees it as more an aesthetically driven process. By looking at the visual-narrative through history (see Chapter 4), the author has started to build an understanding of the visual-narrative process and how the aesthetics (particularly colours) were strategically patterned to tell a story. In particular, how the colours attracted the user’s attention, how they encouraged *aesthetic-interactions* and then how these enticed the user to link up parts of the picture in order to tell a story (see fig. 23).

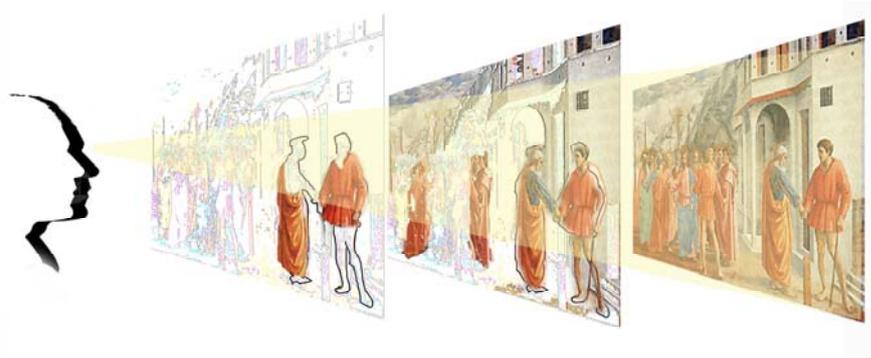


Fig. 23: Reading a Visual-narrative

The goal now is to understand how it might be adapted to newer visual spaces (and media) and to start considering how it might fit in and be further developed in photorealistic VR to create ‘engaging’ experiences. Indeed, it is important to take into consideration both the design of the visual-narrative in the photorealistic VR environment and how the user will experience it. It is crucial to understand how the components of both the visual-narrative and photorealistic VR environment fit and work together. To appreciate the fine balance between the user’s interactions with the aesthetic components and then the medium’s ability to support this interaction and to provide guidance without breaking a sense of flow or engagement through the experience (as discussed in Chapter 4). As seen in the last section, the photorealistic VR environment needs a structure in which a narrative freely emerges from the users experience in the environment. Yet at the same time, a design which maintains the user’s attention also requires a certain degree of constraint.

So similar to Barthes’ hierarchal narrative structure that was discussed in Chapter 3, this research adopts a three-levelled approach; it modifies Barthes’ functions, actions and narration levels to meet the more specific objectives of the visual-narrative process (see Chapter 4) such as visual units, engagement and narration. The aim of this is to provide a certain degree of structure to the design of the visual-narrative. The visual units’ level is similar to Barthes’ functions level where the most basic components of the narrative exist. For this research, these are the aesthetic elements that people are attracted to, sense, notice and think about in an environment. The engagement level is slightly different to Barthes’ actions level in that the focus is more on the character and viewers engagement rather than on action, the emphasis is on visual engagement, being ‘drawn in’ and ‘involved’ as opposed to physical action. The third level is similar to Barthes’ narration level in the sense that both the meaning (i.e. feelings, thoughts, intuitions, memories etc.) and the message of the story come together at this level.

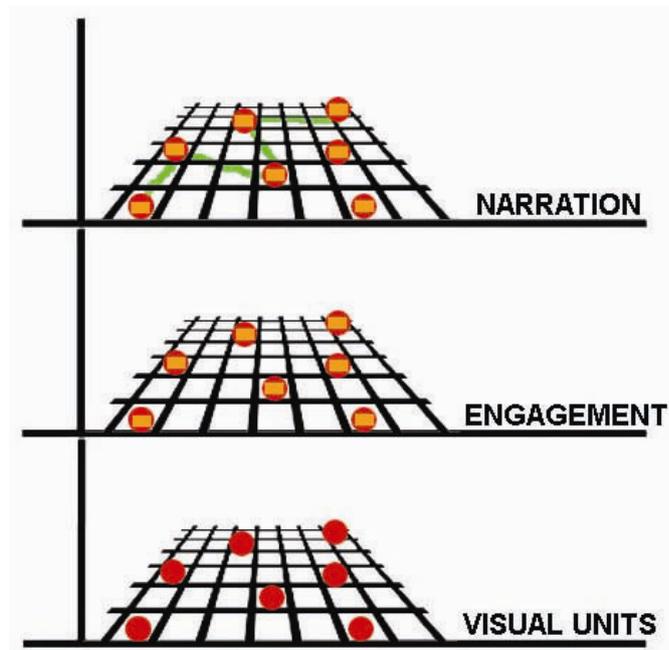


Fig. 24: The Theoretical Visual-narrative Structure

From this, the research is interested in how a visual-narrative will work within the VR environment to trigger a connection between the VR images and the stored visual images, personal feelings, thoughts, intuitions and memories of the user and then how this may result in the creation of an ‘engaging’ experience. To achieve the right balance, the research then proposes to integrate this model with a grid like structure (i.e. Murray’s grid). This provides a more effective tool when dealing with the new differences introduced by the VR technology. As seen in Chapter 3, VR technology gives the viewer the freedom to play a dual role of both the main character in the narrative and narrator. The viewer not only plays a leading character role by engaging visually in the virtual reality environment, but also creates the narrative by randomly looking around the space and connecting the various aesthetic objects together. Therefore by encompassing the three tiered visual-narrative structure based on Barthes’ work into the grid-like structure discussed by Murray, it aims at a versatile yet reasonably controlled framework (see fig. 24). This early visual-narrative structure is designed to create a balance between the user’s exploration of the content and then the photorealistic VR environments ability to support this exploration. The aim is to use it to delimit a set of requirements which can be fed into the final visual-narrative model to provide design guidance for the building of ‘engaging’ photorealistic VR environments.

## 5.2.2 Developing the Visual-narrative Model for Photorealistic VR

To develop the visual-narrative model a design process needs to be implemented which studies the three levels of the proposed visual-narrative structure (i.e. visual units, engagement and narration) within a photorealistic VR setting. To do this, three individual studies (Study A) are devised and their combined findings are then incorporated back into the structure to form and then refine the visual-narrative model. Following that, Study B applies the refined visual-narrative model to the design of a photorealistic virtual environment to test whether or not it is successful in supporting *aesthetic-interactions* and hence creating an ‘engaging’ VR experience (see Chapter 7). This whole approach adopts an iterative design process. The following provides a clear outline for each study:

### 5.2.2.1 Study A

The aim of Study A is to explore the three tiers of the visual-narrative structure in relation to photorealistic VR and in doing so, to highlight certain design requirements which can then be filtered back into the final visual-narrative model (i.e. creating a more specific photorealistic VR model) which will then provide support for the design of an ‘engaging’ VR experience. The first part of the study relates to the lowest level of the structure which contains the most basic components of the narrative: the visual units. The second part of the study corresponds to the middle level of the structure engagement and focuses on how to ensure that participants are ‘engaging’ more in the VR environment. Finally, the highest level of the structure is where the narration takes place and where participants link the cues to make associations and then a narrative.

Study A: Part 1 looks specifically at the visual units section of the theoretical visual-narrative structure. It is proposed to strengthen our understanding of what catches people’s attention and engages them in photorealistic environments. Its aim is to identify aspects and features of the environments that are attracting the attention of the viewers whilst at the same time encouraging them into the sharing of information and ‘engaged interactions’ (See Chapter 2). The study involves the testing of a group of people in a non-narrative photorealistic virtual environment to identify what elements are naturally attracting their attention to create new thoughts and feelings. The aim of Study A: part 1 is to highlight certain design requirements which will help to form the visual units section of the visual-narrative model.

Study A: Part 2 is designed to ascertain ways in which the photorealistic VR environment can be contextualised to strengthen the visual units (identified in Study A:

part 1). Indeed, to achieve this, a scenario is suggested to provide the participant with a context for understanding these visual units while at the same time, engaging them in the environment. This study involves the testing of a group of people in a non-narrative virtual environment to gauge if the use of a scenario increases engagement levels. The findings of this study aim to determine a number of design requirements which can be incorporated into the engagement level of the visual-narrative model.

Study A: Part 3 explores how the implementation of visual-narrative techniques can maintain and further enhance this engagement. It proposes to build an understanding of the relationship between the different visual units and the scenario (i.e. how they can link with one another to build an open-form narrative to support ‘engaging’ experiences). The objective of this Study is to explore possible ways to interweave and pattern these visual units within the scenario so as to guide the reader to specific readings. It involves the application of various visual-narrative techniques (see Chapter 4) into the visual-narrative environment and then the comparison of participants stories from both the visual-narrative and non visual-narrative environment.<sup>47</sup> Each participant will be asked to talk aloud during each VR experience. The results from the comparisons will be drawn from the data received and the findings will be once again fed back into the refining of the visual-narrative model.

#### **5.2.2.2 Study B**

The main objective of Study B is to test whether the integration of a visual-narrative model in the design of the photorealistic VR environment encourages *aesthetic-interactions* and increases ‘engagement’. The study proposes to do this by comparing participants in both the non visual-narrative and the visual-narrative environment. It is interested in the evolution of the visual-narrative and then whether or not this is making participants more ‘engaged’ in the VR experience. For the study, participants will be observed throughout both experiences and will be asked a number of questions afterwards. What is of main interest is whether an *aesthetic-interaction* takes place, whether or not the participants are interacting and ‘engaging’ in the visual-narrative and hence the VR experience.

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<sup>47</sup> The visual-narrative environment is a photorealistic VR environment which has been strategically designed using the visual-narrative model. The non visual-narrative environment is also the same photorealistic environment but has no planned narrative framework designed into it.

### 5.2.3 Discussion

This section of the chapter has been used to map out the design process required to embed a visual-narrative into the *Sitting Room* environment (see the previous section) and hence make it more ‘engaging’. It has introduced the theoretical visual-narrative structure and presented how this will be refined into a visual-narrative model to guide the design of ‘engaging’ photorealistic VR environments. By performing a number of studies (Study A & Study B), the section has shown an iterative process of design where the results of each study feed into the development of the model. The next section of this chapter discusses the methodologies used to elicit the design requirements needed to successfully build the visual-narrative model and then the data to measure the effectiveness of the visual-narrative model.

## 5.3 Methodologies

To successfully execute and then measure the results from these studies, a predominantly qualitative approach is used. This is chosen because it offers a very rich and versatile way of collecting data; it allows a flexibility to concentrate on specific areas of interest while also revealing other emerging areas. The main aim of this section is to not only discuss the place probe, talk aloud and semi structured interview methods used to collect this qualitative data but also to examine the rationale for using them.

### 5.3.1 Procedure

Adopting a similar procedure to the qualitative approach used during the BENOGO project, the author of this thesis is confident that the studies will result in rich and interesting findings. Study A consists of three parts: Part 1 & Part 2 are subsidiaries of the BENOGO project studies and hence will avail of the same experimental procedure, selection of participants and methods of gathering information. Study A: Part 3 and Study B are separate yet similar studies utilising their own procedure, participants and methods. The methods used in Study A: Part 1 & Part 2 include the BENOGO Place probe and the semi structured interviews while Study A: Part 3 and Study B utilise the talk-aloud approach and the semi-structured interview.

### 5.3.2 BENOGO Place Probe

The *Place Probe* was developed by the *BENOGO* team at Napier University, Edinburgh. It was designed to be flexible in its approach to capturing data, producing results relevant for the *BENOGO* VR technology being used and in being easy to administer. The place probe encompasses a variety of data capture methods (e.g. visitor's book, three features, sketch maps, semantic differentials, sounds, photographs and six words (Benyon et al., 2006, p.668-687). For the *BENOGO* project, it helped in identifying data that was missing from any experience of the *BENOGO* VR environment when it was compared to the real. For the purposes of Study A: Part 1 & Part 2, it proved quite successful in highlighting the key features that people were noticing and engaging with in each environment.

### 5.3.3 Talk Aloud

For this research, the main goal of the talk aloud method is to encourage the participant to disclose their immediate thoughts, feelings and experiences in the visual-narrative environment while they are actually happening. In doing this, the author aims to identify the sources of certain interpretations and narrative patterns as they later occur. For Study A: part 3 and Study B, a '*through the keyhole*' scenario is integrated into the talk aloud approach. This requires the participant to enter the room and to look around for clues which might help them in identifying the type and character (i.e. story) of the person that lives there. The key reason for using this approach is to entice participants into a certain mode of engagement while at the same time, to gather rich qualitative data about the individual narratives that are being created. The aim is to identify the main building blocks of the visual-narrative experience inside the photorealistic VR environment at the time of testing and narrative creation. Indeed, Study A: part 3 and Study B are interested in how and why the participants have started to make sense of the environment and the person that lived there. In particular, they are interested in exploring how the use of the aesthetic (particularly colour) has had an affect on the thoughts, feelings, memories and intuitions that were emerging during the experience and then how these influence the overall interpretations and narratives created.

### 5.3.4 Semi-structured Interview

The semi-structured interviews were used in the earlier parts of Study A and in Study B. All questions were asked within a relaxed framework, which allowed for the retrieval of

both general and focused qualitative information. The number of questions varied for each study, they were formulated before each interview, and asked in an informal manner. The interviews lasted between five and twenty minutes and were recorded using a DAT recorder. For Study A: Part 1 & Part 2, some questions are open-ended while others are more specific. For study B, the two questions asked were specific; they were designed and phrased to probe for a specific yes or no answer (i.e. what environment did you find more engaging? What environment did you find more enjoyable?). Overall, the questions were designed to investigate, clarify and provide a valuable insight into the role of aesthetics in the design of the virtual environment and as in Study B to identify whether or not aesthetics can help build 'engaging' photorealistic VR environments.

### 5.3.5 Participants

The sample of participants tested in this research was predominantly from a mixed academic background, their ages and their sex varied.<sup>48</sup>

For the earlier studies (Study A: Part1 & Part 2), the tests were performed in Denmark as part of the BENOGO Project. The sample group was recruited through departmental emails and was predominantly Danish with a good working knowledge of English. They ranged from students to lecturers from Computing, Engineering and Humanities backgrounds and prior to the study, were not acquainted with the author. For Study A: Part 3, twenty-one students (i.e. nine male and twelve female students) took part in the study, they ranged from students to research and administration staff. They were predominantly from the School of Design, the School of Computing and the School of Psychology at Napier University and were recruited through a combination of departmental emails and word of mouth (i.e. existing participants were used to recruit other participants). This can be described as a convenience sample, in that some of these participants, prior to the study, were acquainted with the author (i.e. colleagues and students). However, due to the nature and focus of this Study, the author felt that this familiarity would not bias their core reading of the environments. As already mentioned, Study A: Part 3 was primarily interested in whether or not participants linked the narrative cues to build a more female orientated narrative. Participants familiar to the author would

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<sup>48</sup> The majority of them were recruited through departmental emails and in that sense, might be construed as being biased in that people who enjoy taking part in studies or had time on their hands responded to the call for volunteers. However, the author of this thesis strongly feels that participants were not biased in answering/thinking/feeling one thing over the other (i.e. one environment over the other), and therefore the results gained from these samples can be considered to be representative of the underlying population.

have known she lived with her Welsh partner, so in that sense, the test remained whether they read the female narrative cues and picked up on the single female story as opposed to the couple orientated narrative that they knew to be true. For Study B, twenty participants (i.e. thirteen male and seven female students) took part in the study, these ranged from researchers to PhD students to staff, and they were mainly from Social sciences, Engineering, Construction and Computing backgrounds. Again, participants were recruited through departmental emails and prior to the study, were not acquainted to the author of the research.

### 5.3.6 Analysis

For Study A: Part 1 and Part 2, the analysis used is essentially qualitative, it adopts an enumerative approach in that the data from the place probe, talk aloud and semi-structured interviews will be analysed for common themes, experiences, thoughts and feelings. As discussed, the findings aim to elicit a set of design requirements which can be fed back into the development of the visual-narrative model. For Study A: Part 3 a comparative analysis is applied to reveal how users respond to the photorealistic VR environment designed with the visual-narrative model as opposed to the non narrative environment. In this study, the talk aloud provides the closest link between the individual and the environment (i.e. the creation of the narrative). It allows the author to see where the participants are recognising and linking the narrative cues and in doing so, will provide a way to note the effects of the model. In Study B, the objective is to show how *aesthetic-interactions* articulated through a visual-narrative model can increase 'engagement' in the VR environment. Again a comparative analysis is adopted which uses Berleant's aesthetic engagement model (see Chapter 2) as well as a semi structured interview process to identify which photorealistic VR experience is more 'engaging'. For this study, a binomial hypotheses test is also performed on the 'yes' and 'no' answers of the semi-structured interview to test whether the findings are statistically significant or not.

### 5.3.7 Discussion

This section has primarily looked at the methods applied to gather the data from the studies which were discussed in previous section. In detail, it has discussed a qualitative approach: it has described the place probe, the talk aloud method and the semi structured interview and then reviewed the rationale for using each method. In fact, it has noted that the place probe should be useful in identifying the key features that people notice and engage with in the environment. The talk aloud will provide rich qualitative data

particularly about the individual narratives that are being created and the semi structured interviews should tease out the role and success of aesthetics in the photorealistic VR experience. In conjunction with these methods, the section has also examined the main characteristics of the sample groups used, as well as discussing the best form of analysis for each study.

## **5.4 Conclusion**

This chapter is the back bone for the thesis in that it is where the author starts to make sense of and to shape the information of the previous theoretically chapters. It is in this chapter where she starts to channel the information into a strategic plan (i.e. visual-narrative structure) and to work out ways to answer the research questions posed at the beginning of this thesis. As seen, this chapter has moved beyond the BENOGO VR environments to consider more ‘narrative generating’ environments. It has introduced the visual-narrative structure and in doing so, has disclosed a design process for the research as well as the appropriate methodologies for gathering and analysing data. In conclusion, this chapter has provided the cogs for the following chapters particularly the cyclic process involved in the building of an ‘engaging’ photorealistic VR environment.

# 6: DEVELOPING A VISUAL-NARRATIVE MODEL FOR VR

This chapter will employ the theoretical visual-narrative structure (discussed in the previous chapter) to tease out design requirements for the development of the visual-narrative model. To do this, it will present a series of three studies (Study A). The first study (Study A: part1) will explore how and why people are being attracted to certain objects and areas of photorealistic VR environments. The second study (Study A: part 2) will investigate how the use of a ‘scenario’ can enhance engagement in a photorealistic VR environment and the third study (Study A: part 3) looks specifically at how the findings of the previous two studies can be strategically patterned to encourage participants into the creation of a visual-narrative. As seen in Chapter 4, the visual-narrative has ‘engaged’ people in stories for centuries, therefore, the main aim of this chapter is to explore how this ‘engagement’ can be harnessed in photorealistic VR environments. Indeed, the following pages will concentrate solely on eliciting a number of design requirements which can then be used in the development of a visual-narrative model to support the design of ‘engaging’ photorealistic VR environments.

## 6.1 Study A –Developing a Visual-narrative Model for VR

### 6.1.1 Study A-Part 1: Visual Units

This part of the study is proposed to strengthen the understanding of what attracts the user's attention in a photorealistic virtual environment. Its aim is to identify aspects of the environment that are visually attracting the attention of the viewers, aspects that are getting them feeling certain emotions and thinking certain thoughts. For the purpose of this research, the study is part of an existing Benogo study which proposes to use two different BENOGO IBR virtual environments: a viewpoint in Prague (see fig. 25) which was administered in Aalborg, Denmark in March 2004 and a technical museum in Prague (see fig. 26) which was also administered in Aalborg in December 2004 as a means of identifying a set of design requirements. The aim is then to incorporate these design requirements into level one of the visual-narrative model (see Chapter 5) which in turn will support the development of the overall visual-narrative model.



Fig. 25: Study A: Part 1 – The Viewpoint IBR Environment



Fig. 26: Study A: Part 1 – The Technical Museum IBR Environment

#### 6.1.1.1 Methods

For this study two methods of data gathering were implemented: the *Place Probe* and semi-structured interviews. The *Place Probe* was developed by the *BENOGO* team at Napier University, Edinburgh (see Chapter 5). The semi-structured interview consisted of five main questions (see Table 1) and also some random questions materialising during the interview. The first question is an open-ended question while the subsequent questions are more specific. The interviews lasted between ten and twenty minutes and were recorded using a Digital Audio Tape recorder (DAT).

TABLE 1: STUDY A: PART 1 – THE SEMI-STRUCTURED INTERVIEW QUESTIONS

1. Can you tell me your general feeling and thoughts on your experience in the VR environment?
2. Did anything in the environment trigger your curiosity?
3. Was there anything odd or unusual in the environment?
4. Where did you think you were?
5. What did you think you were doing there?

### 6.1.1.2 *Participants*

The study involved a mixed group of forty three Danish participants (29 in the viewpoint VR environment and 14 in the technical museum VR environment) of different sexes, backgrounds and a range of ages.

### 6.1.1.3 *Procedure*

The procedure for both photorealistic VR environments was quite similar. On arriving at the location of the test, all participants were told briefly about the nature of the test and informed that it would last at the most twenty five minutes for the viewpoint and forty minutes for technical museum. They were informed that they could leave the experiment at any time. Each participant was shown the arena in which the test would occur (cave or HMD) and then were told to look around and experience the environment for about fifteen minutes. After which they were then given the *Place Probe* to complete. The semi structured interview was administered after the *Place Probe* and only during the technical museum study.

### 6.1.1.4 *Results*

For the viewpoint environment, the *Place probe* proved successful in highlighting a range of recurring visual features (i.e. visual units) that the participants tended to notice in the environment. It is clear from the findings that the participants seemed to identify the more prominent features (in terms of size) in the environment (the statue/sculpture was most frequently noted [15 times], then the church [11 times] and the castle [8 times]). To a lesser extent birds, platform, city, trees, bench, camera stand, roofs and sunshine were noted. From these findings, it is evident that while participants were attracted to features that were prominent (i.e. castle, church, statue etc.) in the cityscape, they were also unconsciously drawn to other features in the environment (i.e. blue sky, sunshine, quietness, roofs etc.)

- *'Standing in a nice quiet place high above the city where birds can be heard more than traffic. Nice winter day with mostly blue sky. Standing in a yard/park belonging to an old castle or similar with a nice view down to the city and up the mountain/ hill'* Participant (12)

Indeed, it can be surmised that these other features (i.e. the blue sky, the roofs, the quietness, the trees etc.) have interweaved with the prominent features to further push the

participant's attention into the feeling of certain thoughts and emotions. So much so, the probe shows that the majority of participants found the environment quite attractive (52%), quite pleasant (55%), quite interesting (38%), quite permanent (28%) and quite relaxing (38%) with emerging themes such as peaceful and relaxing, weather, Mediterranean, beautiful, sounds, interesting, realistic, natural and viewpoint.

From the data, it can be seen that some of the participants are beginning to contrive a sense of *holiday* from the experience. This could be the result of a number of different factors, but again from the *place probe* findings, it strongly suggests that the participants are reading and connecting the various visual cues such as the bright yellow sunshine, the red terracotta roofs and the bright yet lightly coloured surfaces. These cues are triggering certain holiday feelings, personal experiences and emotions and are causing some of the participants to assume the environment to be located in the south of Europe and Mediterranean. As seen from the below quotations, participants were feeling like tourists, even though all participants were unaware of the exact location of the environment.

- *'Maybe the city was located in the southern Europe and looked a bit old'*  
Participant (1)
- *'A nice place, seemed warm and quiet. It looked exactly like a modern vacation place'*. Participant (2)
- *'Standing on a platform looking over the city probably somewhere in Italy (I think) close to a monastery or church. At the platform there was a statue of some person'*.  
Participant (18)
- *'I think it's nice. I want to go on holiday now'*. Participant (20)
- *'The view was from a hill overlooking a city in southern Europe on a sunny day'*  
Participant (22)
- *'It feels like a place one visit on holiday. Nice over view on the one side and some kind of attraction on the other side overall a nice place.'* Participant (25)
- *'But I really felt like a tourist... because it was a new place for me... the weather'*  
Participant (26)

The data also shows that certain occurrences due to flaws in the IBR system are also capturing participant's attention. As the technology is still in its infancy, certain breaks in the images occur when one moves out of the region of exploration. Also, there is no vertical

parallax when one tries to look over something.<sup>49</sup> These occur in the form of black spots, which are totally out of place in the environment. Similarly, due to poor resolution, certain objects in the environment are, at times, not very clear. However, the interesting fact is that these gaps enhanced the participant's curiosity and interest and enticed them to build up reasons and even stories to explain why these occurrences are happening. For example:

- *'I think this brown big thing nearby was a bear'* Participant (3)
- *'A black spot, which looked like some kind of industrial'* Participant (23)

Likewise, there is a shadow of the photographer's tripod which is unintentionally evident in the VR environment. The reason for this is that it took some time to capture all the required images for the virtual environment and being an outdoor environment there was no control over the lighting. Nevertheless, one participant who was prompted by the shadow of the tripod at her feet suggested a role of a photographer to explain its unusual presence:

- *'I was a photographer maybe? Because of the shadow'* Participant (26).

For the technical museum environment, the *Place probe* was also successful in highlighting a range of reoccurring visual features that the participants tended to notice in the environment. The participants were attracted to the hanging planes and motorcycles, and to a slightly lesser extent, the trains and railing (the hanging aeroplane was most frequently noted [8 times], then the motorcycles [5 times], the railing [3 times] and the trains [3 times]). As the findings show, they tended to be attracted to these visual features because they were prominent (in terms of size and colour), strange or a little enigmatic (as Barthes would say, see Chapter 3). For example, the plane hanging from the ceiling, the back pack (i.e. the photographer's back pack unintentionally captured in the photos) engaged quite a lot of attention.

- *'There was a golden motorbike... there was I think my back pack standing behind me...'* Participant (2)
- *'Am when I was looking around, there was a plane hanging down from the ceiling...'* Participant (6)

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<sup>49</sup> The Benego IBR technology allowed for horizontal parallax in that when someone looked around an object, they could see behind the object, however it did not allow for vertical parallax in that when someone looked over or under an object, they saw only blackness.

- *‘But there was this strange thing behind me on the right side and around the corner there was something dark like a backpack or something...’* Participant (11 )
- *‘There was one big yellow plane that sort of looked like a glider because I couldn’t actually see any propellers but am there was some sort of obstruction in front of me ...’* Participant (14).

Also, some of the participants became engaged in trying to make out the details. They were also attracted to colours or things they recognised or associated with something in their past and were engaged in trying to explore them further (e.g. the writing on the signs etc.)

- *‘Yes I did, to the left side way up, on the wall there was a picture... am!!! And I couldn’t really make out if it was some sort of rocket... maybe the V2 rocket, WW2, I was in a museum in London a couple of weeks ago, a war museum there have one of those things there and this might have triggered my curiosity’* Participant (1)
- *‘I began to notice more and I quite liked the colours... there was a gorgeous nice orange colour aeroplane... I wanted that... am... there was this blue plane and bike oh I love blue... they were gorgeously blue... And orange... an orange car downstairs and plane behind me’* Participant (5)
- *‘I noticed black holes in the technology. I couldn’t quite see...’* Participant (8)
- *‘Am... would love to read this yellow piece of paper... yellow... ya so must have been colours’* Participant (11)
- *‘Yes there was it looked like a stop sign... in the left end of the room... of the ground floor... a sign like a stop sign... and I couldn’t quite see the image what it was supposed to be so I wanted to get closer and to see what exactly that was and round the containers’* Participant (12)

Overall, the participants were generally *‘happy... liked looking at old machines...’*, and some *‘spent a lot of time looking at the aeroplanes’*. In fact when participants were asked what they were doing there and what they thought their role in the environment was. Some of the participants started to fill in the gaps and link different cues and to create roles for themselves (i.e. they began to link some emerging themes such as emptiness, strangeness, restrictiveness, oldness and physical objects).

- ‘*Ya well I felt a bit awkward because it felt like it was after hours ha ha... I would have loved to be there as a tourist but it felt more like I was a thief or maybe as a cleaning lady... so dark... so something like that maybe a cleaning lady*’ Participant (11)
- ‘*That’s a good question... because the place was all deserted... Perhaps I was there as a custodian after hours...*’ Participant (14)

#### **6.1.1.5 Discussion**

This study has allowed us to identify the types of visual features that the participants were being attracted to in both photorealistic VR environments. More importantly, it has also given us an insight into why people were attracted to them, why they started to feel certain emotions and started to think certain thoughts. In detail, the *Place Probe* and semi-structured interview have enabled us to ascertain specific aspects of the visual features (i.e. size, bright colours, unusual shadows, black spots etc.) that have attracted the participant’s attention. For example, the data from the viewpoint VR experience shows that the participant’s attention is triggered by the prominence of the church, castle and statue, by the bright sunshine, the rustic red rooftops, by unusual and foreign objects in the environment (i.e. the shadow of a tripod) and by black noisy spots of the technology. Also in the technical museum, participants are seen to be attracted to objects with visually exciting colours or sizes, objects that are unusual and those that are enigmatic (i.e. that they can’t quite make out).

In summary, this data shows how size, colour, and enigmatic objects can attract and engage participant’s attention in photorealistic VR environments. It also gives us insight into how the participants have started to link these different visual aspects of the environments to elicit certain impressions which in turn engage and guide them into a certain mode of thinking and feeling. For example, the bright sunshine on the rooftops and the shadow of the tripod in the viewpoint environment has given participants a holiday feeling and the sense of being a tourist or a photographer. Similarly in the technical museum, some of the participants had the sense that they were the cleaning lady or the custodian in the museum after opening hours.

#### **6.1.1.6 Conclusion**

The initial part of Study A reported here, allows us to delimit that colour like in the historical visual-narratives (see Chapter 4) can attract participants to engage not only in specific visual features of a photorealistic VR environment but also in the creation of

specific thoughts and feelings. Indeed, the findings show that objects or areas of photorealistic VR environments that have bright colours or are enigmatic (i.e. unusual shadows, large objects, and black spots) seem to attract and engage participant's attention. Colour can therefore be used as a design requirement for level one of the visual-narrative model and then in doing so, it can feed into the next section of this chapter which focuses on how the photorealistic VR environment can be made more engaging.

### 6.1.2 Study A – Part 2: Engagement

This part of the study investigates the use of a scenario to provide the participant with a context for understanding and further engaging with the visual features (and particularly their colours) of a photorealistic VR environment. Again, this test is related to the *BENOGO* project and in particular, a photorealistic VR environment of a stairway at the technical University of Prague (see fig. 27). For this study, the photorealistic VR environment was imbued with a scenario, as well as, an audio sound of breaking glass, an augmented and a real table. The study took place in the HMD arena. Participants were seated at a real table and through the HMD could see the corresponding augmented table; they could also stand up and sit down, look round 360° and up or down.

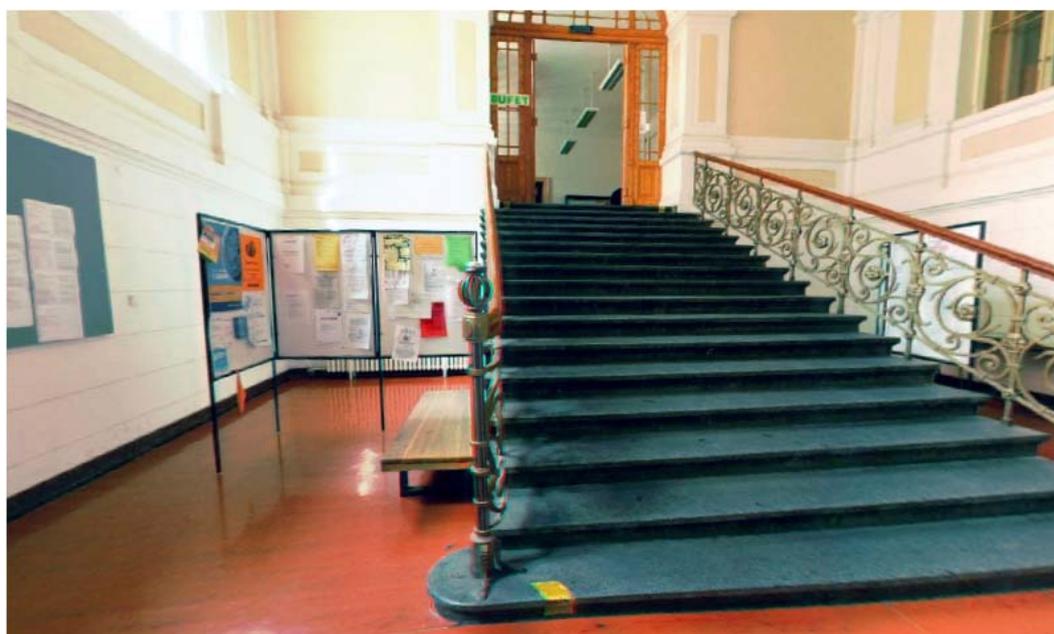


Fig. 27: Study A: Part 2 – The Stairway (Prague University) VR Environment

### 6.1.2.1 Participants

A total of 32 Danish participants (20 male and 12 female) took part in the study.<sup>50</sup> They were of different ages and mainly ranged from computing to Arts and social science backgrounds.

### 6.1.2.2 Methods

The measurement tools administered during this study were two questionnaires: Immersive Tendencies Questionnaire (ITQ) and a Presence questionnaire, a semi structured interview, a talk aloud and a repertory grid.<sup>51</sup> For the purposes of this small study, the findings from the semi-structured interview will be illustrated. The semi-structured interview consisted of nine questions which were carefully devised before the interview (see table 2). The first question is an open-ended question while the subsequent questions are more specific. The following presents the list of questions asked:

TABLE 2: STUDY A: PART2 – THE SEMI-STRUCTURED INTERVIEW QUESTIONS

- |  |
|--|
| <ol style="list-style-type: none"> <li>1. Describe the main features that you experienced while in the room...</li> <li>2. Describe the sense of scale that you experienced while in the room...</li> <li>3. What were you aware of while you were in the room?</li> <li>4. Describe your personal feelings about the room...</li> <li>5. Did you experience enjoyment while exploring the room?</li> <li>6. Did you feel part of, or engaged by, the experience?</li> <li>7. While exploring did you experience a sense of movement, either of the objects in the room or yourself? (e.g. differences in sounds, texture gradients etc.)</li> <li>8. What in your opinion were the three most striking features of the room?</li> </ol> |
|--|

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<sup>50</sup> Ten participants were interviewed, another twelve were asked to take part in a repertory grid analysis. The remaining ten were video taped during the exposure and asked to talk aloud. This study is only concerned with the ten participants that were interviewed.

<sup>51</sup> See (McCall et al., 2004, pp. 783 - 784)

### **6.1.2.3 Procedure**

On arriving at the HMD test location, all participants were informed that the study would last about one hour. They were briefed on the nature of the test and the various measurement methods and were told they could leave the experiment at any time. Firstly, they were then given the Immersive Tendencies Questionnaire (ITQ) to complete, after which they were given a short scenario to read before entering the environment:

*“You have recently been employed by the University to work as a part time security guard. This is your first day and you have been given the job of manning a security desk. Under no circumstances must you leave your desk but you may stand up and look around if you need to. You are provided with a small radio microphone and should any strange events occur you must notify the main security office, telling them immediately about anything that you see or hear.”*

They were then seated at a real table on a real chair while wearing the HMD. During the test, one of the evaluators acted as security control and responded to any comments made by the subject. Once the subject had completed ten minutes within the environment they were then asked to complete the Sense of Presence Questionnaire (SOPQ). After completing the questionnaire ten participants were interviewed and the remaining twelve were asked to take part in a repertory grid analysis. The remaining ten were video taped during the exposure and asked to talk aloud.

### **6.1.2.4 Results**

As mentioned, the results illustrated here are from the semi-structured interview part of the study which was administered to ten participants. From the data collected, it is seen that the introduction of a scenario to the experience of the photorealistic VR environment has appeared to give participants a stronger sense of involvement. The scenario is noted as providing a vehicle for exploring all the important and relevant aspects of the environment and when asked, many of the participants said they were engaged by the experience. They used words like ‘listening’, ‘attention’, and ‘involved’, ‘engaged’ and ‘activities’ to describe the experience:

- *‘My attention was mostly focused on the stairs, cause I was expecting someone to come, to walk in and then of course in front of me I didn’t look much in the back, where they had the board what’s it called and of course not so much at the*

*ceiling... my attention was focused on where I expected something to happen'*

Participant (4)

- *'Emmm... the features I saw, it's a big room, an old room... and university maybe a school, ah... big windows, stairs, am I'm sitting at the ground floor, and ah... I'm watching the room around me, am ... ya'* Participant (10)

The scenario provided them with a context and helped them to understand the environment they were in and also what they were meant to be doing there. Taking on the role of the security guard seems to have instilled enough excitement and curiosity within the participants to engage them in the photorealistic VR environment. From the findings, it is evident that they have taken on the role of the security guard and it had become their job to survey all activity within the room. What is of interest to this research is the relationship between the scenario and the visually augmented desk. The augmented desk helps create this illusion of being a security guard. From the data obtained it clearly shows that many participants seem to link and then associate the job of a security guard with the act of sitting at a desk. And in that sense, the fact that they were seated at a desk and could see it and a sign saying security guard on the desk seemed to enhance the illusion and to instil a greater sense of actually doing the job.

- *'Ok ah...I felt like I was sitting at this desk... Ah... Well I felt that I was sitting at my desk, doing my job'* Participant (1)
- *'Well it felt totally right ... I mean it felt like I was sitting in this chair and I had this ...ya... it was totally like I was there'* Participant (2)
- *'it was a bit boring actually... like being a security guard ...it was good there was a table that you could see and also feel'* Participant (4)
- *'... I was sitting at my security desk, am... there was a fairly high to the ceiling and there was some glass windows three on each side , fairly glass windows'* Participant (6)

Also, it is interesting to note, that many participants found the experience of sitting at a desk rather boring, the words *boring* and *bored* appearing on eight different occasions. They said that the experience was just like how they imagined the job would be.

- *'It was actually quite boring ...amm... it was just a hallway with a lot of steps and a... and I could hear people far away, but nothing happened ... ah ... except one time where there was some glass broken'* Participant (3)

- *‘I could imagine it would be just like that sitting guarding ... a security guard ... in a place where nothing happens ... you’re like sit and waiting, look around sometimes, listening to the sounds...’* Participant (4)
- *‘Emmm...nice ... but am ... a bit boring maybe, ah... didn’t catch any persons while sitting there ... so quite boring’* Participant (10)

Also, the sound of breaking glass further reinforced the whole illusion of being a security guard, sitting at a desk and being bored. Many participants commented that the sounds played a very important part of the whole experience, some felt a bit nervous while others were instilled with an excitement.

- *‘...ah...I would say definitely, I was definitely involved with it...Ah... Well I felt that I was sitting at my desk, doing my job, so... and also I felt I was a bit nervous because you know first day at work and every thing, you know’* Participant (1)
- *‘Well I think I got pretty involved I would say when the glass was breaking I looked around’* Participant (5)
- *‘ya when you hear the sounds around you, I couldn’t see any moving or anything like that so, so its only myself watching around, couldn’t see any people moving or making the sounds’* Participant (7)

#### **6.1.2.5 Discussion**

The findings from Study A: part 2 demonstrates how the use of a scenario can inform the design of a photorealistic VR environment. In fact, using a scenario in sync with certain visual and audio units (i.e. an augmented table and the sound of breaking glass) has demonstrated how the three can work together to encourage further engagement in the photorealistic VR environment. In detail, the scenario fuses with the augmented table and the sound of broken glass to not only emphasise the illusion of being a security guard on duty but also to open up other possibilities (i.e. feelings of boredom, nervousness, and excitement). In doing so, it entices participants to explore and then engage with other aspects of the photorealistic VR environment and in that sense can be viewed as an important requirement for level two of the design of the visual-narrative model.

### **6.1.2.6 Conclusion**

In conclusion, a scenario can be applied to level two of the visual-narrative model to increase engagement in a photorealistic VR environment. The emphasis of this research is on the visual and as this study has demonstrated the scenario has the potential to fuse with the visual features (i.e. visual units) to not only provide a context but also to add a greater understanding to the overall VR experience. In fact, the fusion between the ‘scenario’ and the visual units has the power to not only attract but to also deeply engage the participant in aspects of the photorealistic VR environment. In following Study A: part 3, the author will further explore how the visual units (particularly their colours) in conjunction with a scenario can be then further developed to encourage participants to ‘engage’ in the creation of a visual-narrative.

## **6.1.3 Study A –Part 3: Narration**

This study focuses on how the visual units and engagement levels of the visual-narrative structure (see Chapter 5) can be further developed to entice participants into the creation of visual-narratives. Already Study A: part 1 shows that colour is one of the visual elements that has been successful in attracting people’s attention to specific objects and areas of photorealistic VR environments. Study A: part 2 then demonstrates that the use of a scenario can provide a context to support participants in understanding their role and hence further engaging in the photorealistic VR environment. This study aims to apply these findings and then to explore how they can be further extended to encourage participants to create convincing narratives and ‘engaging’ experiences. In particular, the study will explore how some of the visual-narrative techniques (i.e. the patterning of colour) discussed in Chapter 4 will work with the findings of the previous studies to support the design of a visual-narrative VR environment. The interest lies in whether the participants will be attracted to the colours, engage with the scenario to fill in the gaps and create a visual-narrative. Study A: part 3 aims to identify a set of design requirements which will feed into level three of the visual-narrative structure and then ultimately support the overall development of the visual-narrative model.

### **6.1.3.1 The Visual-narrative Environment**

This is a comparative study which uses two versions of the same sitting room environment. It consists of a non visual-narrative environment which is made up of a photorealistic representation of the interior of a couple’s sitting room in an old Victorian flat in Edinburgh (see fig. 28) and a visual-narrative environment of the same flat but this

time in greyscale with a selective use of colour to highlight the story of the female partner living in the flat (see fig. 29).<sup>52</sup> It is speculated that the narratives created will be emergent (i.e. no two narratives will be identical); however, it is proposed that participants in the visual-narrative environment will tell stories more from a female perspective as opposed to that of a couple's in the non visual-narrative.

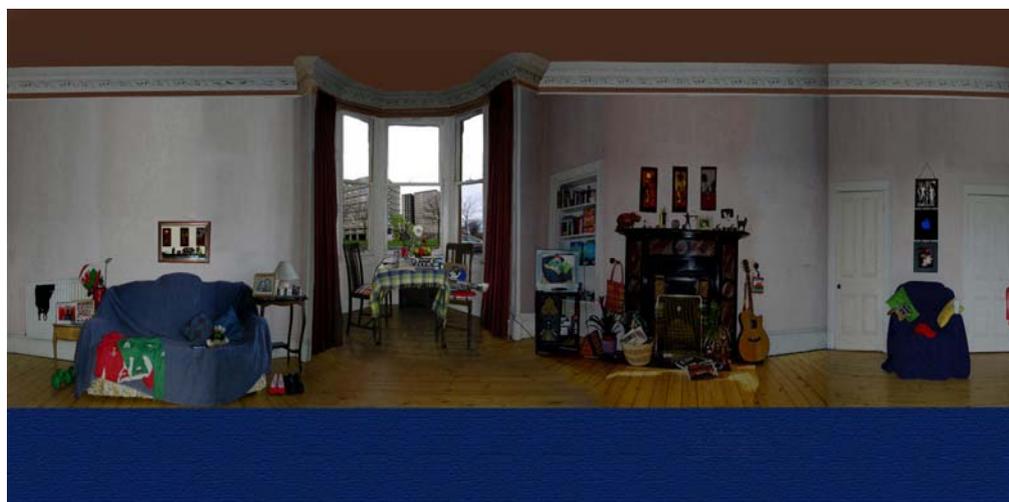


Fig. 28: Study A: Part 3 – Non Visual-narrative Environment of Edinburgh Flat



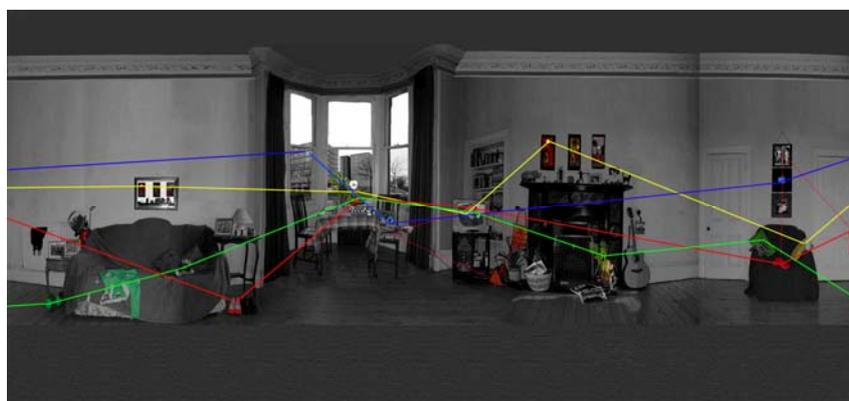
Fig. 29: Study A: Part 3 – Visual-narrative Environment of Edinburgh Flat

The non visual-narrative environment represents a couple's room full of different objects, moods and interests; everything is a mesh mash and it is difficult to distinguish who likes what and who does what.<sup>53</sup> The visual-narrative environment also shows a

<sup>52</sup> This approach to storytelling is inspired by the film *Red Desert* by Antonioni where he drapes his scenes in a greyish white hue and then calculatedly uses bright colours to correlate with his protagonist's emotional state and inner mind (see Chapter 4)

<sup>53</sup> In fact, it is difficult to see that it is the male partner who is Welsh (i.e. Welsh sport paraphernalia) and likes rugby (i.e. Welsh rugby shirt), that he reads a lot (i.e. Rankin and Stevenson books on the main table and a

couple's room full of different objects but this time the environment is in greyscale with colour strategically highlighted in certain areas to encourage the participant to sensuously 'engage' in the content and then to build certain feelings and thoughts about the female character that lives there. Indeed, to sensuously attract participant's attention, a small selection of bright and happy colours is used (i.e. red, blue, green and yellow). Similar to Memling's *Passion of Christ* (see Chapter 4), this small selection of artificially bright colours are spatially arranged around the room to arouse certain feelings and thoughts about the environment and the female person that lives there. Also like Duccio's isochromatic patterns (see Chapter 4), the colours are chosen and strategically placed to guide the participant through the narrative by allowing them to create more direct links between the objects (see fig. 30). These isochromatic patterns correspond with the gestalt theory of similarity (see Chapter 4) and are used to guide the spectator through the narrative (i.e. the bright blue of the Scottish flag matches the blue used on the Apple Mac symbol on the wall opposite and with the cat on the blue rug; similarly there is a direct link between the red shoes, red bag and red ribbon). The objective of this is to strategically use colour to expose the participant to certain calculated feelings and thoughts and similar to Antonioni's *Red Desert*, to use colour to give a greater insight into the main character of the story. Indeed, the aim is to immediately trigger a more female orientated feel and to generate a narrative about the female partner living in the flat.



**Fig. 30:** The Strategic Patterning of Colours around the Environment

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range of books on book shelf), likes drinking tea (i.e. cup on armchair) and playing the guitar (i.e. guitar by fireplace), that he is the one who mainly watches TV (i.e. remote on the sofa and TV set turned on) and likes playing chess (i.e. chess set on table by sofa). It is hard to make out that he is the one who owns the car (i.e. outside the window), works on the computer (i.e. laptop on the table) and likes dogs (i.e. picture of dog on the mantel piece). Also, it is hard to determine that the female partner on the other hand is Irish (i.e. shamrock on the teddy bear, the green rugby shirt), likes going out and partying (i.e. red shoes, red ribbon, and red bag) while at the same time, likes keeping fit (i.e. dumbbells) and has just started to play golf. In general, it is hard to see that she is the one who likes to lead a healthy and natural life (i.e. fruit, flowers), likes to do a bit of travelling (i.e. travel books), and likes to collect art from her travels (i.e. African paintings on the wall). That she likes cats (i.e. picture of the cat on the chair) and is a fairly creative person who works with apple Mackintosh.

In terms of the narrative (see Chapter 5), the coloured objects are selected from two main categories which include physical presence (i.e. personal details, interests, and occupation of the female partner) and also geographical location.<sup>54</sup> These categories are designed to work in conjunction with the scenario *Through the Keyhole* which requires the participant to enter the room and to look around for clues which might help them in identifying the type and character (i.e. the story) of the person that lives there (see Chapter 5). In doing so, the scenario aims to encourage a pervasive movement through the environment while at the same time to deeply engage participants (i.e. allow them to get lost in their own sense of time). Like Memling's *Passion of Christ* (see Chapter 4) the colours highlight certain objects – which are strategically dispersed around the environment – to draw the participant into the visual-narrative. The goal is to trigger certain thoughts and feelings whilst also getting the participant to look around the room. As one can see, there are specific areas where the colours overlap or heavily dominate. This is an intentional strategy applied by the author to draw participants attention to that area of the environment (see fig. 31). For example, the bay window is an important area for the narrative in that it contains many clues as to the geographical location of the room. Also, the television set, sofa and armchair work together to give the illusion of a physical female presence (i.e. on the television screen there is a reflection of a girl wearing the red hat and green rugby jersey, the same rugby shirt and hat are also lying on the armchair and sofa). Indeed, the goal is to assist participants in making connections and interpretations about the people living there (particularly the female character) and the different objects that belong to her within the environment.

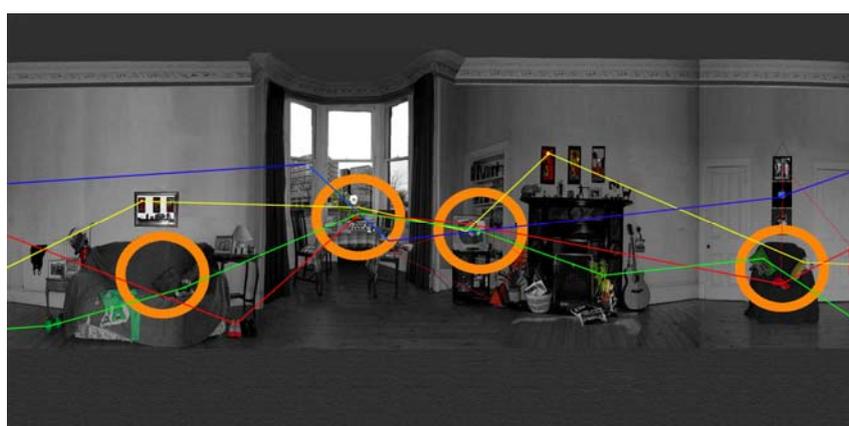


Fig. 31: Key Focal Areas of the Visual-narrative

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<sup>54</sup> These two categories in conjunction with personal time and pervasive movement are what Berleant feels makes up an environmental experience (see Chapter 2).

Like Duccio's *Maestà*, the colours are applied to reveal more about the character in the story; they are used to subtly highlight the *femininity* of the character especially her warm and happy-go-lucky nature. Also, they are used to draw ones attention to the objects stereotypically associated with the woman (i.e. shoes, handbag, ribbon etc.). The more stereotypical male objects such as the men shoes, the guitar, the chess set, the car outside the window, the sport mascot hat (Welsh), the Rugby shirt (Welsh) and sport paraphernalia (Welsh) have been kept in the greyscale background by not highlighting them. Also, similar to the *Maestà*, the visual-narrative environment uses some symbolic colours to elicit further meanings (i.e. the green rugby jersey is associated with being Irish, the red shoes with partying and painting the town red and the white flower with naturalness and perhaps naivety etc). It also repeats some of these colours to again further enhance the theme of the female. As mentioned, the image of a girl (sitting on a single armchair) on the television screen wearing a red baseball hat and green rugby shirt reflects the red baseball hat on the single armchair and the green rugby shirt on the sofa in the sitting room. This repetition of colour has been deliberately applied to encourage a little visual exploration while at the same time to give the illusion of a female presence in the room. Others include the repetition of the red apple and the use of the mirror on the wall which reflects the colours from the three African paintings of women travelling; again, this repeated use of colour highlights the presence of the female as well as the idea of travel.

The main drive of this work is to apply some of the techniques used by Duccio, Memling, and Antonioni in order to strategically pattern colours (within a scenario) in a photorealistic VR environment. The aim is that participants can easily interact with the content to elicit specific feelings, emotions, and thoughts that will in turn guide the creation of an 'engaging' visual-narrative. The key to the success of the visual-narrative is how well the colours and scenario work together with the visual-narrative techniques to entice the participants into new thoughts and feeling, into the making of associations and the unravelling of a story. For example, some of the cues are quite literal (i.e. dumbbells – she works out) while others are more abstract, the picture of Adam and Eve on the wall (i.e. the domineering female holding the highlighted red apple). Also, some of the cues are a little enigmatic (i.e. their absence defines their purpose). For example, the pair of small ladies dumbbells, the two pairs of shoes (ladies and gents) and the two rugby shirts in the non visual-narrative, become only one in the visual-narrative environment (i.e. one dumbbell, one rugby shirt and the ladies shoes are highlighted). The purpose of this is to instil a one person emphasis as opposed to a couple. Finally, some of the cues are also designed to appear quite contradictory, similar to Velasquez's *Las Meninas*, the aim is to encourage participants to work out the narrative. For example the Irish rugby jersey and the

shamrock on the teddy bear signify an Irish theme yet the Scottish flag on the high-rise buildings outside the window suggests a definite location. The high-rise flats could be in any city in the UK but the significance of the Scottish flag hanging from the window means that it is somewhere in Scotland. But, where would one find an old Victorian tenement adjacent to a block of high-rise flats? The author uses this strategy (i.e. superimposing one image onto another) to further engage and tease the imagination of the participant. The interest lies in how the feelings and emotions that emerge from the colours (and the scenario) feed into a greater understanding of the person and hence the piecing together of her story. Indeed, the author creates a visual-narrative, yet, it is the participant's job to make sense of it, to engage in the matching together of the pieces (i.e. thoughts and feelings) to create newer associations and narratives.

### 6.1.3.2 *Methods*

The talk aloud approach was used in conjunction with the *Through the Keyhole* scenario which required the participant to enter the room and to look around for clues which might help them in identifying the type and character of person that lives there. It was used initially to get participants talking about and describing their initial impressions of the flat and who lived there. If unsure and hesitant, each participant was prompted with some extra questions (see Table 3). This process lasted between five and ten minutes and was recorded using a DAT recorder.

TABLE 3: STUDY A: PART 3 –THE SEMI-STRUCTURED INTERVIEW QUESTIONS

- |   |
|---|
| <ol style="list-style-type: none"> <li>1. What do you know about the person/people i.e. personal details/life?</li> <li>2. What is their profession?</li> <li>3. What are their interests?</li> <li>4. Where do they live?</li> </ol> |
|---|

### 6.1.3.3 *Participants*

Twenty-one students (i.e. nine male and twelve female students) from a mixed academic background were asked to take part in the study. (See Chapter 5)

### 6.1.3.4 *Procedure*

On arriving at the location of the test, all participants were told briefly about the nature of the test and were asked to complete a standard Ishihara Test for Colour

Blindness.<sup>55</sup> Each participant was given the *Through the Keyhole* scenario (see above). In random order, they were then asked to experience for five to ten minutes both the non visual-narrative environment and also the visual-narrative environment of the same flat. During these trials each participant was asked to talk-aloud and describe what type of person lives in the flat, as mentioned, if they were hesitant, they were prompted with a number of questions (see table 3). After each environment, they were asked to answer in writing three questions (see table 4).

TABLE 4: STUDY A: PART 3 – THREE ADDITIONAL QUESTIONS

<ol style="list-style-type: none"> <li>1. Did anything attract/ catch your attention in the environment and why?</li> <li>2. Did anything keep your attention/ engage you for any period of time, why?</li> <li>3. Did you find yourself making associations between things? If so elaborate</li> <li>4. Any other comments?</li> </ol>
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### 6.1.3.5 Results

The results from the visual-narrative environment show that thirteen of the twenty-one participants (61.9%) who experienced the visual-narrative environment tended to read a more female/single/female orientated narrative while the remaining eight participants (38.1%) read a couple/family/multiple person narrative (see Appendix A).

These findings indicate that several participants are being attracted to the colours which have been used to highlight the female and the objects stereotypically associated with or which symbolise the woman particularly the red female shoes, the teddy bear, the red bag, the white flowers, the fruit, the cat on the chair, the magazines on the floor, the diary, the ribbon on the door handle and the plants by the fireplace. The participants are engaging with these cues and then linking them to make associations about the female character:

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<sup>55</sup> As the study depended on the identification and patterning of colour, a colour blind test was performed prior to the study to ensure that the participant was not colour blind. See <http://www.toledobend.com/colorblind/Ishihara.html>

- *'She does like to have a bit of a party every now and again because of the red shoes am.'* Participant (1)
- *'Someone not really organised she doesn't know where she wants to be yet... there is a red pair of shoes on the floor she is into her colours, likes her bright colours, she doesn't mind standing out, tidiness is not a thing, she is not a messy person but not a clan freak'* Participant (6)
- *'Someone quite natural and down to earth like organic side of life, natural with fruit and flowers maybe a vegetarian'* Participant (7)
- *'A young woman, she is creative educated intelligent... isn't settled yet, its still early days'* Participant (19)

In terms of geographical location, many participants are noticing the Scottish flag and are assuming a Scottish location:

- *'I would venture to say we are in Edinburgh or Glasgow because of the Scottish flag'* Participant (4)
- *'Located in Scotland, I guess I can see the flag on the high rise flats in Glasgow'* Participant (8)
- *'I didn't notice the Scottish flag before (in previous study) I think maybe it wasn't there the last time but I would say the bay windows are quite Edinburgh'* Participant(15)

While at the same time, they are picking up on the Irish cues and even though located in Scotland, they are associating the occupant as being Irish:

- *'There is a little teddy bear with a clover shirt, maybe with green rugby shirt they are Irish'* Participant (4)
- *'The Irish teddy bear has an Irish sign on it'* Participant (9)
- *'A teddy bear with a shamrock on the top some Irish connection'* Participant (10)
- *'I think its possibly someone that's Irish'* Participant (11)
- *'Teddy bear with shamrock is girly'* Participant (15)

In terms of interests, participants tended to pick up on the coloured cues involving vibes of travel, art and sport and when they started to fill in the gaps they started to make quite accurate associations.

- *'I think they are into working out because dumbbells and that looks like a jump rope on the door and that looks like a tank top over there and there are golf clubs too, so I'm sure the person likes the outdoors and exercising'* Participant (4)
- *'Someone who likes flowers and also fruit, there is also a bag on the door perhaps likes shopping'* Participant (9)
- *'I think it's possibly someone that's Irish someone who's interested in foreign countries or African art'* Participant (11)

However, music (i.e. the guitar) which was not highlighted, (i.e. remained in greyscale) tended to be mentioned too, only a few people made the association between the guitar and her boyfriend.

- *'She is also decorative, she likes her flowers and stuff, she is an active person and she can be exotic with her arts, I don't think she is into her music, I think her boyfriend is into music'* Participant (6)

In reference to their ideas on occupation, some participants made very general assumptions about the occupant's occupation

- *'I think it could be computers or writing'* Participant (1)
- *'Think it's someone in the travel industry'* Participant (2)
- *'Am maybe a writer or a poet still someone who appreciates art'* Participant (3)
- *'I would say someone in the creative fields like history, writing, a journalist, more liberal arts and not so much the science'* Participant (4)

While other participants noticed the blue Mac symbol and made more specific associations:

- *'I see an Mac Icon, I know people who likes Macs are creative and are in that sort of field'* Participant (4)
- *'I don't know maybe Apple Mac reference might be technie or into graphics or graphic type stuff'* Participant (12)

Overall, the majority of participants who thoroughly looked around the environment, tended to notice all the cues, engaging in some more so than others, for example the triangular Thai cushion was an enigma, like Barthes' (1974, p.19) hermeneutic

code (see Chapter 3), it aroused a lot of curiosity as many participants unfamiliar with its design, spent a lot of time trying to figure out what exactly it was:

- *'Not sure what it is down there, it is triangular in shape with glowing lights like a lava lamp perhaps'* Participant (1)
- *'Don't know what the big triangle is on the floor'* Participant (7)
- *'I think it is a candle holder next to the plant by the TV'* Participant (9)
- *'I don't know what triangle thing is with balls?'* Participant (12)
- *'There's something on the floor with red lights but cant make it out'* Participant (21)

Some other aspects of the environment also proved a little enigmatic and they spent time trying to figure these out (i.e. trying to figure out if there is a mirror on the wall over the sofa reflecting the African prints? Who or what was on the TV? And where the flat was located?). The traditional Victorian room superposed next to a high-rise housing estate tended to engage many participants.<sup>56</sup>

Due to the very nature of this emergent narrative, some participants made associations that were quite accurate to the original narrative plan while others came up with things that had not even been considered:

- *'different jerseys, might be a different team, different colours I don't know'* Participant (5)
- *'maybe person is kind of into like picture on the wall, their hobby is like doing circus tricks and stuff'* Participant (7)
- *'I can see a picture of a dog on the mantel piece... so maybe they own a dog as well maybe that's what that thing on the door knob is for'* Participant (13)

Also, the depth to these associations varies considerably from participant to participant, some being quite descriptive while others being a bit more analytical.

- *'possibly the person is looking for another place to live because have old home magazine in the bin or is studying interior architecture'* Participant (7)
- *'there's quite modern art work combined with older art work so broad interest in art'* Participant (8)

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<sup>56</sup> This is a technique used by Jeff Wall (see Chapter 5)

- *'...am thinking of places where there are flat blocks like this across the road from what looks like standard tenement blocks'* Participant (15)
- *'I would think academic books not magazine type book but more serious types of books there are fun books too but I would say working hard to do something education wise'* Participant (18)

As it is an emergent narrative, no narrative is identical and the amount of cues picked up and the content of narrative created varies from person to person. However, overall, the majority of participants picked up enough cues to support a more female orientated narrative.

In the non visual-narrative environment, seven participants (33.3%) read a female/single/female emphasised narrative while the remaining fourteen participants (66.7%) read a couple/family/multiple person narrative (see Appendix B). These findings suggest that, unlike in the visual-narrative environment, participants are reading the room as a whole and are not being attracted to any specific colours or objects. Therefore participants are not being drawn to any specifically contrived narrative but are experiencing the room in its entirety and in doing so, they are picking up a more couple presence as opposed to just a female one. There is an obvious Welsh presence this time, with the words *Wales* appearing seven times and the word *Welsh* appearing eighteen times as opposed to during the visual-narrative experience when the word *Wales* appeared twice and the word *Welsh* appeared nine times.

- *'This time I think the male partner seems more flamboyant because of the colourful golf stuff, his guitar is still there'* Participant (6)
- *'There is a Welsh hat so obviously two rugby fans an Irish and a Welsh'* Participant (8)
- *'ah a Welsh dragon maybe not just Irish... stronger Welsh identity as well as Irish'* Participant (10)
- *'Someone is Welsh and one is Irish, keen on rugby'* Participant (12)

As in the visual-narrative, the interest such as art, sport and travel are still being mentioned but this time also there is more reference to the game of rugby, chess and football, to the Rankin books and to the guitar.

- *'the car parked outside it's a ground floor flat guessing, two flat people live here'* Participant (1)

- *'they like crime books by the looks of it they are reading Rankin'* Participant (7)
- *'am there a guitar here so someone's well into their music and reading as well'* Participant (14)
- *'there are golf clubs as well as a chess board what does that tell ya, I don't know they think they are quite clever'* Participant (15)
- *'am someone who is welsh likes rugby still someone who reads'* Participant (18)

In terms of location, fewer participants are noticing the Scottish flag (five participants mentioned it as opposed to eleven people in the visual-narrative) but similar to the previous study they are assuming a Scottish location:

- *'wait oh is that a Scottish flag in the window up there I think it is, we are in Scotland'* Participant (5)
- *'I would say somewhere in Scotland but then again maybe rugby tops may suggest somewhere in Ireland or Wales but Scottish flag makes me think Scotland'* Participant (8)

Also, only two participants made reference to the apple Mac symbol

- *'not sure actually, somebody into computers with apple'* Participant (11)
- *'to see the Mac sign suggest they are more into the visual culture than maths or excel SS more artist than scientist ya'* Participant (19)

Though similarly some general assumptions about the occupant's occupation were made:

- *'Someone in the travel industry or something like that lots of travel books'* Participant (2)
- *'May be an interest in history as well profession maybe'* Participant (8)
- *'Student or someone who are not earning that much money'* Participant (16)

Every place tells a story, even though it was more a monstration than a narrative environment (see Chapter 5), the participants naturally were inclined to explore and create some sort of narrative to represent their experience. Similar to the previous visual-narrative environment, the content of narratives created varied from person to person. However, what is of interest to us in this study is that this time the majority of participants read a more couple orientated narrative as opposed to the more female narrative.

### **6.1.3.6 Discussion**

Using some of the visual-narratives techniques discussed in Chapter 4, Study A: part 3 has incorporated the findings from Study A: part 1 and Study A: part 2 into the design of a visual-narrative environment. In detail, Study A: part 3 has explored the importance of strategically patterning colour (in conjunction with a scenario) to ‘engage’ and guide participants into a certain mode of thinking, feeling and story making. So much so, the findings illustrate that the majority of participants in the visual-narrative environment read the intentionally planned and strategically patterned ‘female orientated’ narrative.

However, in terms of gathering this data, the author has demonstrated some flexibility in the delivery of the talk aloud method in that she devised a number of extra questions (i.e. in addition to the scenario) to further prompt some participants who were hesitant and unsure of the procedure. For example, some participants started to talk aloud immediately, while others remained silent; the participants that remained unsure and silent were prompted with these extra questions (i.e. what do you know about the person/people that live here? etc.) to kick start them into the talk aloud. To maintain a reasonable consistency, all participants were eventually prompted with the extra questions at some stage through the study (i.e. if they did not initially succeed in covering all the chosen narrative areas, they would be prompted to talk about the remaining areas). In hindsight, the author feels that because of the focus of this particular study (i.e. finding out whether or not the participants were identifying the ‘female’ as opposed to the ‘male’ or ‘couple’), the additional prompts were not a bias to the final findings. However, in preparation for the following Study B – which will be probing a different set of questions – the author proposes to revise the scenario used in this study (i.e. to make it self-explanatory and deliverable in an identical way to all participants).

Also, as explained in Chapter 5, some of the participants used in this study were previously acquainted with the author (see Appendix C). In fact, prior to the study, nine participants were well acquainted with the author (i.e. colleagues), six were formally acquainted with the author (i.e. students) and six were unacquainted with the author. Again, due to the nature and focus of this study, the author felt confident that this ‘familiarity’ would not bias the core objective of the study which involved the identification and linking of the ‘female orientated’ narrative cues in a couple’s sitting room environment. As evident from the findings, participants from all groups were picking up the cues (i.e. five out of the nine well acquainted with the author, three out of the six formally acquainted with the author and five out of the six unacquainted with the author read a more female orientated narrative). In fact, the issue of ‘familiarity’, a factor that might be mistaken as a weak area in another study, indeed, was perceived by the author as strength in that it

illustrated that participants actually read the cues and told the story they experienced as opposed to what they already knew.

In terms of the design, the study has also highlighted several issues with the current design of the visual-narrative environment that will also need to be addressed before the final study B. These include concerns with the use of greyscale in the visual-narrative environment. In some cases; participants are finding the environment a lot duller and at times less appealing because of the greyscale:

- *'it seems darker and less welcoming than previous environment, not as homely'*  
Participant (2)

Others are automatically equating the duller and darker colours with the male partner:

- *'now grey or dark black indicating male element this look on wall it has a certain feel to it'* Participant (17)

While others feel it's a different time of day or season:

- *'I feel it is the same as before but maybe it's a different season...I don't know maybe time has gone'* Participant (4)

These comments have given us insight into possible issues which might interfere with the final Study B and particularly the participant's overall impressions within the environments. To address these it will be necessary to rethink the way colour is applied to the photorealistic VR environment.

Another smaller issue that emerged during Study A is the mismatch of globally stereotypical associations; the golf clubs were highlighted as a sport the female partner played. However, many participants equated the golf clubs with a male sport and as result started to build a male narrative around these conceptions.

- *'golf clubs hard to say male or female'* Participant (2)
- *'I can see a golf rack behind the chair probably she is staying in the same flat as her partner and he plays golf'* Participant (6)
- *'I didn't notice set of golf clubs before and am being completely sexist saying he plays them'* Participant (19)
- *'golf definitely strikes me as more manly'* Participant (21)

This visual cue confused many participants while they were decoding the narrative as it seems to go against its stereotypical meaning and in hindsight, it will be necessary to reconsider its value (i.e. its overall contribution to the narrative). For Study B, it will be necessary to either remove it entirely from the narrative or to find a compromise by changing it to a more stereotypical female colour.

Finally, a lot of participants commented on the poor clarity of the HMD, in that they found it difficult to make out some objects around the room especially the finer details such as names on the books, magazines etc. In terms of updating the technology this is an issue which unfortunately cannot be resolved at this stage, however in terms of design, especially in Study B, it will be possible to manipulate some of the details so that participants can get a clearer image.

- *'I think there were a few keys objects that I couldn't decode because they were too blurry'* Participant (7)
- *'the clearer the focus the better the view and the easier it would have been for me to clearly see what the room is all about'* Participant (16)

Despite these issues, overall it is suggested that these findings successfully demonstrate how colour can be used to engage and draw people into visual-narratives. And more importantly at this stage, it also gives us insight into how this may be improved to create 'engaging' and appealing experiences.

### **6.1.3.7 Conclusion**

Study A: Part 3 demonstrates that colour in conjunction with a scenario can be used not only to attract attention and interest but also when strategically patterned has the potential to involve participants in the making of new thoughts, feelings and hence narrative associations. Indeed, using the visual-narrative techniques of Memling, Duccio and Antonioni to pattern colours within a scenario has the potential to create convincing visual-narrative experiences. In conclusion, the use of symbolism and similarity (i.e. gestalt theory) in spatially arranged and isochromatic patterns of colour can feed into the creation of literal, abstract, enigmatic and contradictory associations which in turn can work with the scenario to create 'engaging' visual-narratives. These findings complete the first version of the visual-narrative model which will be used to support the design of the visual-narrative environment in Study B.

## 6.1.4 Overall Conclusion

The main objective of this theoretical visual-narrative structure is twofold: firstly it aims to provide a rational and relevant structure for the design of a set of studies whose findings can then contribute to the building of the visual-narrative model for photorealistic VR purposes. The second objective is to use this complete visual-narrative model to provide guidance and support in the design of ‘engaging’ visual-narratives in VR. Study A achieved the first objective which asserts that:

- Colour can be used to attract ones attention to visual features in photorealistic VR environments; it can also be used to create new thoughts, feelings and impressions. (part 1)
- A scenario can be used to give a context to these visual features in a photorealistic VR environment as well as to further engage participants in making sense of the environment (part 2)
- Both ‘colour’ and ‘scenario’ can be applied to existing visual-narrative techniques to create direct links, associations and narratives in photorealistic VR environments (part 3)

As mentioned at the beginning of this chapter, the visual-narrative structure is a three tier framework which has been used to break down the design of the photorealistic VR environment into three stages, the first stage (i.e. the lowest level of the model) is the design of the most basic components of the narrative and from Study A: part1, it can be determined that bright colours (i.e. red, blue, yellow and green) can be used not only to attract participants attention but also to instil deeper meanings and feelings into VR experiences. When these bright colours are strategically placed around the environment, they not only draw attention to specific areas and visual features (i.e. visual units) but also to specific thoughts, feelings and impressions. The second stage (i.e. middle level of the model) focuses on engagement and from Study A: part 2, it can be confirmed that a scenario can be worked into the experience to ensure that participants are engaging more in the visual units (i.e. particularly the colours) of the photorealistic VR environment. Finally the last stage (i.e. highest level) is where the narration takes place, this is where the bright colours and scenario work together with existing visual-narrative techniques (such as those used by Duccio, Memling and Antonioni) to get the participants attracted to certain areas and making associations with others to create ‘engaging’ narratives (see fig.30).

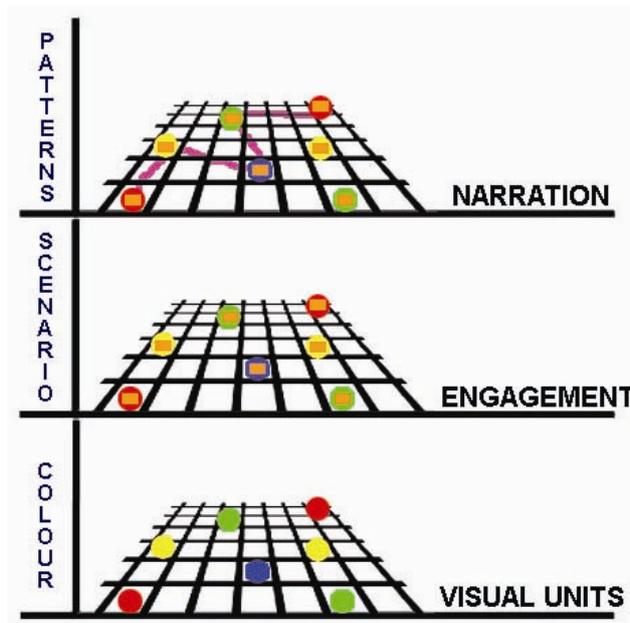


Fig. 32: The Revised Visual-narrative Model

In conclusion, it is now contended that this visual-narrative model has the means to support and guide the design of ‘engaging’ photorealistic VR experiences. As will be seen, the goal of the next chapter is to compare participant’s experiences in the visual-narrative environment (i.e. designed using the visual-narrative model) with similar experiences in non visual-narrative environments and in doing so, to successfully identify which experience is more ‘engaging’ and appealing.

# 7: CREATING ENGAGING PHOTOREALISTIC VR EXPERIENCES

One of the more common goals in VR development is the desire to create an immersive, illusive and ‘engaging’ experience. As indicated by Waterworth & Waterworth (2001, p.203), VR designers typically aim at creating an ‘engaging’ and convincing environment in which users feel ‘present’. However, in practice, it is currently proving quite a challenge to create a high-fidelity yet ‘engaging’ VR experience. This is somewhat due to technical limitations (i.e. processing power, image resolution and communication bandwidth) but also, as the author of this thesis feels, to the fact that the experiential potential of VR design has, generally, been overlooked. In saying that, this thesis focuses primarily on the role of aesthetics in the creation of ‘engaging’ photorealistic VR environments. In particular, this chapter aims to explore how an *aesthetic-interaction* process when articulated through a visual-narrative model has the potential to create ‘engaging’ VR experiences.

To achieve this, firstly, two small pilot tests on the visual-narrative model will be performed to address the design issues that arose in Study A: part3. After these iterations of the visual-narrative model, Study B will then compare participant’s experiences in both the visual-narrative environment (i.e. VR environment designed with the visual-narrative model) and the non visual-narrative environment. What is of main interest is whether or not participants become sufficiently attracted to and engaged in the colours and the

scenario to make associations and hence piece together the visual-narrative. On the whole, the chapter aims to reveal that aesthetics has a significant role in the design and creation of ‘engaging’ virtual environments.

## 7.1 Pre study B – Pilot Tests

From the results of Study A: part 3, it is clear that a number of small issues need to be addressed before the author can proceed with Study B (i.e. comparing participant’s experiences in both the visual-narrative and non visual-narrative environments). These issues include: the negative connotations as a result of the greyscale background, the mismatched stereotype feelings towards the golf bag and then the poor clarity as a result of the HMD technology. It is also important to mention that there were further issues concerning the flexibilities of the talk-aloud method and the sample group used, however, for the forthcoming Study B, it has been decided to develop the scenario used in the talk-aloud method and also to avail of a completely random sample group (i.e. participants who are unknown to the author prior to the study). The following pilot test will mainly address the negative attitude surrounding the greyscale background by revising the background to a slightly warmer sepia tone.<sup>57</sup> The test will implement the necessary changes while focusing primarily on exonerating the negative impressions created by the greyscale background.

### 7.1.1 Test 1: Greyscale versus Sepia Background

The main objective of this pilot test will be to address an issue (which arose in Study A: part 3) concerning the greyscale background in the visual-narrative environment. It will look, particularly, at the negative feelings of cold and loneliness, and the impressions of maleness and darkness which arose in the study due to the greyscale and lack of colour. For this test, the greyscale background of the visual-narrative environment will be changed to a sepia background. Also the golf club bag will be decolourised in the visual-narrative environment and certain book titles and pictures will be enlarged in order to counteract the

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<sup>57</sup> In terms of the mismatched stereotype, it has been decided that the golf bag will be decolourised, as a weak narrative link, it seems rational to discount it from the female narrative and to leave it in the background as a male object. In relation to the poor clarity of the system, at this stage, updating the HMD technology is not a viable option or a primary concern. To counteract the lack of clarity issues, it has been decided to enlarge the details (i.e. text, pictures etc) on some of the objects that were attracting participant’s attention (i.e. objects that they could see but details that they could not accurately distinguish and read).

poor clarity of the VR Technology. The primary focus will be on how the sepia background affects the experiences of the participants while in the visual-narrative environment.



Fig. 33: Pilot Test – The Visual-narrative Environment of Edinburgh Flat (Sepia)

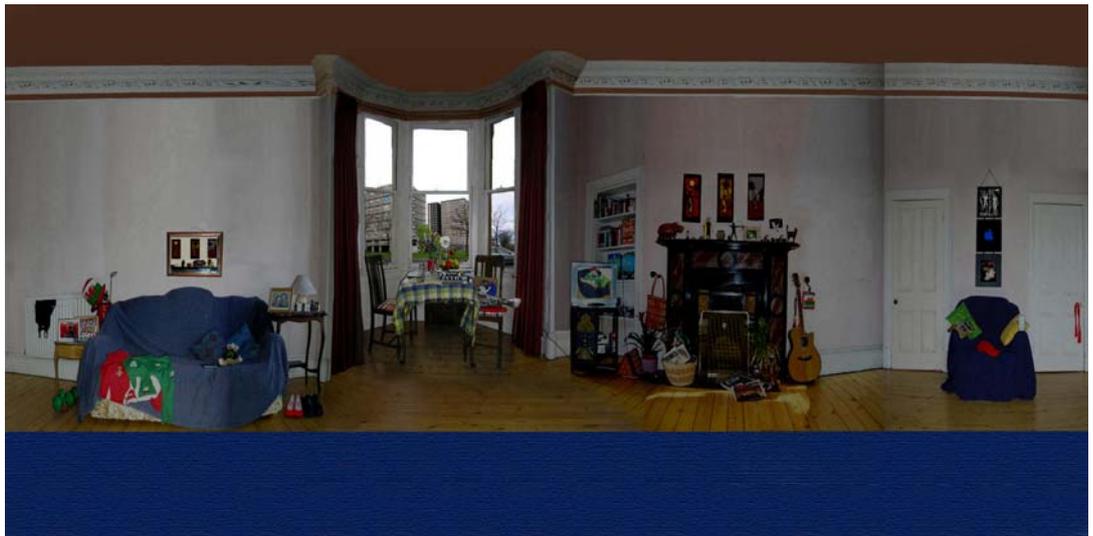


Fig. 34: Pilot Test – Non Visual-narrative Environment of Edinburgh Flat

#### ***7.1.1.1 Participants***

This test was performed by four people (three male and one female) from a mixed academic background.

### 7.1.1.2 Procedure

Similar to Study A: part 3, all participants were told briefly about the nature of the test and were asked to complete a standard Ishihara Test for Colour Blindness.<sup>58</sup> Each participant was given the *Through the Keyhole* scenario, they were asked to enter the room and look around for clues which might help them in identifying the type and character of person that lives there (i.e. What do you know about the person/ people i.e. personal details/ life? What is their profession? What are their interests? Where do they live?). In random order, they were then asked to experience for five to ten minutes both the non visual-narrative environment (see fig. 31) and also the visual-narrative environment (see fig. 32) of the same flat. During these trials each participant was asked to talk-aloud and describe what type of person lives in the flat. After each environment, they were asked to answer three questions in writing (i.e. did anything attract/ catch your attention in the environment and why? did anything keep your attention/ engage you for any period of time, why? did you find yourself making associations between things? If so elaborate).

### 7.1.1.3 Results

The findings show that even though the golf bag and the poor clarity are proving less of an issue, the sepia background like the greyscale is continuing to influence participant's impressions and overall feel of the visual-narrative environment:

- *'its more sterile than the previous one, less realistic'* Participant (1)
- *'The second environment (non visual-narrative) was more effective, there was less contrast in the lighting I suppose. The first one felt dark but with garnish spots but again the second one felt more natural'* Participant (2)
- *'I felt better in the other one (non visual-narrative), this one am... the other one is colourful'* Participant (3)
- *'the second one (non visual-narrative) because everything seemed to be more colourful'* Participant (4)

From the data, it is clear that the sepia background, like the greyscale background, is having a negative effect on the participant's experience in the visual-narrative environment. They found it less natural, less colourful, less realistic and more sterile. In fact, due to the darkened sepia appearance of the visual-narrative environment, participant's attitudes of

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<sup>58</sup> See <http://www.toledo-bend.com/colorblind/Ishihara.html>

preference tend to be biased towards the non visual-narrative environments. They tend to feel better in and enjoy the non visual-narrative environment.

#### **7.1.1.4 Conclusion**

From this, it can be concluded that in order to avoid such interference, it will be necessary to reconsider the overall approach and design of the visual-narrative environment. By subtracting colour from the photorealistic VR environment and producing a greyscale or sepia coloured room, it is biasing the results with preconceived impressions and a somewhat negative feeling. For the next iteration of the model, it is clear that the study will need to work from a more evenly balanced background (i.e. the visual-narrative environment will need a similar base colouring as the non visual-narrative environment).

### **7.1.2 Test 2: Highlight versus Saturation**

This pilot test will explore a more additive colour process for the design of the visual-narrative in the photorealistic VR environment. Instead of subtracting colour and making it greyscale or sepia, the aim is to enhance the narrative cues and in doing so leave the background untouched. To do this, the author will implement a colour saturation technique similar to that present in Zhang Yimou's film *Hero* (see Chapter 4). The main objective is to allow for a more evenly balanced comparison while at the same time ensuring that the narrative cues in the visual-narrative environment continue to stand out and engage attention.

#### **7.1.2.1 Participants**

The second pilot test was performed on seven people (six female and 1 male) from a mixed academic background.

#### **7.1.2.2 Procedure**

The procedure for this test is identical to Test 1 (see above).

#### **7.1.2.3 Results**

The findings show that this time participants in the visual-narrative environment were more relaxed and comfortable:

- *'its seems quite...sounds quite mad ...but it seems quite friendly and quite comforting'* Participant (1)
- *'I have the feeling that the outside is like am a bright winters day... its cold but not too cold and inside the room is quite warm'* Participant (2)
- *'the second (visual-narrative) felt more vibrant, more real'* Participant (3)
- *'it's a kind a comfortable looking place, relaxed and laid back'* Participant (4)
- *'a bit more exciting not as chilled as before, it gives a bit more life, activity'* Participant(5)
- *'...a relaxed atmosphere'* Participant (7)

This time the majority of the participants found the visual-narrative environment more agreeable. In contrast to the previous pilot test, they felt it was a warm, relaxed, quite friendly, comforting and in many ways a more realistic place. Therefore, it is clear in this test that participants are no longer influenced by the darkness and lonely feelings of the sepia and greyscale backgrounds. They are feeling a lot more relaxed though crucial to the overall study, they have still continued to spot and pick up the relevant cues:

- *'the colours seem to stand out more like blue, red, yellow or green'* Participant (5)
- *'I can see things... brighter... the flowers have an impact on me'* Participant (2)
- *'seems the same room but it seems to be different am some of the colours are much richer, much brighter'* Participant (3)
- *'I think the colours in the first one (visual-narrative) were brighter'* Participant (4)

#### **7.1.2.4 Conclusion**

In conclusion, for the purposes of Study B, it has been decided that an additive colour technique works more effectively than a subtractive. However, during this pilot test 2, another issue arose which again proves to have the potential to bias the results of Study B. This matter emerged from participants who were experiencing a HMD for the first time, their results show that they tended to be more engaged in the very first environment they experienced. Regardless of the content and the experience, they were engaged purely because it was their first time in a photorealistic VR environment:

- *'I think the first one because of the novelty, I found it quite neat and the whole experience I thought was really cool so when I went onto the second one it wasn't as novel'* Participant (1)

- ‘The first one cos it was the first time I had this experience of VR, it was very exciting’ Participant (2)
- ‘the first one again because of the novelty of it all’ Participant (7)

To address this *novelty* issue, it has been decided to add a new dimension to Study B which requires all participants to experience a different and unrelated VR environment before they take part in the actual study. This approach enables participants to gain a familiarity with the VR technology and hence, to complete the study on equal terms.

### 7.1.3 Conclusion

To ensure that the visual-narrative environment and the non visual-narrative environment are on unbiased terms for Study B, it has been decided that an additive colour technique be used to saturate the colours in the visual-narrative environment as opposed to the subtractive technique that was used in the previous Study A: part3. Also it was decided to disregard the golf bag cue and to combat the ‘lack of clarity’ issue by enlarging the text and the pictures so that participants could make out the details. In terms of methodologies, it was decided to formalise the talk aloud method (i.e. add some of the probing questions to the scenario prompt) and use a completely random sample group. To avoid any interference (i.e. familiarity or non familiarity with the technology) it was decided to add a new dimension to Study B which requires all participants to experience an unrelated VR environment before they take part in the study. With these iterations to the design and methodologies, the aim is to use the revised visual-narrative model (see fig. 33) to support the design and creation of a visual-narrative environment which will prove more ‘engaging’ than a non visual-narrative environment.

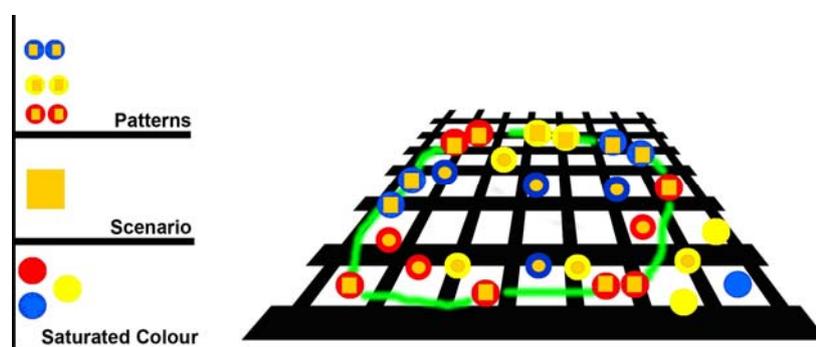


Fig. 35: Saturated Colours – the Revised Visual-narrative Model

## 7.2 Study B – Creating Engaging Photorealistic VR Experiences

The objective of this study is to determine whether or not the revised visual-narrative model has the power to support an aesthetic process of interaction (see Chapter 2) and in turn, the design of an ‘engaging’ photorealistic VR environment. The key goal is to illustrate how the aesthetic objects (i.e. saturated colours) entwined within a scenario are entities within themselves (i.e. existing through the feelings, thoughts, and impressions they make) as well as in how they represent and encourage further meanings, feelings and hence ‘engaging’ photorealistic VR experiences. Similar to the previous Study A: part 3, this study will focus on two versions of the same photorealistic virtual environment: a non visual-narrative environment which consists of a photorealistic representation of the interior of a couple’s old Victorian flat in Edinburgh (see fig. 34) and a visual-narrative environment of the same flat (see fig. 35). However, unlike Study A: part 3, the aim of this study is to probe whether participants felt more ‘engaged’ in the visual-narrative environment (i.e. and in the creation of the visual-narrative) when compared with the non visual-narrative environment. To determine this, Study B aims to use Berleant’s model of *Aesthetic Engagement* (see Chapter 2) as a benchmark when analysing participant’s experiences in both environments as well as a semi-structured interview to determine which environment participants actually found more ‘engaging’.

### 7.2.1 Building the Visual-narrative

As a result of the pilot tests, the greyscale and sepia backgrounds of the previous studies have been abandoned and like the non visual-narrative environment, the visual-narrative environment has retained its natural background colours. The visual-narrative environment is now almost visually identical to the non visual-narrative environment. The only identifiable difference is that the narrative cues in the visual-narrative environment are now saturated to stand out from the coloured background and to highlight the story of the female partner living in the flat (the same story that was described in Chapter 5). The non visual-narrative environment still remains without a planned narrative framework.

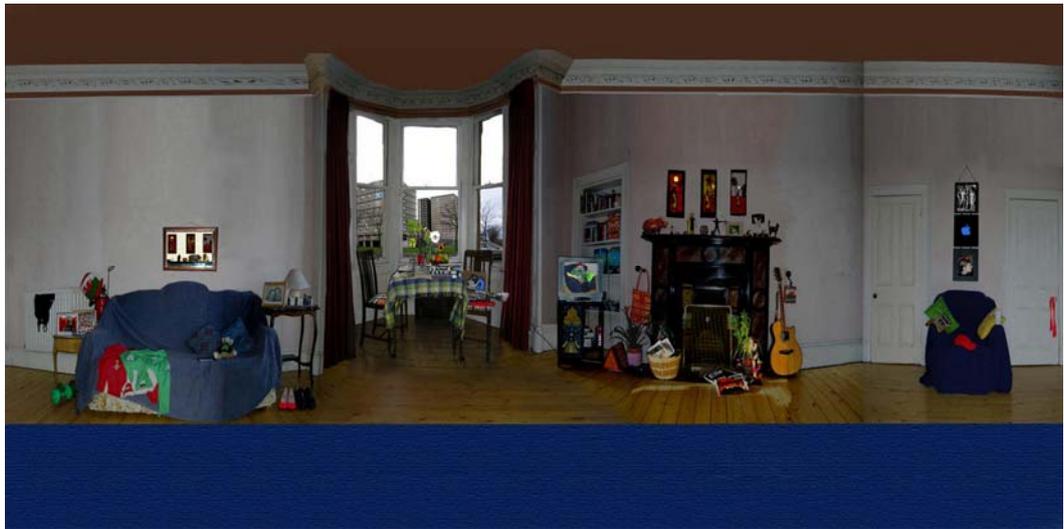


Fig. 36: Study B – The Visual-narrative Environment of Edinburgh Flat

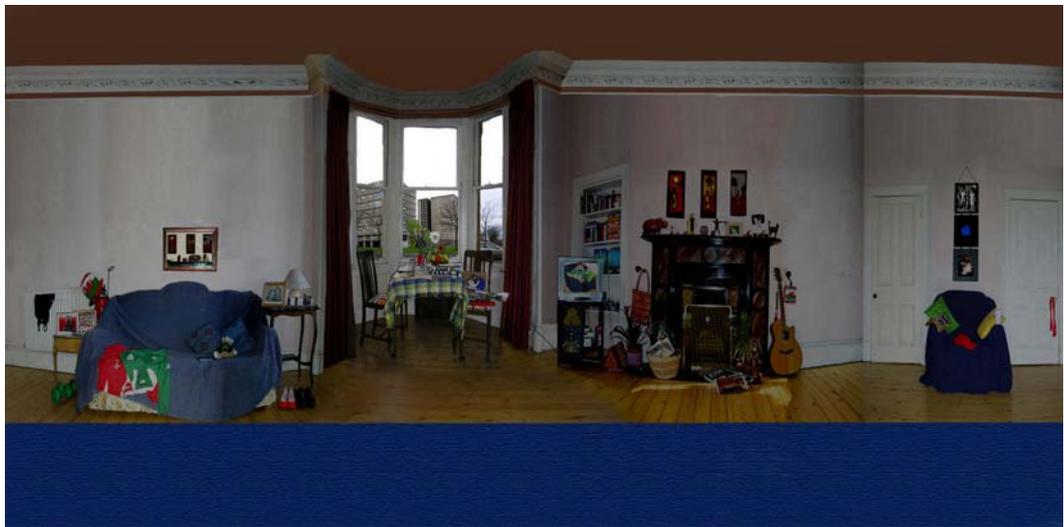


Fig. 37: Study B – The Non Visual-narrative Environment of Edinburgh Flat

The visual-narrative environment has been created using the revised visual-narrative model. As discussed in the previous chapter, the visual-narrative model is a three tier structure which divides the design of the photorealistic VR environment into three stages. The first stage (i.e. the lowest level of the model) involves the visual units and in this case the aesthetic objects (i.e. particularly red, blue, yellow and green saturated colours). As noted, the main purpose of this level is twofold: it firstly aims to use aesthetic qualities to arouse certain thoughts and feelings, to build certain impressions about the environment and its occupants. Secondly, it also focuses on attracting participant's attention to particular objects and areas of the environment and in doing so to get them interested and looking thoroughly around the room. This feeds into level two of the model, which uses a *Through the Keyhole* scenario to frame these impressions as well as to instil further meanings and feelings into the chosen objects and areas of the photorealistic VR environment. This stage

concentrates on engagement; it looks at how a scenario can be implemented to not only nourish existing impressions created by the colours but also to involve participants in further thoughts, feelings and intuitions.

Indeed, the visual-narrative environment is, firstly, about the bright and saturated colours which arouse certain impressions. Secondly, it is about framing these impressions within a scenario. The saturated colours (i.e. the red shoes, the green shamrock on the teddy bear, the red bag, the white and yellow flowers, the red apples, the cat on the blue rug, the magazines on the floor, the red diary, the red ribbon on the door handle and the plants by the fireplace) have a powerful presence on their own (i.e. in terms of the feelings, thoughts and intuitions they create). They also have an important role in how they intertwine with the scenario *Through the Keyhole* (i.e. how the colours – highlighting the physical presence and geographical location of the protagonist – work with the scenario to encourage participant's sense of engagement and movement through the environment).

The last stage (i.e. level three) is where the narration takes place; this is where the saturated colours and scenario are merged together into a narrative pattern to further 'engage' the participant. To achieve this, it is necessary to adopt some of the visual-narrative techniques discussed in chapter three (i.e. particularly Duccio's use of isochromatic patterns and symbolism and Memling's use of artificial colour and spatial narrative). As a result of the pilot tests, it has been decided to discard the greyscale and sepia toned backdrop which was very much inspired by Antonioni's technique of using colour on a greyscale set to correlate with the protagonist's emotions and inner mind. Instead, Study B aims to use a more additive process of colouring (i.e. colour saturation) such as that present in Zhang Yimou's film *Hero*. The underlying aim is to create a photorealistic VR environment which entices participants into *aesthetic-interactions* with the content. The goal is to build an environment that arouses impressions, feelings and thoughts which in turn feed into and incite the creation of a visual-narrative and 'engaging' VR experiences.

Therefore, similar to Study A: part 3, the idea is that the small selection of artificially saturated colours (red, blue, green and yellow) which are spatially arranged around the environment (like Memling's *Passion of Christ*) enables us (the spectator) to build certain impressions. Similar to Duccio's isochromatic patterns, these colours are there to guide the participant through the narrative by allowing them to create more direct links between the objects. As already exemplified, the bright blue of the Scottish flag corresponds with the same blue used on the Apple Mac symbol on the wall opposite and with the cat on the blue rug; there is a direct link between the red shoes, red bag and red ribbon etc (see Chapter 6). As well as using the colours to elicit certain feelings, thoughts and intuitions, similar to Duccio's *Maestà*, the visual-narrative environment also makes use of the colours to draw

out symbolic associations (i.e. the green rugby jersey is associated with being Irish, the red shoes with partying and painting the town red and the white flower with naturalness and perhaps innocence etc). The main drive of Study B is to design a visual-narrative environment that entices participants into *aesthetic-interactions* and hence, into the creation of an ‘engaging’ visual-narrative VR experience.

### 7.2.2 Participants

Twenty students (i.e. thirteen male and seven female students) from a mixed academic background were asked to take part in the study.

### 7.2.3 Procedure

On arriving at the location of the test, all participants were asked to familiarise themselves with the VR experience especially the HMD and the equipment, they were asked to try a sample and unrelated VR environment for a few minutes. They were then told briefly about the nature of the test (i.e. informed that it would last at the most 30 minutes) and were asked to complete a standard Ishihara Test for Colour Blindness.<sup>59</sup>

Again, each participant was given the *Through the Keyhole* scenario, they were asked to enter the room and look around for clues which might help them in identifying the type and character of person that lives there (i.e. what do you know about the person/ people? What is their profession? What are their interests? Where do they live?). In random order, they were then asked to experience for 5 to 10 minutes both the non visual-narrative environment and also the visual-narrative environment of the same flat. During these trials each participant was asked to talk-aloud and describe what type of person lives in the flat. After experiencing each environment, they were asked to answer in writing the following three questions: Did you enjoy the experience? Why? Were you engaged in the environment? Why? (i.e. Did it catch your attention and get you involved in the experience?). They were then shown both environments again briefly and then elaborating on the written questions, they were asked two similar questions which were recorded using the DAT (i.e. which one did you enjoy the most? which environment did you find more engaging?)

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<sup>59</sup> See <http://www.toledo-bend.com/colorblind/Ishihara.html>

## 7.2.4 Results

As discussed at the start of this thesis, *aesthetic-interaction* has been described as an ‘engaged interaction’ between the participant and the design work which has the power to engage and guide both the senses and the thoughts of the participant into the creation of new impressions, thoughts and feelings. Building from this, the author has proposed the visual-narrative model as a way of articulating the outcomes of the *aesthetic-interaction* into the creation of an ‘engaging’ photorealistic VR environment. To measure its success a qualitative method of analysis has been adopted. The analysis aims to probe into each participant’s experience of both the visual-narrative environment and the non visual-narrative environment in order to decipher which environment more successfully endorses an ‘engaging’ experience. The author will use Berleant’s model of *Aesthetic Engagement* (see Chapter 2) as a benchmark for analysing participant’s sense of ‘engagement’ in both environments. It will specifically look at the participant’s continuity, perceptual integration and participation in each environment (i.e. how an aesthetic process of interaction generated through a visual-narrative model can increase ‘engagement’ and also enjoyment in the photorealistic VR environment). For the purposes of this study, a comparative analysis is adopted however a binomial hypotheses test is also performed to test whether the findings are significant or not.

In that light, it can be said that the results of Study B have proved interesting. The majority of participants felt their attention was captured more in the visual-narrative environment than in the non visual-narrative environment. They reported that they were attracted to the saturated colours; they felt that the objects stood out more; they were noticing more things and in that sense, they were involved more in their surroundings (i.e. they were participating):

- *‘The first one (visual-narrative) because I was more curious, some of the colours attract your eyes (i.e. the bag), in the first one I saw it directly and in the second one (non visual-narrative) I had to look for it, it was there but I wouldn’t have seen it like that, I saw it directly, in the first, you can show what you want to show it’s easier, ya I think the first one engaged you more because its much more curious...’* Participant (1)
- *‘The second one (visual-narrative), I could see things more, it was clearer, there was lighter and when I was bending down it was better, seems to be better’* Participant (2)

- *'The colours are a bit brighter I can see a lot more things'* Participant (4) in the visual-narrative environment.
- *'Am the second one (visual narrative) I think because more things were jumping out and standing out more, you could have a better nose.'* Participant (6)
- *'The second one (visual-narrative) because it was clearer and more engaging it made me look for things and more details'* Participant (8)
- *'I think the first one (visual-narrative) because of the colours of the flowers, the screen and perhaps the colours on the pictures and the apple – the blue apple – as well you focus less on hanging on the rail, for example, you see you never focus that much on the bottom so you kind of focus more on the detail...'* Participant (19)

It seems that even though both the visual-narrative environment and the non visual-narrative environment were almost identical, participants were inclined to think that there were fewer objects in the non visual-narrative environment. In fact, the findings show that the saturated colours in the visual-narrative environment have attracted participant's attention to objects that they did not necessarily notice in the non visual-narrative environment. The saturated colours have put an emphasis on certain areas in the room and in doing so, they have subtly persuaded participants to participate, to become involved with each object and then also to look thoroughly at each area around the environment. In addition, the saturated colours have also succeeded in getting participants to feel in certain ways; they are using their senses to create new meanings (i.e. perceptual integration) and to build their own impressions. Through the colours, some of the participants are forming happy, peaceful feelings while others are being more specific when they claim that the colours are giving them more female orientated feelings and impressions.

- *'The first one (visual-narrative) because of the colours, it is much more colourful and I think it gives you as well as the feeling of happiness that you have more colour, more brighter colours, brightness actually thinks it makes you feel much more happy. Much more you know, peaceful feeling, I don't know if that makes sense...a peaceful and colourful environment... if its not colourful you feel much more sad...'* Participant (1)
- *'The feeling of the room gives off a girls feeling...'* Participant (7), visual-narrative
- *'The first thing that occurs to me as I think it's a girl room am I think I can see female clothing lying around but then when I think the colours I immediately felt female.'* Participant (13), visual-narrative

- *'I would say a girl... the colours are shiny colours like what a girl uses'* Participant (14), visual-narrative

The data also shows that the colours are having a positive impact on the participants; their involvement with the colours is feeding into their impressions of the room (i.e. the colours are making them feel more cheered up and happy which in turn are giving them lively and warm impressions of the room).

- *'the feeling from the colours impressed me more'* Participant (20), visual-narrative
- *'it seems a little bit livelier, the room'* Participant (4), visual-narrative
- *'But the first one (non visual-narrative) felt like a dull day so the bright colours would automatically make me feel more cheered up.'* Participant (5), visual-narrative
- *'Like the first one (non visual-narrative) has less contrast the second one (visual-narrative) has more contrast and striking colours I would say the first one is a bit dull and second one is more open to you'* Participant (14)
- *'The first one I think it had more yellow it was more yellow it was brighter it was just more warm ya it looks like less messy more I don't know looks like someone taking care of the colours'* Participant (19)
- *'I think maybe the second one because of the painting with some bright points also even I'm not certain the colours of the walls is a little darker ya but it's a strong difference it can give people feeling clearly clear feelings the first one is just too plain...'* Participant (20)

When one probes closer, it is interesting to see how these feelings strongly differ from those felt in the non visual-narrative environment. The following comparisons show a distinct contrast between how participants felt in each environment:

In the visual-narrative environment, participant 1 felt:

- *'I will say a lively place, there's life here... it's a very relaxed atmosphere, ya its like because it's ordered but not totally ordered it's like everything ... ya it's a nice one'* Participant (1), visual-narrative

While in the non visual-narrative, participant 1 felt:

- *'It's exactly the same but it looks sad... I still feel comfortable but in the other one I would still have a smile on my face while looking at the bed room but in this one I will just look at it I don't know how to express it, it's a global feeling...its much more sad...'* Participant (1), non visual-narrative

In the visual-narrative environment, Participant 11 felt:

- *'I think I feel warm about this room (visual-narrative) ah why...the colours of the room, there are many warm colours in the room...the room is small, not many things in the room and warm in my mind, it feels comfortable maybe there is a beautiful girl'* Participant (11), visual-narrative

In the non visual-narrative, they felt:

- *'It's very similar but I feel some lonely ...am am it's a simple and lonely room'* Participant (11), non visual-narrative

In the visual-narrative, participant 18 felt:

- *'its a lot warmer its seems to have come to life a lot more am... certainly younger ah don't know if I would still go with student am the flat seems warmer I don't know if I would still say that it is rented certainly younger probably 20's am'* Participant (18), visual-narrative

While, in the non visual-narrative, participant 18 felt:

- *'I cant tell but am it strikes me as being slightly cold I think it may be the lack of light elsewhere in the room'* Participant (18), non visual-narrative

In fact, when further investigated, quite a few participants pondered over the contrasting feelings they were receiving from both environments (i.e. why they were feeling these). In many ways Berleant's idea of 'continuity' is beginning to emerge (i.e. 'continuity' between the visual-narrative environment and the user's individual and cultural experiences).

- *'got slightly different feelings. it feels am... the first one (visual-narrative), I keep going back to colours but they were things that stood out first and foremost for me,*

*am they would give me a different impression to the person who lived there, the second one (non visual-narrative) I almost felt the person who lived there was in a, you know, longer relationship, don't really know why, could be to do with things like flamboyance for example the shoes... ya that's it'* Participant (5)

- *'I don't know because I thought story for the first environment... if I think the second one (non visual-narrative) is an old story and sad one in the first (visual-narrative) there is more activity, in the second one I don't know if the place was deserted just a little more deserted not a lot cos there are woman's shoes so in the second one'* Participant (17)
- *'The second one (visual-narrative) it seemed warmer, it seemed more inviting am there was less. I don't know if it was the limitation of the equipment am but details seemed to be clearer. The whole place seemed to be am...almost more living than just a temporary place to stay... the whole sense that I got was there was someone living there'* Participant (18)

In terms of the visual-narrative, it is interesting to see how the feelings, thoughts, and intuitions etc. created by the colours are starting to fuse with the scenario to encourage participants to piece together a story. As Participant (1) demonstrates the saturated colours and the consequent feelings created are being framed within the scenario to feed the narrative (i.e. the happy routine of the person living in the visual-narrative environment versus the more 'mundane' routine of the person living in the non visual-narrative environment.)

- *'The second one (non visual-narrative environment) shows you a kind of routine, the first one shows you a happy routine but a more lively, the second one is much more a routine because the colours are always the same'* Participant(1)

It is true, the visual-narrative environment more so than non visual-narrative environment has promoted the sharing of information between the photorealistic VR environment and the participants. The saturated colours have not only triggered the participant's attention but also they have started to influence their thoughts, feelings and intuitions and hence the narratives that they are creating.

- *'I think the two rooms were two times of the day, the first one maybe noon or afternoon; the second one is more like morning'* Participant (11)

- *'very strange because I feel two atmosphere... think I feel a normal atmosphere ...and the dark atmosphere'* Participant (16)

Indeed, the participants are sensually, intuitively, reminiscently and intellectually interacting with the colours within the room, so much so, the happy, warm female feelings that are emerging are seen to feed directly into the building of a narrative.<sup>60</sup> From the impressions the colours have aroused, the participants have started to tease out a female presence. The colours have influenced the participant's judgement on some of the finer details concerning this female character (i.e. the colours have made participants feel that the character is quite young):

- *'younger people probably 20's to 30's this time ok'* (Participant 4, visual-narrative)
- *'I would say the person is probably mid 20's early 30's'* Participant (5), visual-narrative
- *'certainly younger ah...don't know if I would still say that it is rented certainly younger probably 20's am... ya'* Participant (18)
- *'I would say that she is in her late to mid twenties that am...'* Participant (7)

However, in the non visual-narrative participants are building different impressions, they feel that the character living in the flat is that bit older:

- *'it kind of an old ladies flat... oh no perhaps not middle aged slightly younger, kinda 30's to 40's maybe'* Participant (4), non visual-narrative
- *'I would probably say they were a little bit more reserved... in terms of what they were, maybe reserved is not the right word maybe a little bit ... they are not as flamboyant'* Participant (5), non visual-narrative

In both environments, participants are seen to engage with the content and to create some form of a narrative. Indeed, it is a quite a natural phenomenon for humans to build a narrative of their experiences and surroundings. As Pradl (2000, line 4) says *'without stories our experiences would merely be unevaluated sensations from an undifferentiated stream of*

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<sup>60</sup> The majority of participants who experienced visual-narrative environment tended to engage in and build more female/single orientated impressions (see Appendix D). While the majority in non visual-narrative environment read a more couple/two people narrative (see Appendix E).

*events. Stories are the repository of our collective wisdom about the world of social/cultural behaviour; they are the key mediating structures for our encounters with reality [virtual reality].*' However, what is interesting about this research is the impact of aesthetics on the narratives that are being created, particularly how the use of colour is pulling participants into a specific narrative experience, how it is influencing their impressions of the environment and then the stories they are building. As the findings show, participants are beginning to form female orientated narratives in the visual-narrative environment, they are creating narratives about a young and even 'beautiful' female, a lively person, who is in a happy routine and living in a comfortable, relaxed flat. In the non visual-narrative environment, participants are reading the opposite; they feel it is about an older and less flamboyant couple who are in a long term relationship and in a routine, who perhaps live simple, lonely and sad lives. The use of saturated colour and even lack of saturated colour are having an obvious effective on the narratives being created. What is important for this and future research is developing methods that possess similar amounts of control (and lack of control) over the narratives and experiences created. As Carlson (2002c, line 6) says it's '*this kind of bringing together and balancing of feeling and knowing which is at the heart of any aesthetic experience*' and as the following tests verify, this is quite powerful when it comes to the creation of 'engaging' VR environments.

From Study B, it was established that fifteen out of nineteen participants (one participant was unsure) found the visual-narrative environment more 'engaging' (see Table 5). Reflecting on the above qualitative data, it is feasible to suggest that the aesthetic qualities of the photorealistic VR environments, in conjunction with the scenario and visual-narrative techniques have been successful in getting participants to participate, perceptually integrate and create a 'continuity' (when compared to the non visual-narrative environment). The findings show that the majority of participants found the visual-narrative environment more 'engaging' than the non visual-narrative environment.

TABLE 5: STUDY B – RESULTS FROM THE SEMI-STRUCTURED INTERVIEWS

	Which did you find more 'engaging'?	Which did you enjoy the most?
Participant 1	V-Narr. Environment	V-Narr. Environment
Participant 2	V-Narr. Environment	V-Narr. Environment
Participant 3	V-Narr. Environment	V-Narr. Environment
Participant 4	V-Narr. Environment	V-Narr. Environment
Participant 5	V-Narr. Environment	V-Narr. Environment
Participant 6	V-Narr. Environment	V-Narr. Environment

Participant 7	Non N.Environment	Non N.Environment
Participant 8	V-Narr. Environment	V-Narr. Environment
Participant 9	Non N.Environment	Non N.Environment
Participant 10	Non N.Environment	Non N.Environment
Participant 11	V-Narr. Environment	Non N.Environment
Participant 12	Not Sure	V-Narr. Environment
Participant 13	V-Narr. Environment	Non N.Environment
Participant 14	V-Narr. Environment	Non N.Environment
Participant 15	Non N.Environment	Non N.Environment
Participant 16	V-Narr. Environment	V-Narr. Environment
Participant 17	V-Narr. Environment	V-Narr. Environment
Participant 18	V-Narr. Environment	V-Narr. Environment
Participant 19	V-Narr. Environment	V-Narr. Environment
Participant 20	V-Narr. Environment	V-Narr. Environment

However, to ensure that this finding is statistically significant, a binomial hypothesis test is performed on the data. Such a test is appropriate because (a) each trial has exactly two possible outcomes ('engaging', not 'engaging'), and (b) the trials can be assumed to be independent – that is, a participant's response will not be influenced by any other participant's response.

The test is as follows. Let:

$p$  = the probability of a participant 'engaging' more in the visual-narrative environment

$H_0$ :  $p = 0.5$  (i.e. the null hypothesis is that neither environment is more 'engaging')

$H_1$ :  $p \neq 0.5$  (i.e. the alternative hypothesis is that one environment is more 'engaging' than another)

The test will assume a significance level of  $\alpha = 0.05$ . Also, a two tailed test is applied, because if the alternative hypothesis is true (i.e.  $p \neq 0.5$ ), then there is no reason to immediately assume that ( $p > 0.5$ ) or ( $p < 0.5$ ). Next let:

$X$  = the number of people who prefer environment B

Using the binomial distribution, and assuming  $H_0$  the probability of 15 or more people preferring environment B is:

$$\begin{aligned}
&= P(X = 15) + P(X = 16) + P(X = 17) + P(X = 18) + P(X = 19) \\
&= 0.0074 + 0.002 + 0.0003 + 0.00004 + 0.0000 \\
&= 0.0096
\end{aligned}$$

Because this is a two tailed test, it is necessary to double the value, giving 0.01921. The value 0.01921 is less than our significance level  $\alpha = 0.05$ , thus we can reject the null hypothesis  $H_0$ , and conclude that visual-narrative environment is significantly more ‘engaging’ than the non visual narrative environment.

Study B has also explored levels of enjoyment in both the visual-narrative and non visual-narrative environments. The results show that thirteen out of the twenty people (65%) enjoyed the visual-narrative environment more than the non visual-narrative environment. However, a two tailed binomial hypothesis test performed on these results reveals that, currently, there is insufficient evidence to conclude that one environment is significantly more enjoyable than another. A possible reasoning for this might be the simple fact that some of the participants prefer dark colours and hence even though they found the visual-narrative environment more ‘engaging’, they enjoyed the non visual-narrative and the dark colours more.

In conclusion, it can be said that the *aesthetic-interactions* articulated through the visual-narrative model have successfully generated more ‘engaged interactions’ where specific thoughts, feelings and narratives have emerged. Indeed, as the findings show, it has successfully influenced the participant’s thoughts and feelings within the environment to create new and ‘engaging’ experiences.

### 7.2.5 Discussion

This study has focused on the role of aesthetics (and in particular the *aesthetic-interaction*) in the creation of ‘engaging’ photorealistic VR experiences. From Study A: part 3, the author has determined that aesthetics has the strength to sway the user’s thoughts and feelings into certain narratives in a photorealistic VR environment. Study B takes this further by primarily concentrating on ‘engagement’ and whether the *aesthetic-interaction* process entwined in the visual-narrative model can make photorealistic VR experiences more ‘engaging’. Indeed, this study shows how saturated colours embedded in a scenario and then patterned with visual-narrative techniques have started to prompt participants to participate, perceptually integrate and create a ‘continuity’ within the photorealistic VR environment. In doing so, Study B demonstrates how the visual-narrative model has

successfully enticed participants to start aesthetically interacting with the content in order to ‘engage’ further in the creation of deeper thoughts and narratives. It is this power to ‘engage’ participants that emphasises the importance of the *aesthetic-interaction* process within the visual-narrative and hence within the photorealistic VR environment. In fact, it is this very ‘power’ that exposes the need to rethink the current drive within photorealistic VR development and to start considering how these environments actually make us feel as opposed to solely looking at what they enable us to do. In terms of HCI, this idea of *aesthetic-interaction* takes the general understanding of interaction to a new level, to the ‘engaged interaction’ and the *invisible style* of interaction (Marsh et al, 2001, p.2) that has previously been talked about. It takes interaction beyond usability and more towards the experiential which as seen, introduces many possibilities for new and exciting experiences

### 7.3 Conclusion

The findings reported in this chapter confirm that the aesthetic process of interaction when articulated through the revised visual-narrative model has the power to create ‘engaging’ photorealistic VR environments. Overall, these findings highlight the potential of aesthetics in influencing how participants feel in a photorealistic VR environment and then what type of experiences they might adhere to. In terms of HCI, this allows us to grasp how one might design for certain perceptions, cognition and behaviours amongst users in VR. In terms of narrative, it introduces the idea of aesthetic reading and the visual-narrative, it takes photorealistic VR beyond the cognitive backdrop to which many VR narratives have emerged and instead exposes the VR community to a new way of creating meaningful VR experiences. Finally, in terms of photorealistic VR design, the findings prove that art plays as crucial a role in VR design as science, it shows that aesthetics has as much an input into the design of ‘engaging’ photorealistic VR environments as performance issues or efficiency.

## 8: CONCLUSION

This chapter summarises the work reported in this thesis. It answers the research questions posed in Chapter 1 and reflects on the contributions made throughout the rest of this thesis. The questions of ‘if’ and ‘how’ aesthetics can be used to build ‘engaging’ photorealistic VR environments are addressed. In particular, the importance of the *aesthetic-interaction* to entice ‘engagement’ and then the visual-narrative model to elicit this *aesthetic-interaction* are identified. This thesis outlines the potential of aesthetics in the field of HCI and in doing so, future research directions are also suggested.

### 8.1 Thesis Summary

One of the main thrusts in this thesis has been to show that the strategic patterning of colour in photorealistic VR environments can make for a more ‘engaging’ VR experience. In achieving this, the author has intended not only to highlight the experiential side of VR technology, but also to emphasise the huge potential of the *aesthetic-interaction* to HCI design. As the final study has shown, a photorealistic VR environment designed with the visual-narrative model is significantly more ‘engaging’ than the non visual-narrative environment. In fact, from the comparisons made between the visual-narrative environment and the non visual-narrative environment, it is clear that the visual-narrative model (used in the design of the visual-narrative environment) has instigated certain *aesthetic-interactions* which in turn have fed into different variations of the intended narrative to create a more ‘engaging’ experience.

From these findings, it is therefore reasonable to assert that colour has the potential to be used in various media and technologies to help entice the user into *aesthetic-interactions* which, when articulated through a visual-narrative model, can create ‘engaging’

experiences. In terms of HCI, this not only brings a new type of interaction but also a new dimension to the design of technology. *Aesthetic-interaction* puts an emphasis on aesthetics and the ‘engaged interaction’ to create the desired feelings, thoughts, and impressions that fuel ‘engaging’ experiences. In doing so, it joins forces with other experiential HCI research (i.e. research looking at the interactive experiences created by sound, haptics, gestures and smell etc.) to challenge the traditional cognitivist approach to the design of ‘engaging’ human-computer interactions. Indeed, *Aesthetic-interaction* is seen to feed the generic debate against ‘*form follows function*’ by showing that the aesthetic is a powerful entity within itself and does not necessarily need to be driven by the functionality.<sup>61</sup> In summary, this research has concentrated on ‘engagement’ and the creation of an ‘engaging’ experience. On one level, it has demonstrated that aesthetics can be as equally effective, if not more, as ‘illusion’ and ‘realism’ in the creation of ‘engaging’ photorealistic VR experiences. On another, it has introduced a new perspective for the design of ‘engaging’ Human-Computer Interactions. In the following sections, the author will now reflect in more detail on the strengths and weaknesses of the different components that have made this research possible.

#### ***8.1.1.1 The Empirical Study***

This research has adopted an empirical method of inquiry. The author has implemented an iterative design process where participants’ interactions with existing photorealistic VR environments has been used to inform the design of the visual-narrative model. In turn, this has helped in the creation of an ‘engaging’ photorealistic VR environment. To deliver this as a reliable and valid piece of research, the author has employed a consistent procedure throughout all the studies with methods (i.e. the place probe, the talk aloud and the semi-structured interviews) that have been rigorous and objective in their handling of the data.

Indeed, from the start, the research has proved steadfast in that it has emerged from the author’s own work on the BENOGO project where she noticed firsthand a lack of attention given to the aesthetic content of photorealistic VR environments. To counteract this, the thesis has emerged investigating the potential of the aesthetic in the creation of

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<sup>61</sup> The phrase "form follows function" was coined by the architect Louis Henry Sullivan (1856-1924) and then further developed by the Bauhaus movement (1920s). Its focus was on functionality in that the appearance and form of a design was seen to evolve through the functional aspects of the design. In terms of this research, it is comparable to traditional HCI design where, until recently, the functionality of the design has driven the aesthetics of the design.

‘engaging’ photorealistic VR environments. After some methodical research on aesthetics in the field of HCI and photorealistic VR, a research rationale was materialised to explore the idea of the *aesthetic-interaction* and the visual-narrative model to ‘engage’ people in photorealistic VR. To prove its success two studies (i.e. Study A & Study B) have been performed. Study A consisted of three studies. Study A: part 1 & part 2 were subsidiaries of the BENOGO project and used well established methods for gathering the data from a random sample of participants in the non narrative photorealistic BENOGO environments. Study A: part 3 and Study B were also systematic in their overall approach, however, Study A: part 3 proved slightly more flexible in the choice of its sample group and its application of the talk aloud method to gather data from this group (see Chapter 6). In terms of analysis, the research employed the reliable qualitative approaches that were effectively implemented on the BENOGO project. The early studies adopted an enumerative approach while Study B applied a comparative analysis and a binomial hypotheses test. Overall, through the rigorous investigation of the subject area, the use of non biased sample groups, established methods of data gathering and reliable modes of analysis, the research can successfully confirm that aesthetics plays an important role in the creation of ‘engaging’ virtual environments.

#### **8.1.1.2 *The Visual-narrative Environment***

As seen in Chapter 5, the visual-narrative environment (i.e. the author’s own sitting room environment) evolved from the existing BENOGO environments. In fact, after much exploration with the more outdoor spaces (see Chapter 5), the sitting room environment was chosen as the platform for the visual-narrative. The reasons for choosing this personal space were twofold: firstly, the author realised (i.e. during the experimentation with the outdoor environments) that in order for the visual-narrative to succeed, the environment would need to provide enough substance and ‘meat’ to carry the visual-narrative. At the time of choosing the sitting room environment, the author was quite inspired by the autobiographical works of Tracey Emin and the photo-narratives of Jeff Wall (see Chapter 5). Secondly, on realising the depth of material required to make the visual-narrative work, the author felt it more feasible to explore her own space and in doing so, to avoid any data protection laws and privacy issues that could arise in using other peoples work or in exposing other peoples’ personal lives. In summary, the author decided on the autobiographical route and chose the sitting room environment as the most effective platform to create the appropriate *aesthetic-interactions* to ‘engage’ participants in the recreation of her story.

### **8.1.1.3 *Aesthetic-interaction***

*Aesthetic-interaction* has been described in Chapter 2 as an approach to HCI which focuses on the use of aesthetics in the design of the interface to sensually attract and arouse the user into the sharing of information and hence entice them into ‘engaged interactions’. As mentioned, it is seen to have many crossovers with information visualisation in that it is an interaction in itself, it occurs between the interface (i.e. information) and the user. However, unlike information visualisation, *aesthetic-interaction* also involves the senses and has the power to manipulate the perceptions of the user to create new thoughts and feelings about the interface. Without a doubt, this addition of the ‘senses’ opens many new doors for HCI design. However, the author of this thesis has perhaps been a little ambiguous in that she has discussed this ‘complete’ idea of the *aesthetic-interaction* while in fact, only touching on a fraction of its full potential. *Aesthetic-interaction* has the power to encompass all the senses. Due to time commitment and the sheer expansiveness of the *aesthetic-interaction*, the author has decided to focus solely on the visual aesthetic and the visual-interaction. In that sense, it is important to be aware that although the *aesthetic-interaction* described in this research is ‘independent’ in itself, it is also only part of the whole experience that could be created.

### **8.1.1.4 *The Visual-narrative Model***

The visual-narrative model has been engineered in order to harness the idea of the *aesthetic-interaction* discussed in Chapter 2; it has been devised to give a structure (i.e. strategic pattern) to the *aesthetic-interaction* and the idea of ‘engaged interactions’. As seen, the idea of the visual-narrative model emerged from existing visual-narratives (i.e. from cave paintings to computer games, etc.) which for centuries, have attracted us into the picture, got us aesthetically interacting with the visual elements to then ‘engaging’ us in the creation of stories. To replicate this visual-narrative process, the author has suggested a theoretical visual-narrative structure based on Barthes’ narrative structure, Murray’s grid and some visual-narrative techniques explored in Chapter 4. As witnessed in Study A, this visual-narrative structure has then been customised specifically for photorealistic VR in that it has been applied to existing photorealistic environments as a means of identifying design requirements which can be filtered back into the structure to form the visual-narrative model (specific for photorealistic VR). Despite the fact that an iterative design process has been adopted, very little emphasis has been placed on testing the robustness of the model across other media. In theory, the visual-narrative structure can be applied to a number of different media as a means of probing out specific design requirements for the creation of

their own models. To fully test the robustness of this visual-narrative structure, it would be advantageous to compare the visual-narrative model (designed specifically for photorealistic VR) with that for other media to see how successful it actually is in attracting the user's attention and getting them to aesthetically interact with the content to create 'engaging' experiences.

#### ***8.1.1.5 The Narrative 'flow'***

The visual-narrative model provides the building blocks for the creation of the visual-narrative in the photorealistic VR environment. This visual-narrative has been described as "emergent" in that it emerges and flows as the participant looks around and experiences the environment. As the findings of Study A: part 3 and Study B have shown, the participants are independently picking up various narrative cues and then forming their own interpretations and stories. However, at times, in Study A: part 3 the author has found that the narrative has had to be kick-started in that it has needed to be prompted with a few general questions (i.e. what do you know about the person/people that live here? etc.). In Study B, these questions have been incorporated into the scenario. In terms of 'flow' and the idea of the emergent narrative (see Chapter 3 & 4), the author proposes that more work needs to be done on the visual-narrative model to get the three levels of the model working more in synchronisation with one another. For example, the scenario needs to be strong enough to draw the participants into identifying the narrative cues and then to carry them through to linking them together.

#### ***8.1.1.6 Measuring 'Engagement'***

In this thesis the term 'engagement' has been closely associated with the concept of the 'engaged interaction' (i.e. having a deep involvement and effortless progression in something or some activity which influences ones thoughts, feelings and impressions). To measure this 'engagement' the author has proposed a qualitative approach; she has implemented Berleant's notion of 'aesthetic engagement' (see Chapter 2) as a benchmark when analysing the data received from both environments as well as a semi-structured interview to ask participants which environment they found more 'engaging' and why? For the purposes of this research, Berleant's 'aesthetic engagement' has enabled the author to compare the data from both VR experiences and in conjunction with the semi-structured interview, it has allowed her to tease out which one was more 'engaging' (i.e. the findings show that participants in the visual-narrative environment were more involved in that it enticed them to look for things, they found it more curious and it triggered new thoughts

and feelings). However, for further research or for more detailed studies on ‘engagement’, the author would propose looking more closely into participant’s real time involvement in both the environments (i.e. tracking their eye movements through the environment to identify how long their attention remains on specific areas etc.). Also, the author would suggest exploring in more detail the talk aloud method as a means of measuring the ‘effortless progression’ and ‘transformation’ of the participant in the photorealistic VR environment (i.e. using the participants reading of the environments, particularly the flow of their narratives, as indicators of their effortless progression and transformation).

## 8.2 Thesis Contributions

Whilst the principle objective of this thesis has been to focus on the development of the experiential side of photorealistic VR design, the underlining goal has also been to embrace the broadening scope of HCI design. In doing so, the research contributes to the new design drive of HCI (see Chapter 2) and in particular, the development of a new type of interaction which lends itself to the creation of ‘engaging’ HCI experiences. This new interaction has been called an *aesthetic-interaction* and as has been discussed, it is the strategic patterning of aesthetic elements in an interface or technological device in order to create new thoughts, feelings and impressions. The very fact that this new *aesthetic-interaction* exists independently of the ‘functionality of the system’ opens many new opportunities for HCI. Indeed, for years the emphasis in HCI has been on the cognitive approach (i.e. developing an approach to enhance the functionality of a system and hence the performance and efficiency issues that come along with it). Moving on, this thesis has introduced the *aesthetic-interaction* as new type of interaction that can work in harmony with the ‘functionality’ but also possesses the strength to exist on its own and to create ‘engaging’ experiences. In conjunction with this, the *aesthetic-interaction* offers a fine yet exciting balance between the designer’s control (and lack of control) over the experiences created. This adds a new dimension to HCI in that it gives the user the flexibility and power to create their own experiences. In many ways, the outcomes of the *aesthetic-interaction* are vast in that it has the potential to be orchestrated by HCI designers to initiate many different experiences in many different technologies. In this thesis, the objective has been on the creation of ‘engaging’ photorealistic VR environments and, through the visual-narrative model, an *aesthetic-interaction* has been articulated to ‘engage’ its users in a narrative. Likewise, with other scenarios and other media, a process of

*aesthetic-interaction* can be engineered to achieve specific results and to have specific effects on the technology experienced.

In terms of Virtual Storytelling, it can also be said that this thesis contributes to the new discipline that links the ancient human art of storytelling to the latest VR technologies. It opens a new dimension to storytelling, as the thesis has shown the older semiotic approaches to narrative are not quite enough to satisfy the full narrative potential of VR. As O'Neill (2005, p.42) says '*older semiotic theory, in the most part, is aimed at analysing static texts... a semiotics of new media has to be able to cope with dynamic texts that alter over time as users interact with interfaces and content*'. In answer to this, the author of this thesis has proposed an aesthetic process of interaction that encompasses many different modes of interpretation such as thought, feeling, sensation, intuition, and culture as a means to 'engage' the participant in the VR interface and the telling of a story. This broader dimension to storytelling contributes to the new virtual storytelling discipline in that it opens up further possibilities for the VR narrative. It creates a narrative experience, that emerges, exists and is valued in itself, that is 'engaging' and unique.

Finally, looking at the greater picture, the work presented in this thesis can also be seen as playing a role in the lessening of the divide between art and science in photorealistic VR development (i.e. the photorealistic VR content versus its technical capabilities). As discussed earlier, the technical possibilities (i.e. what is known here as the science) have, in the past, tended to take precedence over the VR content (i.e. what is known here as the art) in that more time and energy has been spent in trying to improve the technical capability of photorealistic VR than has been spent on developing its content. To counteract this, the author of this thesis has put an emphasis on the development of photorealistic VR content, and in doing so, has shown that it has the potential to create 'engaging' experiences. As Mitchell et al. (2003, line 191) point out '*the arts and design worlds opens the possibility of discovering new methodologies for and solutions to problems that, until now, have been beyond the reach of the computer science field to solve or perhaps even articulate*'. By revealing the potential of the 'aesthetic' in photorealistic VR, the author of this thesis has indirectly contributed to the narrowing of this 'art and science' divide and in doing so, the design of more complete and convincing experiences.

### **8.3 Further Investigation**

As mentioned, this thesis emerged from the BENOGO project (2003-2005) however, despite sharing a similar goal (i.e. the desire to create 'engaging' environments),

the ideologies leading to this present work have been quite different to those of the main BENOGO objective. This work has been interested in opening up the experiential side of photorealistic VR design, and focusing on photorealistic VR content as opposed to the VR technology in order to demonstrate how important the aesthetic is in the design of an ‘engaging’ VR experience. However, it goes without saying that in order to be able to perform these aesthetic studies, a certain amount of technology has been required. In fact, the existing BENOGO environments (and IBR technologies) were used to complete some of the early studies (i.e. Study A mainly availed of the IBR environments whilst Study B utilised the most basic static mosaic environment). For further research, it would be valuable to investigate how future developments in the IBR or similar technologies might lend themselves to the aesthetic process of interaction (i.e. how the visual-narrative model might inform the development of the IBR technology to create ‘engaging’ as well as immersive experiences). As already mentioned the prospect of both the science and the art of photorealistic VR design working together seems to be quite worthwhile – indeed, as Fencott (1999b, p.1) once mentioned, both are necessary in the process of designing effective virtual environments.

In terms of the experiential side of VR design, this research has looked at how a good understanding of the aesthetic experience can inform us as to how we might be encouraged to ‘engage’ in our virtual surroundings. However, in terms of the full aesthetic potential of photorealistic VR, it could be argued that this research has been a little ambiguous in that it has looked solely at the visual. Virtual reality described earlier as predominantly an image environment (Lister et al, 2003, p.35), is in fact a multi modal medium (see Chapter 3). To measure the full impact of the aesthetic of the photorealistic VR medium, it would therefore be necessary to consider the broader aesthetic spectrum. This could be done by looking at other visual elements such as size, scale, tone, line etc. as well as other senses such as sound, odour and taste. As mentioned earlier, an *aesthetic-interaction* is not necessarily tied to the visual – in fact anything that attracts the participants’ attention, gets them interacting and ‘engaging’ sensuously, intellectually, reminiscently and culturally with the VR interface could be categorised as an aesthetic element. This thesis has concentrated mainly on the aesthetic element of colour within the photorealistic VR interface, and in terms of ‘engagement’ it has successfully demonstrated its potential to ‘engage’ users in their photorealistic VR surroundings. However, in terms of enjoyment, the findings have demonstrated that some of the participants preferred the dark colours of the non visual-narrative environment, and hence their decision of what environment was more enjoyable depended solely on their preference of colour. By choosing to work solely with colour as opposed to the full aesthetic spectrum available to photorealistic VR, the author of this

thesis has perhaps, therefore, limited the scope and persuasiveness of what could have been achieved. This is an area that deserves further investigation in that not only does exploring the broader aesthetic spectrum fit more naturally with one's experience of the photorealistic VR medium but also, it holds much potential for new types of interactions which, in turn, can further broaden the scope of HCI design.

In accordance with this, it would also be interesting to explore some alternative approaches of analysis. Similar to what Lessiter et al. (2001) believe, it would be worthwhile to consider the issues of individual differences, such as personality, gender and culture, on people's experiences of new media (i.e. photorealistic VR environments). In the research presented here (particularly Study A: part3 and Study B), each participant was required to document their gender, age and background (i.e. area of study, occupation etc.). The data that was recorded shows a random sample of participants consisting of almost equal numbers of males and females, and a group mostly within an age bracket of twenty to fifty years of age. Although it was never the intention to look at such matters in these studies, it is possible that these issues may influence the level of the *aesthetic-interaction* that occurs. Indeed, there is quite a lot of current work that specifically looks at the powerful impact of culture (Khaled et. al., 2006), (Ford & Gelderblom, 2003); gender (Burnett et al., 2008), (Simon, 2000), (Adam, 2000); emotional and personality preferences (Bosser et al., 2007), (Da Cunha & Greathead, 2007), (Alcaizi et. al, 2003), (Karsvall, 2002) on the design and experience of new technologies. In the future it would be interesting to probe the individual differences of each sample group and to investigate the impact that gender, culture, age, emotions, personality and background has on the *aesthetic-interaction* and the choosing of the more 'engaging' photorealistic VR environment.<sup>62</sup>

Finally, emerging from this thesis are also the thoughts on the future of HCI and where the *aesthetic-interaction* fits in. Is it moving towards a new unified theory of interaction or is it a complementary paradigm to HCI? The author of this thesis has described the *aesthetic-interaction* as new type of interaction which has the strength to exist on its own but also the capacity to work with the physical interaction (i.e. functionality). In that way, it can help to contribute to a more complete and unified theory of interaction. Arising from this, then, are other more specific questions: How does this fit in with the other research being done on aesthetics in HCI? How do the *aesthetic-interaction* and the visual-narrative model translate to other media? How will they be measured and evaluated? In terms of further investigation, it would be beneficial to investigate how this *aesthetic-*

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<sup>62</sup> To explore these individual differences, further research could possibly investigate the use of questionnaires, interviews, physiological measures, personality tests, and cultural probes etc.

*interaction* fits in with other current research on the aesthetic in HCI and also how it might work together towards firmly establishing the role of aesthetics within the field. In light of this thesis, it would also be interesting to explore how the *aesthetic-interaction* and the visual-narrative model translate to other media and then to tease out the more effective and efficient ways of measuring and evaluating the different outcomes. Overall, the future of this research lies not only in establishing the importance of the aesthetic and the ‘engaged interaction’ in HCI design, but also in devising effective and efficient ways of articulating, measuring and evaluating these processes across the whole HCI platform.

## 8.4 Conclusion

As more and more new technologies are appearing in everyday life, they are not only influencing us in what they can do for us (or even what they can enable us to do), they are also affecting us in the way that they fit into our lives and make us feel. In fact, our interaction with these technologies is moving further and further beyond the performance and functionality concerns of traditional HCI and more towards an interaction with the content, makeup and design of the technology and the experiences that these create. Indeed, in order to fully understand human-computer interactions, one needs to step up from the operational level and to clearly consider the experiences that can be created.

At the start of this thesis, photorealistic VR was discussed as a medium which was still very much dominated by the development of new visualisation technologies to create that ‘much sought after’ sense of realism, engagement and ‘presence’. Prompted by this, the author of this thesis has set out to explore other aspects of photorealistic VR, particularly the aesthetic potential for the development of ‘engaging’ VR experiences. As seen, the author has performed a number of studies investigating both the role and application of aesthetics in existing photorealistic VR environments. In the vein of these studies, the real success has been achieved through the notion of *aesthetic-interaction*; not only how it has introduced a new dimension to HCI design, but also how it has presented, through the visual-narrative model, an approach for the creation of ‘engaging’ photorealistic environments. By pursuing the ‘engaged interaction’ instead of the physical interaction, the thesis has successfully shown the power of the aesthetic in HCI to trigger emotions, associations and intuitions as a means to fuelling the creation of ‘engaging’ experiences.

## Bibliography

- ADAM, A. (2000). Gender and computer ethics. *SIGCAS Computer Society* 30 (4). Pp. 17-24. (Online) Available from: <http://doi.acm.org/10.1145/572260.572265> (31/05/2008).
- AKBAR, A. (2006). Tracey Emin to represent Britain at Venice Biennale. (Online) Available from: [http://news.independent.co.uk/uk/this\\_britain/article1221928.ece](http://news.independent.co.uk/uk/this_britain/article1221928.ece). (15/09/2007).
- AIGA. (2006). What is Experience Design? (Online). Available from: [http://www.aiga.org/content.cfm?contentalias=what\\_is\\_ed](http://www.aiga.org/content.cfm?contentalias=what_is_ed) (30/10/2006).
- ALCAIZI, M. & BANOS, R. & BOTELLA, C. & REY, B. (2003): The EMMA Project: Emotions as a Determinant of Presence. *Psychnology*, 1 (2). Pp. 141-150. (Online). Available from: [http://www.psychnology.org/File/PSYCHNOLOGY\\_JOURNAL\\_1\\_2\\_ALCANIZ.pdf](http://www.psychnology.org/File/PSYCHNOLOGY_JOURNAL_1_2_ALCANIZ.pdf) (31/05/2008)
- ALTENGARTEN, J. (2002). Creativity and the rule of thirds. *Apogee Photo Magazine* (Online). Available from: <http://www.apogeephoto.com/jan2002/altengarten.shtml> (20/06/2007).
- ANDERSON FEISNER, E. (2000). *Colour*. London: Laurence King Publishing Ltd.
- ANDREWS, L. (1995). *Story and Space in Renaissance Art: the Rebirth of Continuous Narrative*. USA: Press Syndicate of the University of Cambridge.
- ANSTEY, J. & PAPE, D. & SANDIN, D. (2000). Building a VR Narrative. In: *Proceedings of SPIE – Stereoscopic Displays and Virtual Reality Systems VII (The Engineering Reality of Virtual Reality 2000), 28th January, San Jose, CA*. Washington: SPIE Publishers. (Online). Available from: <http://216.239.59.104/search?q=cache:04aUH7TZD5EJ:www.evl.uic.edu/pape/papers/narrative.spie00/spie00.pdf+Building+a+VR+Narrative.&hl=en&gl=uk&ct=clnk&cd=1> (08/01/2007).
- ANTIQUES DIGEST. (No date given). Velasquez – His Colour. (Online). Available from: <http://www.oldandsold.com/articles28/velasquez-7.shtml> (16/04/2007).
- ARNHEIM, R. (1969). *Visual Thinking*. California: University of California Press.
- ARTMUSEUM-NET. (2000). Through the Looking Glass. (Online). Available from: <http://www.artmuseum.net/w2vr/overture/looking.html>. (12/07/2007).
- AYLETT, R. (1999). Narrative in Virtual Environments – towards Emergent Narrative. In: *AAAI Fall Symposium (Technical Report FS-99-01), 7<sup>th</sup> October, Menlo Park, CA*. Menlo Park: AAAI Press. Pp. 83-86. (Online). Available from: <http://www-2.cs.cmu.edu/afs/cs/user/michaelm/www/nidocs/Aylett.html>. (25/06/2007)
- AYLOR, B. (2002). Descending into hidden worlds – Aesthetic experience and the art of seeing. (Online). Available from: [http://gseweb.harvard.edu/~t656\\_web/Spring\\_2002\\_students/aylor\\_britt\\_aesthetic\\_experience\\_seeing.htm](http://gseweb.harvard.edu/~t656_web/Spring_2002_students/aylor_britt_aesthetic_experience_seeing.htm) (18/09/2006).
- AVGERINIYOU, M. (1997). What is Visual Literacy? *IVLA*. (Online). Available from: [http://www.ivla.org/org\\_what\\_vis\\_lit.htm](http://www.ivla.org/org_what_vis_lit.htm) (21/06/2007).
- BAKSTEIN, H. & PAJDLA, T. (2004). Visual Fidelity of Image Based Rendering. In: *Proceedings of the Computer Vision Winter Workshop, February 2004, Ljubljana*. Slovenia: Slovenian Pattern Recognition Society. Pp. 139-148. (Online). Available

from:<http://www.BENOGO.dk/publications/Bakstein-Pajdla-CVWW04.pdf>  
(14/05/2007).

- BALET, O. & SUBSOL, G. & TORGUET, P. (Eds.) (2003). *Virtual Storytelling – Using Virtual Reality Technologies for Storytelling*. Berlin: Springer.
- BARRY, B. (2000). Story Beads: a Wearable for Distributed and Mobile Storytelling. [Online]. Msc Thesis. Available from: <http://ic.media.mit.edu/icSite/icpublications/Thesis/barbaraMS.html> (30/04/2004).
- BARTHES, R. (1977). *Image, Music, Text*. London: Fontana Paperbacks.
- BARTHES, R. (1974). *S/Z*. Toronto, Canada: Collins Publishers.
- BATAILLE, G. (1980). *Prehistoric Painting, Lascaux or the Birth of Art*. Great Britain: Macmillan London Ltd.
- BATES, J. (1991). Virtual Reality, Art and Entertainment. [Online]. Available: <http://www.hci.iastate.edu/~nelsonkj/documents/vrae.pdf> [Accessed 10/03/2004].
- BENYON, D. & O'NEIL, S. & MCCALL, R. & CARROLL, F. (2006). The Place Probe. *Presence*. 15. (6) pp.668-687. (Online). Available from: <http://www.mitpressjournals.org/doi/abs/10.1162/pres.15.6.668?journalCode=pres> (21/06/2007).
- BERGER, J. (1977). *Ways of Seeing*. London: British Broadcasting Corporation.
- BERLEANT, A. (1992). *The Aesthetics of Environment*. Philadelphia: Temple University Press.
- BERLEANT, A. (2004). Beauty and the way of modern life. (Online). Available from: <http://www.autograff.com/berleant/pages/recentart3.html> (02/09/2005).
- BERLEANT, A. (1991). *Art and Engagement*. Philadelphia: Temple University Press.
- BLYTHE, M & WRIGHT, P. & MCCARTHY, J. (2006). Theory and Method for Experience Centred Design. In: *CHI 2006 – Conference on Human Factors in Computing Systems, 22-27<sup>th</sup> April, Montréal, Québec, Canada*. New York: ACM Press. Pp.1691 - 1694. (Online). Available from: [portal.acm.org/ft\\_gateway.cfm?id=1125764&type=pdf](http://portal.acm.org/ft_gateway.cfm?id=1125764&type=pdf) (30/10/2006).
- BOLTER, JD. & GRUSHIN, R. (2000). *Remediation – Understanding New Media*. USA: MIT Press Paperback.
- BORDWELL, D. & KRISTEN, T. (1990). *Film Art: an Introduction*. New York: McGraw- Hill Publishing Company.
- BOSSER, A., LEVIEUX, G., SEHABA, K., BUENDIA, A., CORRUBLE, V., & DE FONDAUMIÈRE, G. (2007). Dialogs taking into account experience, emotions and personality. In: *Proceedings of the 2nd international Conference on Digital interactive Media in Entertainment and Arts, Perth, Australia, 19<sup>th</sup> - 21<sup>st</sup> September 2007*. DIMEA '07, vol. 274. New York: ACM Press. Pp. 9-12. (Online). Available from: <http://doi.acm.org/10.1145/1306813.1306823> (31/05/2008).
- BOYD-DAVIS, S. (1998). The design of virtual environments with particular references to VRML (SIMA: Support Initiative for Multimedia Applications). (Online). Available from: <http://lansdown.mdx.ac.uk/lceaSite/about/staff/StephenBoydDavis/pdf/VRMLDES.pdf> (12/03/2007).
- BOYD DAVIS, S. (2004). Representing Space: the Pictorial Imperative. In: TURNER, P. & TURNER, S. & DAVENPORT, E. (Eds.), *Space, Spatiality & Technology Workshop Proceedings, 12th - 14<sup>th</sup> December, Edinburgh*. Edinburgh: Napier University. Pp.65 -69.
- BRANIGAN, E. (1992). *Narrative Comprehension and Film*. London: Routledge.
- BRASS, M. (1999). *The Antiquity of Man: Artifactual, Fossil and Gene Records Explored*. (Online). Available from: [http://www.antiquityofman.com/Trance\\_Lewis-Williams.html](http://www.antiquityofman.com/Trance_Lewis-Williams.html) (26/06/2007).

- BRAUN, N. (2003). Storytelling collaborative augmented reality environment. *In: Proceedings of Computer Graphics, Visualization and Computer Vision, 3-7<sup>th</sup> February, Plzen - Bory, Czech Republic*. West Bohemia: WSCG. (Online). Available from: [http://wscg.zcu.cz/wscg2003/Papers\\_2003/G03.pdf](http://wscg.zcu.cz/wscg2003/Papers_2003/G03.pdf) (04/04/2007).
- BROWN, J. (2002). Michelangelo Antonioni. *Senses of Cinema*. (Online). Available from: <http://www.sensesofcinema.com/contents/directors/02/antonioni.html> (16/12/2005).
- BROWN, S. & LADEIRA, I. & WINTERBOTTOM, C. & BLAKE, E. (2002). An investigation on the effects of mediation in a storytelling virtual environment (Technical Report CS02-08-00). (Online). Available from: <http://216.239.59.104/search?q=cache:IpewbqHPTYEJ:pubs.cs.uct.ac.za/archive/00000145/01/techrep.pdf+An+investigation+on+the+effects+of+mediation+in+a+storytelling+virtual+environment.%5B&hl=en&gl=uk&ct=clnk&cd=3>. (08/01/2007).
- BRUCE, V. & GREEN, P.R. & GEORGESON, M. (1996). *Visual Perception: Physiology, Psychology and Ecology*. Hove, East Sussex: Psychology Press.
- BULUT, T. & YURDAISIK, A. (2005). Visual Semiotics and Interpretation in the Television Commercial. *Applied Semiotics: A Learned Journal of Literary Research on the World Wide Web*. 6. (16) pp.46-53. (Online). Available from: <http://www.chass.utoronto.ca/french/as-sa/ASSA-No16/Article3en.html> (06/05/2007).
- BUNT, B. (2006). Oblique reflections: software art & the 3D games engine *In: ACM Proceedings of the 2006 international conference on Game research and development, 4-6th December, Australia*. Pp.242 - 248. Perth: Murdoch University. (Online). Available from: [http://delivery.acm.org/10.1145/1240000/1234380/p242\\_bunt.pdf?key1=1234380&key2=1347540811&coll=ACM&dl=ACM&CFID=12434038&CFTOKEN=73705961](http://delivery.acm.org/10.1145/1240000/1234380/p242_bunt.pdf?key1=1234380&key2=1347540811&coll=ACM&dl=ACM&CFID=12434038&CFTOKEN=73705961) (26/06/2007)
- BURNETT, M., WIEDENBECK, S., GRIGOREANU, V., SUBRAHMANIYAN, N., BECKWITH, L., & KISSINGER, C. (2008). Gender in end-user software engineering. *In: Proceedings of the 4th international Workshop on End-User Software Engineering, Leipzig, Germany, 12th May. WEUSE '08*. New York: ACM Press. Pp. 21-24. (Online) Available from: <http://doi.acm.org/10.1145/1370847.1370852> (31/05/2008)
- BÜSCHER, M. & KOMPAST, M. & LAINER, R. & WAGNER, I. (1999). The Architect's Wunderkammer: Aesthetic Pleasure & Engagement in Electronic Spaces. *Digital Creativity* 10. (1). pp. 1-17. (Online) Available from: <http://as15.iguw.tuwien.ac.at/desarte/TheArchitectsWunderkammer.pdf> (14/11/07)
- BUUR, J. & STIENSTRA, M. (2007). Towards Generic Interaction Styles for Product Design. *In: Human-Computer Interaction (Interaction design and usability), 22nd -27th July, Beijing, China*. pp. 30-39. Heidelberg: Springer.
- CALTER, P. (1998). *Squaring the Circle: Geometry in Art & Architecture*. (Online). Available from: <http://www.dartmouth.edu/~matc/math5.geometry/unit12/unit12.html> (26/06/2007).
- CANDY, L. & EDMONDS, E. (2002). Interaction in Art and Technology. *Crossings: eJournal of Art and technology*. 2. (1). (Online) Available from: <http://crossings.tcd.ie/issues/2.1/Candy/> (14/07/2007).
- CARD, S. & MACKINLAY, J.D. & SHNEIDERMAN (Eds.) (1999). *Readings in Information Visualisation using Vision to Think*. USA: Morgan Kauffmann Publishers.
- CARD, S. & MORAN, T.P. & NEWELL, A. (1983). *The Psychology of Human-Computer Interaction*. New Jersey: Lawrence Erlbaum Associates.
- CARLSON, A. (2000). *Aesthetics and the Environment – the Appreciation of Nature, Art and Architecture*. London: Routledge.

- CARLSON, A. (2002a). What is environmental aesthetics? *Environmental Aesthetics*. In: CRAIG, E. (Ed.), *Routledge Encyclopaedia of Philosophy*. London: Routledge. (Online). Available from: <http://www.rep.routledge.com/article/M047SECT1> (14/07/2005)
- CARLSON, A. (2002b). The central philosophical issue of environmental aesthetics: *Environmental Aesthetics*. In: CRAIG, E. (Ed.), *Routledge Encyclopaedia of Philosophy*. London: Routledge. (Online). Available from: <http://www.rep.routledge.com/article/M047SECT4> (14/07/2005)
- CARLSON, A. (2002c). The central philosophical issue of environmental aesthetics: *Environmental Aesthetics*. In: CRAIG, E. (Ed.), *Routledge Encyclopaedia of Philosophy*. London: Routledge. (Online). Available from: <http://www.rep.routledge.com/article/M047SECT7> (14/07/2005)
- CARROLL, J.M. (2001). *Human Computer Interaction in the Millennium*. New York: ACM Press, Addison-Wesley.
- CARROLL, N. (1999). *The Philosophy of Art, a Contemporary Introduction*. London: Routledge.
- CARSON, D. (2000). Environmental Storytelling Part II: Bringing Theme Park Environmental Design Techniques to the Virtual World. (Online). Available from: [http://www.gamasutra.com/features/20000405/carson\\_pfv.htm](http://www.gamasutra.com/features/20000405/carson_pfv.htm) (26/03/2003).
- CAVAZZA, M. & CHARLES, F. & MEAD, S. J. (2002). Interacting with Virtual Characters in Interactive Storytelling. In: *Proceedings of the First International Joint Conference on Autonomous Agents and Multi Agent Systems: Part 1, 15–19<sup>th</sup> July, Bologna, Italy*. New York: ACM Press. Pp.318 - 325. (Online). Available from: <http://www-scm.tees.ac.uk/users/f.charles/publications/conferences/2002/aamas2002.pdf> (25/06/2007)
- CHANDLER, D. (2002). *Semiotics: the Basics*. London: Routledge.
- CHANDLER, D. *Semiotics: the Basics*. (2006). (Online). Available from: <http://www.aber.ac.uk/media/Documents/S4B/sem04.html> (14/03/2007).
- CHANG, PAI-LING (2005). Investigating Interactivity: Exploring the Role of User Power through Visual Interpretation. In: *The European Academy of Design (6th Conference), 29-31st March, Bremen, Germany*. Bremen: EAD Publishers. (Online). Available from: [http://ead.verhaag.net/fullpapers/ead06\\_id136\\_2.pdf](http://ead.verhaag.net/fullpapers/ead06_id136_2.pdf) (26/06/2007).
- CHEN, C. & CARR, L. (1999). A Semantic-Centric Approach to Information Visualisation. In: *IEEE International Conference on Information Visualization, 14-16<sup>th</sup> July, London*. Washington: IEEE Computer Society. Pp.18-23. (Online). Available from: <http://ieeexplore.ieee.org/iel5/6353/16965/00781529.pdf> (21/05/2007).
- COLLINSON, D. (1992) Aesthetic Experience. In: HANFLING, O. (Ed.) *Philosophical Aesthetics, an Introduction*. Oxford: Blackwell Publishers and the Open University.
- CORLISS, R. (2002). In the Mood for Swordplay. *Time Magazine*. (Online). Available from: <http://www.time.com/time/magazine/article/0,9171,501021223-400044,00.html> (15/06/2007).
- COULTER-SMITH, G. (2000). *The Visual-Narrative Matrix*. Southampton: Southampton Institute.
- CSIKSZENTMIHALYI, M. (1990b). *Flow – The Psychology of Optimal Experience*. New York: Harper and Row Publishers.
- CSIKSZENTMIHALYI, M. & ROBINSON, R E. (1990a). *The Art of Seeing – an Interpretation of the Aesthetic Encounter*. New York: J Paul Getty museum.

- DA CUNHA, A. D. & GREATHEAD, D. (2007). Does personality matter? An analysis of code-review ability. *Commun. ACM* 50 (5). Pp. 109-112. (Online). Available from: <http://doi.acm.org/10.1145/1230819.1241672> (31/05/2008).
- DAVENPORT, G. (1996a). Smarter Tools for Storytelling: Are They Just Around the Corner? *IEEE Multimedia*. 3. (1) pp.10-14. (Online). Available from: <http://66.102.11.104/search?q=cache:365RLtVRqrgJ:ic.media.mit.edu/Publications/Journals/vvSmarterTools/PDF/SmarterTools.pdf+smarter+tools+for+storytelling&hl=en> (04/05/2004).
- DAVENPORT, G. (1996b). 1001 Electronic Story Nights: Interactivity and the Language of Storytelling. In: *Australian Film Commission's Language of Interactivity Conference, summer 1996, Sydney, Australia*. (Online). Available from: <http://ic.media.mit.edu/Publications/Conferences/StoryNights/HTML/gidAus1.html> (12/07/2007).
- DAVENPORT, G. (2000). Your own Virtual Story world. *Scientific American*. 283. (5) Pp.79-82. (Online). Available from: <http://66.102.9.104/search?q=cache:UP8uj0uUL8gJ:ic.media.mit.edu/Publications/Journals/VirtualStoryworld/PDF/VirtualStoryworld.pdf+Your+own+Virtual+storyworld&hl=en> (05/05/2004).
- DAVIES, C. (2002). Osmose: Notes on Being in Immersive Virtual Space. In: BEARDON, C. & MALMBORG, L. (Eds.). *Digital Creativity: A Reader*. Lisse, The Netherlands: Swets & Zeitlinger Publishers. Pp. 101-110. (Online). Available from: <http://www.immersence.com/> (28/09/07)
- DAVIES, C. (2004). Virtual Space. In: PENZ, F. & RADICK, G & HOWELL, R. (Eds.). *Space: In Science, Art and Society*. Cambridge, England: Cambridge University Press (2004). Pp. 69-104. (Online). Available from: <http://www.immersence.com/> (28/09/07)
- DE VOS, D. (1994). *Hans Memling*. Belgium: Groeninge Museum.
- DEVEREAUX, M. (2004). Moral Judgements and Works of Art: the case of narrative literature. *Journal of Aesthetics and Art Criticism*. 1. (62) pp.3-11.
- DEWEY, J. (1934). *Art as Experience*. London: The Berkley Publishing Group.
- DIETRICH, F. (1985). Five Aspects of a Theory of Computer Art. In *panel notes on Aesthetics of Computer graphics, 22<sup>nd</sup> -26<sup>th</sup> July, San Francisco*. New York: ACM Siggraph Press. (Online). Available from: <http://portal.acm.org/citation.cfm?doid=325334.325257> (25/07/2007)
- DJAJADININGRAT, J.P. & GAVER, W.W. & FRENS, W.J. (2000). Interaction relabelling and extreme characters: methods for exploring aesthetic interactions. In: *Proceedings of the Conference on Designing Interactive Systems: processes, practices, methods, and techniques, 17-19<sup>th</sup> August, New York City, United States*. New York: ACM Press. Pp.66 - 71. (Online). Available from: <http://studiolab.io.tudelft.nl/static/gems/publications/00DjajDISInte.pdf> (26/06/2007).
- DOURISH, P. (2004). *Where the Action is – the Foundations of Embodied Interaction*. Massachusetts: MIT Press.
- ECO, U. (1976). *A Theory of Semiotics*. USA: Indiana University Press.
- ELSAESSER, T. (1990). *Early Cinema, Space Frame and Narrative*. London: British Film Institute.
- ESAAK, S. (2007). Artist Profile: Duccio (di Buoninsegna). (Online). Available from: <http://arthistory.about.com/cs/namesdd/p/duccio.htm> (16/04/2007).
- FAIRCHILD, A. W. (1991). Describing Aesthetic experience: creating a model. (Online). Available from: [www.csse.ca/CJE/Articles/FullText/CJE16-3/CJE16-3-03Wzeltl-Fairchild.pdf](http://www.csse.ca/CJE/Articles/FullText/CJE16-3/CJE16-3-03Wzeltl-Fairchild.pdf) (21/09/2006).
- FALK, J. (2003). Interfacing the Narrative experience. In: BLYTHE, M. (Ed.) *Funology: From Usability to Enjoyment*. Netherlands: Kluwer Academic Publishers.

(Online). Available from: <http://mf.media.mit.edu/pubs/other/InterfacingNar.pdf> (25/06/2007)

- FENCOTT, C. (1999a). Content and Creativity in Virtual Environment Design. *In: Virtual Systems and Multimedia, 1-3<sup>rd</sup> September, Dundee*. Scotland: University of Abertay Dundee Publishers (Online). Available from: <http://www-scm.tees.ac.uk/users/p.c.fencott/vs99/welcome.html> (01/03/2004)
- FENCOTT, C. (1999b). Towards a Design Methodology for Virtual Environments. *In: King's Manor Workshop: User Centered Design and Implementation of Virtual Environments, 30th September, York*. (Online). Available from: [http://www.cs.york.ac.uk/hci/kings\\_manor\\_workshops/UCDIVE/fencott.pdf](http://www.cs.york.ac.uk/hci/kings_manor_workshops/UCDIVE/fencott.pdf). (01/03/2004)
- FENCOTT, C. & ISDALE, J. (2001). Design Issues for Virtual Environments. *In: Web3D 2001 Conference, 19th February, Paderborn, Germany*. (Online). Available from: [http://jerry.c-lab.de/web3d/VE-Workshop/Clive\\_Fencott.pdf](http://jerry.c-lab.de/web3d/VE-Workshop/Clive_Fencott.pdf) (29/ 01/2007)
- FERGUSON, D. (2004). That Zhang you do. *The Manitoban*. 92. (16). (Online). Available from: <http://www.themanitoban.com/2004-2005/1208/article.php?section=arts&article=02> (15/06/2007).
- FIELD, R. (2006). John Dewey. *The Internet Encyclopaedia of Philosophy*. (Online). Available from: <http://www.iep.utm.edu/d/dewey.htm#H5> (10/10/2006).
- FISHER, S. (1990). Virtual Interfaces Environments. *In: Laurel, B. (Eds). The Art of Human Computer Interface Design*. USA: Addison-Wesley Publishing Company, INC.
- FISHWICK, P. (Ed.) (2006). *Aesthetic Computing*. Massachusetts: MIT Press.
- FONTEYNE, E. & MAGLI, R. & VAN DE VELDE, W. (2001). Aesthetic Expression of Feelings. (Online). Available from: <http://www.dfki.de/imedia/workshops/i3-spring01/w1/index.htm> (10/10/2006).
- FORD, G. & GELDERBLOM, H. (2003). The effects of culture on performance achieved through the use of human computer interaction. In: Proceedings of the 2003 Annual Research Conference of the South African institute of Computer Scientists and information Technologists on Enablement Through Technology, 17<sup>th</sup> -19<sup>th</sup> September. J. Eloff, A. Engelbrecht, P. Kotzé, and M. Eloff, Eds. ACM International Conference Proceeding Series, vol. 47. South Africa: South African Institute for Computer Scientists and Information Technologists Pp.218-230. (Online). Available from: <http://portal.acm.org/citation.cfm?id=954038> (31/05/2008).
- FORLIZZI, J. (2006). How Do HCI Researchers View Interaction Design? (Online). Available from: <http://goodgestreet.com/theory/hcid.html> (26/10/2006).
- FORLIZZI, J. & BATTARBEE, K. (2004). Understanding Experience in Interactive Systems. *In: Proceedings of the 2004 conference on Designing interactive systems: processes, practices, methods, and techniques, 1-4<sup>th</sup> August, Cambridge, MA, USA*. New York: ACM Publishers. Pages: 261 - 268.
- FREMANTLE, R. (No date given). Masaccio 1401-1428? (Online). Available from: <http://www.mystudios.com/art/italian/masaccio/masaccio.html> (16/04/2007).
- FRIDAY, J. (2002). *Aesthetics and Photography*. London: Ashgate Publishing Limited.
- GAGE, J. (2000). *Colour and Meaning: Art, Science and Symbolism*. California: University of California Press.
- GALYEAN, T. A. (1995). Guided Navigation of virtual environments. *In: Proceedings of the 1995 symposium on Interactive 3D Graphics, 9 - 12<sup>th</sup> April, Monterey, CA*. USA: MIT. Pp.103. (Online). Available from: <http://ic.media.mit.edu/icSite/icpublications/Conference/GuidedNavigation.html>. (28/04/2004)
- GANDER, P. Two Myths about Immersion in New Storytelling Media. (1997). (Online). Available from: <http://www.pierregander.com/mytexts/immersion.doc> (05/05/2004).

- GANDY, M. (2003). Landscapes of delinquency in Michelangelo Antonioni's Red Desert. *Transactions of the Institute of British Geographers*. 28. (2) pp.218–237. (Online). Available from: [http://66.102.9.104/search?q=cache:9Fe7tyGHVlJ:www.geog.ucl.ac.uk/~mgandy/pdf3.pdf+antonioni+%27s+red+desert,the+use+of+pace+and+colour&hl=en&ie=UTF-8](http://66.102.9.104/search?q=cache:9Fe7tyGHVlJ:www.geog.ucl.ac.uk/~mgandy/pdf3.pdf+antonioni+%27s+red+desert,the+use+of+space+and+colour&hl=en&ie=UTF-8) (16/12/2005).
- GARGETT, A. (2001). Going Down – The Art of Tracey Emin. (Online). Available from: [http://www.3ammagazine.com/litarchives/oct2001/going\\_down.html](http://www.3ammagazine.com/litarchives/oct2001/going_down.html). (15/09/2007)
- GASKELL, I. (No date given). Interdisciplinary Aesthetics. *American Society for Aesthetics Online*. (Online). Available from: <http://www.aesthetics-online.org/ideas/gaskell.2.html> (13/09/2006).
- GAZZARD, A. (2007a). Playing without Gaming. In: *Digital Games: Design and Theory*, 14<sup>th</sup> September, Brunel University, London. (Online). Available from: <http://arts.brunel.ac.uk/gate/gamesconference/> (10/02/08).
- GAZZARD, A. (2007b). Playing in a Virtual World: Exploration and Aspects of Play. In: *17th International Conference on Artificial Reality and Telexistence*, 28<sup>th</sup>-30<sup>th</sup> November, Esbjerg, Denmark. pp. 288-289 (Online). Available from: <http://csdl2.computer.org/comp/proceedings/icat/2007/3056/00/30560288.pdf> (10/02/08).
- GENETTE, G. (1980). *Narrative Discourse – An Essay in Method*. New York: Cornell University Press.
- GOLDSTEIN, B.E. (2002). *Sensation and Perception*. USA: Wadsworth Group.
- GOMEZ, G. & EGGENBERGER HOTZ, P. (2004). An evolved learning mechanism for teaching a robot to Foveate. In: *Proceedings of AROB 9th Artificial Life and Robotics*, 28 –30<sup>th</sup> January, Beppu, Japan. (Online). Available from: [http://www.liralab.it/projects/adapt/files/arob9\\_2004.pdf](http://www.liralab.it/projects/adapt/files/arob9_2004.pdf) (14/05/2007).
- GORDON, I.E. (2004). *Theories of Visual Perception*. USA: Psychology Press.
- GRASBON, D. & BRAUN, N. (2001). A Morphological Approach to Interactive Storytelling. In: *Proceedings of on Artificial Intelligence and Interactive Entertainment (CAST '01)*, 21-22<sup>nd</sup> September, Sankt Augustin, Germany. (Online). Available from: [http://cobnitz.codeen.org:3125/citeseer.ist.psu.edu/cache/papers/cs/23137/http:zSzzSznetzspannung.orgzSzcast01zSzproceedingszSzpdfszSzPDFs\\_by\\_NamezSzGrasbon.pdf/grasbon01morphological.pdf](http://cobnitz.codeen.org:3125/citeseer.ist.psu.edu/cache/papers/cs/23137/http:zSzzSznetzspannung.orgzSzcast01zSzproceedingszSzpdfszSzPDFs_by_NamezSzGrasbon.pdf/grasbon01morphological.pdf) (02/04/2007)
- GRAU, O (2003a). Immersion and Interaction – From circular frescoes to interactive image spaces. (Online). Available from: [http://www.medienkunstnetz.de/themes/overview\\_of\\_media\\_art/immersion/4/](http://www.medienkunstnetz.de/themes/overview_of_media_art/immersion/4/) (06/11/2004).
- GRAU, O. (2003b). *Virtual Art – from Illusion to Immersion*. USA: MIT Press.
- GROMALA, D. (2007). The living book of the senses. (Online). Available from: <http://www.lcc.gatech.edu/~gromala/art.htm#living> (28/09/07)
- HALL, M. (1992). *Colour and Meaning, Practise and Theory in Renaissance Painting*. UK: Cambridge University Press.
- HAWKES, T. (1977). *Structuralism and Semiotics*. London: Methuen & Co.
- HEWETT & BAECKER & CARD & CAREY & GASEN & MANTEI & PERLMAN & STRONG & VERPLANK (1996). ACM SIGCHI Curricula for Human-Computer Interaction. (Online). Available from: <http://sigchi.org/cdg/cdg2.html> (26/10/2005).
- HOFFMAN, R. & KRAUSS, K. (2004). A Critical Evaluation of Literature on visual aesthetics for the web. In: *Proceedings of the 2004 Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists on IT Research in Developing Countries*, 4-6<sup>th</sup> October, Stellenbosch. South Africa: ACM International Conference Proceeding Series. Pp.205 - 209. (Online). Available from: <http://portal.acm.org/citation.cfm?id=1035053.1035077> (11/06/2005).

- HOLMES, T. (2006). Jeff Wall. (Online) Available from: <http://www.photography-art-contemporary.info/Jeff Wall> (15/09/2007).
- HOLTZMAN, STEVEN (1998). *Digital Mosaics – the Aesthetics of Cyberspace*. New York, USA: Touchstone.
- HOSKIN, T. (2003). Virtual Art: Illusion to Immersion. (Online). Available from: [http://www.msstate.edu/fineart\\_online/Backissues/Vol\\_17/faf\\_v17\\_n11/reviews/grau.html](http://www.msstate.edu/fineart_online/Backissues/Vol_17/faf_v17_n11/reviews/grau.html) (13/08/2005).
- HUDDLESTIN, S. (2001). The Theatrical Baroque: European Plays, Painting and Poetry (1575-1725). *Fathom Archive* (Online). Available from: <http://www.fathom.com/course/10701023/session2.html>. (24/01/2005).
- HUGO, J. (1996). Visual literacy and software design. (Online). Available from: <http://www.chi-sa.org.za/articles/vislit2.htm> (20/06/2007).
- IJSSELSTEIJN, W. (2003). Presence in the Past: what can we learn from media History? (Online). Available from: [http://216.239.59.104/search?q=cache:ofKDynUPNt4J:www.vepsy.com/communication/book4/4\\_02IJSSELS.PDF+Presence+in+the+Past:what+can+we+learn+from+media+History%3F&hl=en](http://216.239.59.104/search?q=cache:ofKDynUPNt4J:www.vepsy.com/communication/book4/4_02IJSSELS.PDF+Presence+in+the+Past:what+can+we+learn+from+media+History%3F&hl=en) (06/05/2004).
- ILSTEDT HJELM, S. (1995). Semiotics in Product Design. (Online). Available from: <http://smart.tii.se/smart/publications/pubs/semiotics.pdf> (21/05/2007).
- INNOCENT, T. (2005). Idea-ON>! Iconica & Semiomorph: creating identities for game spaces through visual style and digital aesthetics. *In: Proceedings of the second Australasian conference on Interactive entertainment, 23-25<sup>th</sup> November, Sydney*. Australia: Creativity & Cognition Studios Press. Pp.83 - 87. (Online). Available from: <http://delivery.acm.org/10.1145/1110000/1109193/p83-innocent.pdf?key1=1109193&key2=6486540811&coll=ACM&dl=ACM&CFID=12434038&CFTOKEN=73705961> (29/05/2007)
- ISDALE, J. & DALY, L. & FENCOTT, C. & HEIM, M. (2002). Content development for Virtual environments. *In: Stanney, K. M. (Ed). Handbook of Virtual Environments: Design, Implementation and Applications*. USA: Lawrence Erlbaum Associates. Pp.519-532. (Online). Available from: [http://vr.isdale.com/vrTechReviews/VRContentDev/ContentDev4VE\\_FINALDRAFT.doc](http://vr.isdale.com/vrTechReviews/VRContentDev/ContentDev4VE_FINALDRAFT.doc) (12/03/2007).
- JACOBSON, B. (2000). Experience Design. *A List Apart: Online Magazine*. (Online). Available from: <http://alistapart.com/articles/experience> (04/05/2007).
- JACOBSON, L. (1992). *Cyberarts, Exploring Art and Technology*. USA: Miller Freeman Inc.
- JENKINS, H. (No date given). Game design as narrative architecture. (Online). Available from: <http://web.mit.edu/cms/People/henry3/games&narrative.html> (07/05/2004).
- JOHNSON, P. (2003). Cave Paintings (40,000 - 10,000 BC). *Art: A New History* (Online). Available from: <http://www.artchive.com/artchive/C/cave.html> (16/04/2007).
- JOHNSON, P. (1992). *Human Computer Interaction- Psychology, Task analysis and Software Engineering*. England: McGraw-Hill Book Company Europe.
- JONSSON, S. & MONTOLA, M. & WAERN, A. & ERICSSON, M. (2006). Game: Prosopopeia: experiences from a pervasive Larp. *In: Proceedings of the 2006 ACM SIGCHI international conference on Advances in computer entertainment technology Hollywood, 5<sup>th</sup> September, California*. New York: ACM Press. (Online). Available from: <http://delivery.acm.org/10.1145/1180000/1178850/a23-jonsson.pdf?key1=1178850&key2=7607540811&coll=ACM&dl=ACM&CFID=12434038&CFTOKEN=73705961> (29/05/2007)
- JUDELMAN, G. (2004). Aesthetics and Inspiration for Visualization Design: Bridging the Gap between Art and Science. *In: Eighth International Conference on Information Visualisation, 14-16th July, London, UK*. Los Alamitos, California:

- IEEE Computer Society. Pp.245-250. (Online). Available from: <http://www.gregjudelman.com/media/judelmanIV04paper.pdf> (21/05/2007).
- JUUL, J. (2001). Games Telling stories? – A brief note on games and narratives. *Games Studies: the International Journal of Computer Game Research*. 1. (1). (Online). Available from: <http://www.gamestudies.org/0101/juul-gts/> (29/05/2007).
  - KALAWSKY, R.S. (1993). *The Science of Virtual Reality and Virtual Environments* Great Britain: Addison-Wesley Publishers.
  - KARSVALL, A. (2002). Personality preferences in graphical interface design. In: *Proceedings of the Second Nordic Conference on Human-Computer interaction, Aarhus, Denmark, 19<sup>th</sup> - 23<sup>th</sup> October, 2002*. New York: ACM Press. Pp. 217-218. (Online). Available from: <http://doi.acm.org/10.1145/572020.572049> (31/05/2008).
  - KHALED, R., BARR, P., FISCHER, R., NOBLE, J., & BIDDLE, R. (2006). Factoring culture into the design of a persuasive game. In: *Proceedings of the 20th Conference of the Computer-Human interaction Special interest Group (Chisig) of Australia on Computer-Human interaction: Design: Activities, Artefacts and Environments, 20<sup>th</sup> - 24<sup>th</sup> November, Sydney, Australia*. New York: ACM Press. Pp. 213-220. (Online). Available from: <http://doi.acm.org/10.1145/1228175.1228213> (31/05/2008).
  - KARAT, J. & KARAT, C. M. (2003). The evolution of user-centred focus in the human-computer interaction field. *IBM Systems Journal*. 42. (4). (Online). Available from: <http://www.research.ibm.com/journal/sj/424/karat.html> (26/10/2006).
  - KEMBER, S. (2003). The Shadow of the Object: Photography and Realism. In: WELLS, L. (Ed.). *The Photography Reader*. Oxon: Routledge.
  - KERESSEY, B. (no date given). Duccio Di Buoninsegna. (Online). Available from: <http://emsh.calarts.edu/alumni/bkeresey/duccio.html> (16/04/2007).
  - KNOPPEL, F. (2005). Visual information display in AR-environments. (Online). Available from: [http://referaat.cs.utwente.nl/documents/2005\\_02\\_C-Intelligent\\_Interaction/2005\\_02\\_C\\_Knoppel,%20F.L.A-Visual\\_Information\\_Display\\_in\\_AR\\_environments.pdf](http://referaat.cs.utwente.nl/documents/2005_02_C-Intelligent_Interaction/2005_02_C_Knoppel,%20F.L.A-Visual_Information_Display_in_AR_environments.pdf) (28/09/07)
  - KNUTSLIEN, S. (2001). The Future of Interaction Design. (Online). Available from: [http://www.ivt.ntnu.no/ipd/forskning/artikler/2001/Knutslie\\_II.pdf](http://www.ivt.ntnu.no/ipd/forskning/artikler/2001/Knutslie_II.pdf) (27/10/2006).
  - KRAICER, S. (2003). Absence as spectacle: Zhang Yimou's Hero (Online). Available from: <http://www.chinesecinemas.org/hero.html> (15/06/2007).
  - KRESS, G. & VAN LEEUWEN, T. (1996). *Reading Images: The Grammar of Visual Design*. London: Routledge.
  - LAFFERTY, M. (2003). Metal Gear Solid 2: Substance Review. (Online). Available from: <http://ps2.gamezone.com/gzreviews/r20463.htm> (15/06/2007).
  - LAUREL, B. (1993). *Computers as Theatre*. USA: Addison-Wesley Publishing Company.
  - LAUREL, B. & STRICKLAND, R. & TOW, R. (1994). Placeholder: landscape and narrative in virtual environments. *ACM Computer Graphics Quarterly* 28 (2). (Online). Available from: [http://www.tauzero.com/Brenda\\_Laurel/Severed\\_Heads/CGQ\\_Placeholder.html](http://www.tauzero.com/Brenda_Laurel/Severed_Heads/CGQ_Placeholder.html) (20/03/2003).
  - LAVIE, T. & TRACTINSKY, N. (2004). Assessing dimensions of perceived visual aesthetics of web sites. *International Journal of Human-Computer Studies*. 60. pp.269-298. (Online). Available from: [http://www.ise.bgu.ac.il/faculty/noam/papers/04\\_tl\\_nt\\_ijhcs.pdf#search=%22lavie%20%20visual%20aesthetics%20of%20web%20sites%22](http://www.ise.bgu.ac.il/faculty/noam/papers/04_tl_nt_ijhcs.pdf#search=%22lavie%20%20visual%20aesthetics%20of%20web%20sites%22) (03/10/2006).
  - LEATH, C. (1996). The Aesthetic Experience. (Online). Available from: <http://shared.nidelven-it.no/colin/cleath/docs/asexp113.htm> (11/08/2006).

- LEE, J.J. (2007). Emotion and Sense of Telepresence: The Effects of Screen Viewpoint, Self-transcendence Style, and NPC in a 3D Game Environment. *In: Human Computer Interaction (Intelligent Multimodal interaction Environments) '07. 22<sup>nd</sup> - 27th July, Beijing, China. pp. 392-399.* Heidelberg: Springer.
- LEEB, R. & SCHERER, R. & LEE, F. & BISCHOF, H. & PFURTSCHELLER, G. (2004). Navigation in Virtual Environments through Motor Imagery. *In: Proceedings of the CVWW'04. 4-6th February, Piran, Slovenia.* Pp.99-108. (Online). Available from: [http://www.cs.ucl.ac.uk/research/vr/Projects/Presencia/ConsortiumPublications/graz\\_papers/Leeb\\_NavigationInVEthroughMotorImagery.pdf](http://www.cs.ucl.ac.uk/research/vr/Projects/Presencia/ConsortiumPublications/graz_papers/Leeb_NavigationInVEthroughMotorImagery.pdf) (14/05/2007).
- LESSITER, J. & FREEMAN, J. & KEOGH, E. & DAVIDOFF, J. (2001). A cross-media presence questionnaire: The ITC-Sense of Presence Inventory. *In: Presence: Teleoperators & Virtual Environments, 10 (3).* p. 282-298. Cambridge, USA: MIT Press.
- LISTER, M. & DOVEY, J. & GIDDINGS, S. & GRANT, I. & KELLY, K. (2003). *New Media: A Critical Introduction.* London: Routledge.
- LIU, H. (2004). Articulation, the Letter, and the Spirit in the Aesthetics of Narrative. *In: Proceedings of the 2004 ACM Workshop on Story Representation, Mechanism, and Context (SRMC'04), 15th October 2004, New York.* New York: ACM Press. (Online). Available from: <http://web.media.mit.edu/~hugo/publications/papers/SRMC2004-narrative-aesthetics.pdf>. (29/03/2007)
- LIU, H. & MAES, P. (2005). The Aesthetoscope: Visualizing Aesthetic Readings of Text in Color Space. *In: Proceedings of the Eighteenth International Florida Artificial Intelligence Research Society Conference (AI in Music & Art Special Track), 15-17<sup>th</sup> May, Menlo Park, California.* USA: AAAI Press. Pp.74-79. (Online). Available from: [http://ambient.media.mit.edu/assets/\\_pubs/FLAIRS2005-aesthetoscope.pdf](http://ambient.media.mit.edu/assets/_pubs/FLAIRS2005-aesthetoscope.pdf) (16/04/2007)
- LIVINGSTON, M.A. & ELLIS, S. R. & MIZELL, D.W. & RUFFNER, J.W. & WHITTON, M.C (2006). How Do We Solve Human Factors for AR and VR Applications? *IEEE Virtual Reality Conference 2006 Panels.* (Online). Available from: <http://www.vr2006.org/program/panels.htm> (07/11/2006).
- LOK, B. C. & HODGES, L.F. (2004). Human Computer Interaction in Virtual Reality. *In: BAINBRIDGE, W. (Ed.) Encyclopaedia of Human Computer Interaction.* Barrington, MA: Berkshire Publishers. (Online). Available from: <http://www.cise.ufl.edu/~lok/research/ehci04-vr/vr-hci.doc> (7/11/2006)
- LOUCHART, S. (2002). Narrative theory and Emergent Interactive Narrative. *International Journal of Continuing Engineering Education and Lifelong Learning. 14. (6)* (Online). Available from: <http://www.macs.hw.ac.uk/~ruth/Papers/narrative/IJCEELL05.pdf> (28/04/2004).
- LOUCHART, S. & AYLETT, R. (2004A). Emergent Narrative, requirements and high level architecture. *In: SETN 04, 5th-8th May, Samos, Greece.* (Online). Available from: <http://66.102.9.104/search?q=cache:oLRINA6RIVwJ:www.macs.hw.ac.uk/~sandy/Source/SETN04-Louchart-Aylett.pdf+Emergent+Narrative,+requirements+and+high+level+architecture&hl=en&ct=clnk&cd=1> (8/01/2007).
- LOUCHART, S. & AYLETT, R. (2004B). The emergent Narrative theoretical investigation. *In: International Conference on Narrative and Interactive Learning Environments, 10-13<sup>th</sup> August, Edinburgh.* Newcastle upon Tyne Northumbria University. Pp.25-33 (Online). Available from: <http://vitalstatistix.nicve.Salford.ac.uk/~sandy/Source/LouchartAylettNile04.doc> (8/01/2007)
- LÖWGREN, J. (2002). Just How Far Beyond HCI is Interaction Design? (Online). Available from: [http://www.boxesandarrows.com/view/just\\_how\\_far\\_beyond\\_hci\\_is\\_interaction\\_design\\_](http://www.boxesandarrows.com/view/just_how_far_beyond_hci_is_interaction_design_) (2/11/2006).

- LÖWGREN, J. & STOLTERMAN, E. (2004). *Thoughtful interaction Design – a Design Perspective on Information Technology*. USA: MIT Press.
- LUND, A. & WATERWORTH, J.A. (1998). Experiential Design: reflecting embodiment at the human-computer interface (Online). Available from: <http://www.informatik.umu.se/~jwworth/MetaDesign.html>. (17/11/2005).
- LYNTON, N. & SMITH, A. & CUMMING, R. & COLLINSON, D. (1985). *Looking into Paintings*. Milton Keynes: The Open University.
- MAHLKE, S. & LINDGAARD, G. (2007). Emotional Experiences and Quality Perceptions of Interactive Products. In: *Human-Computer Interaction (Interaction design and usability), 22nd -27th July, Beijing, China*. pp.164- 173. Heidelberg: Springer.
- MALLON, B. & WEBB, B. (2005). Games: Stand up and take your place: identifying narrative elements in narrative adventure and role play games. *Computers in Entertainment (CIE)* 3. (1). Pp.6-6. (Online). Available from: <http://delivery.acm.org/10.1145/1060000/1057285/p6b-mallon.pdf?key1=1057285&key2=5087540811&coll=ACM&dl=ACM&CFID=12434038&CFTOKEN=73705961> (29/05/2007).
- MANOVICH, L. (2001a). *The Language of New Media*. Cambridge, Massachusetts: MIT Press.
- MANOVICH, L. (2001b). Macrocinema: Spatial Montage. (Online). Available from: <http://www.manovich.net/macrocinema.doc> (15/07/ 2007).
- MARION, C. (2000). What is Interaction Design and What Does It Mean to Information Designers? *News and Views*. (Online). Available from: <http://mysite.verizon.net/resnx4g7/PCD/WhatIsInteractionDesign.html> (03/10/2006).
- MARSH, A. (2004). Pragmatist Aesthetics and New Visions of the Contemporary Art Museum: The Tate Modern and the Baltic Centre for Contemporary Art. *The Journal of Aesthetic Education*. 38. (Number 3). Pp. 91-106. (Online). Available from: <http://jae.press.uiuc.edu/38.3/marsh.html> (30/05/2007).
- MARSH, T. & WRIGHT, P. (2000). Maintaining the Illusion of Interacting within a 3D Virtual Space. In: *Presence 2000, 27-28th March, Delft, Netherlands*. (Online). Available from: <http://www.cs.york.ac.uk/hci/inquisitive/papers/presence00/marshwright00.pdf> (02/05/2007)
- MARSH, T. & WRIGHT, P. & SMITH, S. (2001). Evaluation for the design of experience in virtual environments: modelling Breakdown of interaction and illusion. *Journal of CyberPsychology and Behavior*. 4. (2) pp.225-238. (Online). Available from: <http://www.cs.york.ac.uk/hci/inquisitive/papers/cyberpsy01/cyberpsy01.pdf> (04/04/2007).
- MCCALL, R. & O'NEILL, S. & CARROLL, F. (2004). Measuring presence in virtual environments. In: *CHI '04 extended abstracts on Human factors in computing systems, 24-29<sup>th</sup> April, Vienna, pp. 783 - 784*. New York: ACM Press. (Online). Available from: <http://portal.acm.org/citation.cfm?doid=985934>. (28/07/07).
- MCCARTHY, J. & WRIGHT, P. (2004). *Technology as Experience*. Massachusetts: MIT Press.
- MCMILLAN, C. (2002). How does digital editing help children develop their understanding of narrative? (Online). Available from: [http://www.bfi.org.uk/education/research/teachlearn/pdf/04\\_mcmillan\\_carrie.pdf](http://www.bfi.org.uk/education/research/teachlearn/pdf/04_mcmillan_carrie.pdf) (23/03/2007).
- MITCHELL, W.J. & INOUE, A.S. & BLUMENTHAL, M.S (2003). The Influence of Art and Design on Computer Science Research and Development. *Beyond Productivity: Information, Technology, Innovation, and Creativity*. USA: National Academy Press (Online). Available from: [http://bob.nap.edu/html/beyond\\_productivity/ch4.html](http://bob.nap.edu/html/beyond_productivity/ch4.html) (10/05/ 2007).
- MOGGRIDGE, B. (1999). Expressing experiences in Design. *ACM Digital Library, Interactions*. 6. (4) pp.17 - 25 (Online). Available from: <http://delivery.acm.org>

/10.1145/310000/306430/p17-moggridge.pdf?key1=306430&key2=5164022611  
&coll=Portal&dl=GUIDE&CFID=4739955&CFTOKEN=91571747.  
(30/10/2006).

- MORRIS, C. (1964). *Signification and Significance*. Cambridge, Massachusetts: MIT Press.
- MORSE, M. (1998). *Virtualites USA*: Indiana University Press.
- MOYLES, T. Great Games – Metal Gear Solid. (2002). (Online). Available from: <http://www.gamecritics.com/great-games-mgs> (26/06/2007).
- MURRAY, J. (2000). *Hamlet on the Holodeck – the Future of Narrative in Cyperspace*. USA: The MIT Press.
- NADIN, M. (1988). Interface Design: a semiotic paradigm. (Online). Available from: <http://www.cs.ucsd.edu/users/goguen/courses/nadin.pdf>. (21/05/2007).
- NDALIANIS, A. (2000). Baroque Perceptual Regimes, Senses of cinema. In: *Special Effects/Special Affects: Technologies of the Screen symposium held at the University of Melbourne, 25th March, Melbourne*. (Online). Available from: <http://www.sensesofcinema.com/contents/00/5/baroque.html> (14/05/2007)
- NELL, V. (1988). *Lost in a Book, the Psychology of Reading for Pleasure*. New Haven: Yale University Press.
- NEWMAN, W.M. & LAMMING, M.G. (1995). *Interactive Systems Design*. England: Addison Wesley Longman Ltd
- NIAMARK, M. (1990). Realness and Interactivity. In: *Laurel, B. (Eds). The Art of Human Computer Interface Design*. USA: Addison-Wesley Publishing Company, INC.
- NIELSEN, J. (2003). An introduction to usability. (Online). Available from: <http://www.useit.com/alertbox/20030825.html> (31/10/2006).
- NIX. (2003). Hero Movie Review. (Online). Available from: <http://www.beyondhollywood.com/?p=1127> (15/06/2007).
- NO-AUTHOR-GIVEN. (2007). Masaccio – Innovator of Perspective and Illusion (Online). Available from: <http://www.antiessays.com/free-essays/60.html> (16/04/2007).
- O'NEILL, S. (2005a). Comparing Compatible Semiotic Perspectives for the Analysis of Interactive Media Devices. *Applied Semiotics: A Learned Journal of Literary Research on the World Wide Web*. 6. (16) (Online). Available from: <http://www.chass.toronto.edu/french/as-sa/ASSA-No16/Article1en.html> (25/04/2007).
- O'NEILL, S. (2005b). Exploring a Semiotics of New Media. PhD Thesis. *Computing*. Edinburgh: Napier University.
- O'SULLIVAN, T. & HARTLEY, J. & SAUNDERS, D. & MONTGOMERY, M. & FISKE, J. (1994). *Key Concepts in Communication and Cultural Studies*. London: Routledge.
- O'TOOLE, M. (1994). *The Language of Displayed Art*. London: Leicester University Press.
- PACKER, R. & JORDON, K. (2001). *Multimedia from Wagner to Virtual Reality*. USA: Norton Paperback.
- PARKER, D H. (2003). *The Principles of Aesthetics*. City: (Online). Available from: <http://www.authorama.com/principles-of-aesthetics-5.html> (21/09/2006).
- PEARCE, C. (1997). Narrative environments: virtual reality as a story telling medium. In: *Proceedings of the 24th annual conference on Computer graphics and interactive techniques, 3-4<sup>th</sup> August, Los Angeles*. New York: ACM Press/Addison-Wesley Publishing Co. Pp.440 - 441. (Online). Available from: <http://delivery.acm.org/10.1145/260000/258901/p440-pearce.pdf?key1=258901&key2=4279193801>

&coll=GUIDE&dl=ACM&CFID=21200257&CFTOKEN=34968732  
(25/06/2007)

- PEARCE, C. (1997a). Narrative Environments: virtual reality as a storytelling medium. (Online). Available from: <http://www.siggraph.org/s97/conference/panels/w2b.html> (04/05/2004).
- PEARCE, C. (1997b). Narrative Environments: Creating a New Entertainment Medium. In: *Avatars 97, 20-22<sup>nd</sup> October, San Francisco* (Online). Available from: <http://www.ccon.org/conf97/program/ceiap.html> (25/06/2007)
- PETERSEN, M.G. & IVERSEN, O. S. & KROGH, P.G. & LUDVIGSEN, M. (2004). Aesthetic Interaction – a pragmatist’s aesthetics of interactive systems. In: *Designing Interactive Systems: processes, practices, methods, and techniques, 10<sup>th</sup> March, Cambridge, MA*. New York: ACM Press. pp.269 - 276 (Online). Available from: [http://www.daimi.au.dk/~sejer/Home\\_files/Aesthetic.pdf](http://www.daimi.au.dk/~sejer/Home_files/Aesthetic.pdf) (13/07/2007).
- PHELPS, K. (1998). Story shapes for digital media. (Online). Available from: <http://www.glasswings.com.au/modern/shapes/> (06/05/2004).
- POLLARD, M. (2002). Hero. (Online). Available from: <http://www.kungfucinema.com/reviews/hero2002.htm> (15/06/2007).
- PRADA, R. & MACHADO, I. & PAIVA, A. (2000). TEATRIX, virtual environment for story creation. In: *Proceedings of Intelligent Tutoring Systems. (5th International Conference), 19-23<sup>rd</sup> June, Montréal, USA*: Springer. Pp.464–473. (Online). Available from: <http://gaips.inesc-id.pt/gaips/shared/docs/Prada00Teatrix.pdf> (23/03/2007).
- PRADL, G. (2000). Narratology, the study of story structure. (Online). Available from: <http://www.ericdigests.org/pre-921/story.htm> (01/06/2004).
- PROPP, V. (1968). *Morphology of the Folktale*. Austin, USA: University of Texas Press.
- RANTALA, V. (No date given). Environmental Experience: Beyond Aesthetic Subjectivism and objectivism. (Online). Available from: <http://www.lancs.ac.uk/depts/philosophy/awaymave/onlineresources/rantalla.pdf> (27/04/2006).
- RIESER, M. & ZAPP, A. (Eds.) (2002). *New screen Media. Cinema, Art, Narrative*. London: The British Film Institute.
- ROSE, G. (2001). *Visual Methodologies*. London: SAGE publications Ltd.
- ROUSSOU, M. & DRETTAKIS, G. (2003). Photorealism and Non-photorealism in Virtual Heritage Representation. In: *CHALMERS, A. & ARNOLD, D. & NICCOLUCCI, F. (Eds). First Eurographics Workshop on Graphics and Cultural Heritage. 5-7th November, Brighton, UK*. (Online). Available from: <http://www-sop.inria.fr/revs/Basilic/2003/RD03b/RoussouDrettakis03.pdf> (30/09/07).
- RUDNER, R. (1951). On semiotic Aesthetics. *Journal of Aesthetic and Art Criticism*. 10. (1) pp.67-77. (Online). Available from: <http://links.jstor.org/sici?sici=0021-8529%28195109%2910%3A1%3C67%3AOSA%3E2.0.CO%3B2-D&size=LARGE> (16/10/2006).
- RYAN, M.L. (2001a). Beyond Myth and Metaphor – the case of narrative in digital media. *The International Journal of Computer Game Research*. 1. (1) (Online). Available from: <http://www.gamestudies.org/0101/ryan/> (2/04/2007).
- RYAN, M.L. (2001). *Narrative as Virtual Reality*. USA: The Johns Hopkins University Press.
- SAFFER, D. (2004). Experience design versus Interaction design. (Online). Available from: <http://lists.interactiondesigners.com/htdig.cgi/discuss-interactiondesigners.com/2004-November/003501.html> (30/10/2006).
- SEIF EL-NASR, M. & NIEDENTHAL, S. & KNEZ, S. & ALMEIDA, P. & ZUPKO, J. (2006) Dynamic Lighting for Tension in Games. (Online). Available from: [http://gamestudies.org/0701/articles/elnasr\\_niedenthal\\_knez\\_almeida\\_zupko](http://gamestudies.org/0701/articles/elnasr_niedenthal_knez_almeida_zupko) (25/09/07)

- SANES, K. Transparency. (2000a). (Online). Available from: <http://www.transparencynow.com/lascaux.html> (18/02/2005).
- SANES, K. Transparency. (2000b). (Online). Available from: <http://www.transparencynow.com/Overview/fantasy.html> (18/02/2005).
- SCAIFE, M. & ROGERS, Y. (2001). Informing the design of a virtual environment to support learning for children. *International Journal of Human-Computer Studies*. 55. (2). Pp.115-143. (Online). Available from: <http://www.informatics.sussex.ac.uk/research/groups/interact/publications/S&R-IJHCS'02.pdf> (08/01/2007).
- SCHARFE, H. (2004). A study in Computer Aided Narrative Analysis – *CANA*. PhD Thesis. (Online). Available from: [http://www.hum.aau.dk/~scharfe/scharfe\\_afhandling.pdf](http://www.hum.aau.dk/~scharfe/scharfe_afhandling.pdf) (23/03/07).
- SCHUBERT, T. & CRUSIUS, J. (2002). Five Theses on the Book Problem: Presence in Books, Film and VR. In: *Fifth Annual International Workshop Presence, 9-11<sup>th</sup> October, Porto, Portugal*. (Online). Available from: <http://216.239.59.104/search?http://216.239.59.104/search?q=cache:YKI4kRANy3IJ:www.igroup.org/projects/porto2002/SchubertCrusiusSlidesPorto2000.pdf+Five+theses+on+the+book+problem+Presence+in+Books,Film+and+vr&hl=en> (25/06/2007).
- SCRUTON, R. (1983). *The Aesthetic Understanding*. Great Britain: Carcanet New Press Ltd.
- SCRUTON, R. & MUNRO, T. (2003). Aesthetics. *Encyclopedia Britannica*. (Online). Available from: <http://www.compilerpress.atfreeweb.com/Anno%20Scruton%20Aesthetics%20EB%202003%20a.htm> (16/08/2006).
- SHEDROFF, N. (1994a). Interaction Design Course Syllabus (Online). Available from: <http://www.nathan.com/thoughts/course.html> (01/06/2007).
- SHEDROFF, N. (1994b). Information Interaction Design: A Unified Field Theory of Design. (Online). Available from: <http://www.nathan.com/thoughts/unified/2.html> (03/10/2006).
- SHEDROFF, N. (2005a). Experience Design. (Online). Available from: <http://www.nathan.com/ed/glossary/index.html> (27/10/2006).
- SHEDROFF, N. (2005b). Interaction Design Course Syllabus. (Online). Available from: <http://www.nathan.com/thoughts/course.html> (27/10/2006).
- SHERMAN, W. R. & CRAIG, A. B. (1995). Literacy in virtual reality: a new medium. *Graphics World*. Pp.35-41 (Online). Available from: <http://www.ncsa.uiuc.edu/VR/VR/Papers/vrlit.html> (28/04/2004).
- SHUSTERMAN, R. (1992). *Pragmatist Aesthetics – Living Beauty, Rethinking Art*. Cambridge, Massachusetts: Blackwell publishers.
- SHUMAKER, R. (Ed.) (2007). *Virtual Reality*. Heidelberg: Springer.
- SIMON, S. J. (2000). The impact of culture and gender on web sites: an empirical study. *SIGMIS* 32 (1). Pp.18-37. (Online). Available from: <http://doi.acm.org/10.1145/506740.506744> (31/05/2008).
- SKOG, T. & LJUNGBLAD, S. & HOLMQUIST, L. (2003). Between Aesthetics and Utility: designing ambient information visualisations. In: *IEEE Symposium on Information Visualisation. 19-21<sup>st</sup> October, Seattle*. Pp.239-240. (Online). Available from: <http://ieeexplore.ieee.org/iel5/8837/27965/01249031.pdf> (21/05/2007).
- SMITH, S & WATSON, J. (2001). The Rumpled Bed of Autobiography: Extravagant Lives, Extravagant Questions. (Online). Available from: <http://www.egs.edu/faculty/emin/emin-the-rumpled-bed-of-autobiography.html>. (15/09/2007).
- STANNEY, K.M. (Ed.) (2003). *International Journal of Human-Computer Interaction*. USA: Lawrence Erlbaum Assoc Inc

- STAPPERS, P. J. & SAAKES, D. & ADRIAANSE, J. (2001). On the narrative structure of Virtual Reality Walk throughs. In: *CAAD Futures 2001 – Proceedings of the 9th International Conference on Computer Aided Architectural Design Futures, 8-11<sup>th</sup> July, Eindhoven*. Dordrecht: Kluwer Academic Publishers (Online). Available from: <http://66.102.9.104/search?q=cache:rWV9af1IOt4J:www.io.tudelft.nl/id-studiolab/research/pdfPool/2001/01StapCAANar.pdf+On+the+narrative+structure+of+Virtual+Reality+Walk+throughs&hl=en> (04/05/2004).
- STUBBLEFIELD, W.A. (2000). Narrative structure in virtual collaborative environments. *ACM SIGGROUP Bulletin* 21. (1) Pp.22 - 23 (Online). Available from: <http://portal.acm.org/citation.cfm?id=377288&jmp=indexterms&dl=GUIDE&dl=ACM> (04/05/2004).
- SUTCLIFFE, A.G. (1995). *Human-Computer Interface Design – second edition*. London: MacMillan Press Ltd.
- SZILAS, N. (1999). Interactive Drama on Computer: Beyond Linear Narrative. In: *AAAI 1999 Fall Symposium on Narrative Intelligence, 5-7<sup>th</sup> November, Cape Cod North Falmouth, Massachusetts*. (Online). Available from: <http://www.lcc.gatech.edu/~mateas/nidocs/Szilas.pdf> (03/04/2007).
- TANNEY, S. & SCHWARTZ, P. & YEN, S. & SHEN, L. & FURNESS, T. (1998). A design Method for Virtual Environments Using Narrative and Pattern Languages. (Online). Available from: <http://www.hitl.washington.edu/publications/r-98-13/r-98-13.pdf> (05/05/2004).
- THIBAUT, M. & WALBERT, D. (2003). Reading Images: an Introduction to Visual Literacy. (Online). Available from: <http://www.learnnc.org/lp/pages/vlintro0602> (20/06/2007).
- THOMPSON, S. (2004). Zoe Beloff. *Bits & Bytes Column: Dialogue Magazine*. (Online). Available from: <http://www.wigged.net/html/news/janfeb04.htm> (26/06/2007).
- TOMASULA, S. (1997). An Image and Narrative Roundup. (Online). Available from: <http://www.altx.com/ebr/reviews/rev7/r7tom.htm> (24/01/2005).
- TRACTINSKY, N. (2005). Does Aesthetics matter in Human Computer Interaction? (Online). Available from: [http://mc.informatik.uni-hamburg.de/konferenzbaende/mc2005/konferenzband/muc2005\\_02\\_tractinsky.pdf](http://mc.informatik.uni-hamburg.de/konferenzbaende/mc2005/konferenzband/muc2005_02_tractinsky.pdf) (30/10/2006).
- TRACTINSKY, N. (1997). Aesthetics and Apparent Usability: Empirically Assessing Cultural and Methodological Issues. In: *CHI 97 – Looking to the Future, 22-27<sup>th</sup> March, Atlanta, Georgia*. (Online). Available from: <http://acm.org/sigchi/chi97/proceedings/paper/nt.htm> (30/10/2006)
- TRACTINSKY, N. (2004). Towards the Study of Aesthetics in Information Technology. In: *25th Annual International Conference on Information Systems, 12-15th December, Washington*. Pp.771-780. (Online). Available from: [http://www.ise.bgu.ac.il/faculty/noam/papers/04\\_nt\\_icis.pdf](http://www.ise.bgu.ac.il/faculty/noam/papers/04_nt_icis.pdf) (30/10/2006)
- TURNER, J. (Ed.) (1996). *The Dictionary of Art*. London: Macmillan Publishers Ltd.
- VAN DER BERG, D. J. (2001). Spectators in Jerusalem: urban narrative in the scenic tradition. *Image & Narrative: Online Magazine of the Visual Narrative* (3) (Online). Available from: <http://www.imageandnarrative.be/illustrations/dirkvanderberg.htm> (27/04/2004).
- VERNON, M.D. (1962). *The Psychology of Perception*. New York: Penguin Books.
- VIHMA, S. (1995). *Products as Representations – a Semiotic and Aesthetic Study of Design Products*. Helsinki: University of Art and Design Helsinki.
- VIHMA, S. (2003). Design Semantics and Aesthetics. (Online). Available from: <http://home.snafu.de/jonasw/PARADOXVihmaE.html> (14/05/2007).
- VINCE, J. (1998). *Essential Virtual Reality*. London: Springer.

- WAGSTAFF, S. (2005) Beyond the threshold. (Online) Available from: <http://www.tate.org.uk/tateetc/issue4/inthestudio4.htm> (15/09/2007).
- WAGNER, I. & KOMPAST, M. & LAINER, R. (2002). Visualization strategies for the design of interactive navigable 3-D worlds. *Interactions*. 9 (5), pp.25-34. (Online). Available from: <http://doi.acm.org/10.1145/566981.566994> (14/11/2007)
- WALSH, D. (1974). Aesthetic Objects and works of art. *Journal of Aesthetic and Art Criticism*. 33. (1). Pp.7-12. (Online). Available from: <http://links.jstor.org/sici?sici=0021-8529%28197423%2933%3A1%3C7%3AAOAWOA%3E2.O.CO%3B2-U> (16/10/2006).
- WASHINGTON-NATIONAL-GALLERY-OF-ART (2003). Byzantine Art and Painting in Italy during the 1200s and 1300s. (Online). Available from: <http://www.nga.gov/collection/pdf/gg01en.pdf> (16/04/2007).
- WASHINGTON-NATIONAL-GALLERY-OF-ART (2007). Duccio di Buoninsegna. (Online). Available from: <http://www.nga.gov/collection/gallery/gg1/gg1-14.0.html> (16/04/2007).
- WATERWORTH, E. L. & WATERWORTH, J. A. (2001). Focus, Locus, and Sensus: The Three Dimensions of Virtual Experience. *Journal of CyberPsychology & Behavior*. 4(2) pp. 203-213. (Online). Available from: <http://www.liebertonline.com/doi/abs/10.1089/109493101300117893> (20/07/2007).
- WEDDINGTON, H. (2004). Education as aesthetic experience: Interactions of Reciprocal Transformation. *Journal of Transformative Education*. (2) pp.120-137 (Online). Available from: <http://jtd.sagepub.com/cgi/reprint/2/2/120> (19/09/2006).
- WENZEL, C (2006). Advanced real-time rendering in 3D graphics and games: Real-time atmospheric effects in games. In: *International Conference on Computer Graphics and Interactive Techniques, 30<sup>th</sup> July - 3<sup>rd</sup> August, Boston, Massachusetts*. New York: ACM Press. Pp.113 - 128 (Online). Available from: <http://delivery.acm.org/10.1145/1190000/1185831/p113-wenzel.pdf?key1=1185831&key2=9456540811&coll=ACM&dl=ACM&CFID=12434038&CFTOKEN=73705961> (29/05/2007)
- WEST-VIRGINIA-WESLEYAN-COLLEGE. (No date given). Masaccio: The Master of Illusion. (Online). Available from: <http://www.wvwc.edu/wvwc/Humanities/Masaccio.html> (16/04/2007).
- WILHELMSSON, U. (2006). Computer games as playground and stage In: *ACM International Conference Proceedings of the 2006 international conference on Game research and development, 15 - 16th November, Perth*. Australia: Murdoch University. Pp.62 - 68 (Online). Available from: <http://delivery.acm.org/10.1145/1240000/1234353/p62-wilhelmsson.pdf?key1=1234353&key2=7438540811&coll=ACM&dl=ACM&CFID=12434038&CFTOKEN=73705961> (13/07/2007).
- WILMER, E. (2006). History and Appreciation II. (Online). Available from: [http://webed.vw.cc.va.us/vwbaile/pages\\_art102/102distance/Lectures/102deren.html#Duccio](http://webed.vw.cc.va.us/vwbaile/pages_art102/102distance/Lectures/102deren.html#Duccio) (16/04/2007).
- WILSON, K. (2004). Narrative notes, Media know all. (Online). Available from: <http://www.mediaknowall.com/alevkeyconcepts/narrative.html> (05/06/2004).
- WINOGRAD, T. (1997). From Computing Machinery to Interaction Design. In: DENNING, P. & METCALFE, R. (Eds.) *Beyond Calculation: The Next Fifty Years of Computing*. New York: Copernicus Springer-Verlag. Pp.149-162. (Online). Available from: <http://hci.stanford.edu/~winograd/acm97.html>
- WRIGHT, P. & BLYTHE, M. & MCCARTHY, J. (2006). The idea of design in HCI. (Online). Available from: [http://www-users.cs.york.ac.uk/~pcw/papers/DSVIS%20paper18\\_08.pdf](http://www-users.cs.york.ac.uk/~pcw/papers/DSVIS%20paper18_08.pdf) (02/11/2006).

- YAMAZAKI, K. & FURUTA, K. (2007). Design Tools for User Experience Design. *In: Human-Computer Interaction (Interaction design and usability), 22<sup>nd</sup> -27<sup>th</sup> July, Beijing, China. pp.298-307.* Heidelberg: Springer
- YOUNG, R.M. (2004). Liquid Narrative Group- Interactive Models of Narrative. (Online). Available from: <http://liquidnarrative.csc.ncsu.edu/papers.html> (3/05/2004).
- ZETTL, H. (1999). *Sight, Sound, Motion: Applied Media Aesthetics.* USA Wadsworth Publishing Company.
- ZAMMITTO, V. (2005). The Expressions of Colours. Changing Views: Worlds in Play. *In: DIGRA. Vancouver University.* (Online). Available from: [http://www.digra.org/dl/display\\_html?chid=06278.05074.pdf](http://www.digra.org/dl/display_html?chid=06278.05074.pdf) (11/14/2007)
- ZIMMERMAN (2003) Position Paper on Design in HCI Education. (Online). Available from: [http://www.cs.cmu.edu/~johnz/pubs/2003\\_Interact\\_pp.pdf](http://www.cs.cmu.edu/~johnz/pubs/2003_Interact_pp.pdf) (26/10/2006).
- ZHOU, H. & FU, X. (2007). Understanding, Measuring, and Designing User Experience: The Causal Relationship between the Aesthetic Quality of Products and User Affect. *In: Human-Computer Interaction (Interaction design and usability), 22nd -27th July, Beijing, China. pp.340-349.* Heidelberg: Springer

## Appendix A

Study A: Part 3		Quotations from the Visual-narrative Environment
5	Female lives here	<ul style="list-style-type: none"> <li>• <i>'Definitely a woman with shoes, I would say its definitely a woman because of the shoes'</i> Participant (1)</li> <li>• <i>'she has moved on with a different team... female'</i> Participant (5)</li> <li>• <i>'Its female I would say due to the bags'</i> Participant (9)</li> <li>• <i>'It's a woman's flat, a young woman'</i> Participant (19)</li> <li>• <i>'There is a woman who likes cats'</i> Participant (20)</li> </ul>
1	Single person lives here	<ul style="list-style-type: none"> <li>• <i>'I think from this one you get a more single vibe for some reason, ya a single person living here just I think in the last one there was more noticeable personal things lying around but this one nothing couply seems to stand out as much I don't know why...hard to say who male or female...'</i> Participant (2)</li> </ul>
5	Female lives here with male (other) influence	<ul style="list-style-type: none"> <li>• <i>'a girl lives in the room or in the flat, I will go with either a mature student or someone temping... probably staying in the same flat as her boyfriend'</i> Participant (6)</li> <li>• <i>'I can tell definitely partner is important, maybe she goes travelling with him or he maybe lives abroad.'</i> Participant (7)</li> <li>• <i>'guessing it's a girl as well because there's girls shoes and a girls top on the radiator... am could be a guy or girl going by things lying around.'</i> Participant (8)</li> <li>• <i>'definitely a girl is living here or is around, lots of girly stuff... there is a picture of a guy and a girl, maybe two people are living here'</i> Participant (12)</li> <li>• <i>'there's definitely a woman here because of the shoes, flowers and the plants...the golf and the hat is more a mans thing, if I was to say one or the other I would say female'</i> Participant (21)</li> </ul>
2	Couple lives here with female influence	<ul style="list-style-type: none"> <li>• <i>'Certainly a couple quite young...lots of stuff going on more things more on feminine side'</i> Participant (18)</li> <li>• <i>'guessing it's a man and a woman, a man and his wife or boyfriend and girlfriend something like that because of picture, two pairs of shoes, clothes on the radiator, also flowers are generally more of a girly thing but then there are masculine things too... could be just a woman's house... no I would say two young people living here'</i> Participant (10)</li> </ul>
1	Maybe a couple	<ul style="list-style-type: none"> <li>• <i>'maybe a couple... ya there could be a couple'</i> Participant (3)</li> </ul>
5	Couple lives here	<ul style="list-style-type: none"> <li>• <i>'I think it's a couple because of the photos of a couple'</i> Participant (4)</li> <li>• <i>'still think it's a couple... the room feels quite masculine but the flowers on the window and the mantel piece give it a feminine touch'</i> Participant (11)</li> <li>• <i>'it feels like a couple who lives here... it seems a bit more masculine than last time don't know if that's because of the weights on the floor, having weights lying around is what you would associate with a guy...don't think a guy would have a bunch of flowers on the table... seems to me it's a couple who lives here'</i> Participant (13)</li> <li>• <i>'I presume the people in the photo are the people living here'</i> Participant (15)</li> <li>• <i>'I wouldn't be surprised if this room was for a couple, I see colours that suggest male and female... its gives me the suggestion that two people live here'</i> Participant (17)</li> </ul>
1	A male and female lives here	<ul style="list-style-type: none"> <li>• <i>'definitely both female and male definitely evidence of both here'</i> Participant (14)</li> </ul>
0	Two people live here	
1	A small family lives	<ul style="list-style-type: none"> <li>• <i>'I think a family or a young family from the pictures on the table'</i> Participant (16)</li> </ul>

## Appendix B

Study A: Part 3		Quotations from the Non Visual-narrative Environment
2	Female lives here	<ul style="list-style-type: none"> <li>• <i>'It's a female room because of the handbag'</i> Participant (20)</li> <li>• <i>'definitely feels more like female person because the cuddly toy and shoes'</i> Participant (18)</li> </ul>
0	A single person	
4	Female lives here with male (other) influence	<ul style="list-style-type: none"> <li>• <i>'Definitely a girl, one person, this is definitely a single room but you can tell they have other guests coming over, maybe her boyfriend in the picture.'</i> Participant (5)</li> <li>• <i>'ya definitely female, quite arty but I think they are a student, I don't think they study art maybe they have a boyfriend I think because there is a picture of them together'</i> Participant (7)</li> <li>• <i>'one thing makes me suggest a female other things make me think otherwise, shoe suggest female person also teddy bear suggest female but golf clubs suggest male...I think female and the single chair makes me think single person'</i> Participant (17)</li> <li>• <i>'a young girl/ a young woman 28/26 ... her boyfriend could be welsh... not sure he lives here though'</i> Participant (19)</li> </ul>
1	Couple lives here with female influence	<ul style="list-style-type: none"> <li>• <i>'a guy and a girl... definitely female touch with flowers and stuff'</i> Participant (12)</li> </ul>
4	Maybe a couple lives here	<ul style="list-style-type: none"> <li>• <i>'two or three people, possibly a couple because of pictures on the unit'</i> Participant (11)</li> <li>• <i>'Definitely male or young couple because of the photos'</i> Participant (16).</li> <li>• <i>'everything looks same... I don't really see much difference...I feel it is the same room... still same as before'</i> Participant (4) (maybe a couple)</li> <li>• <i>'a very tidy am a girl and maybe a boy'</i> Participant (3)</li> </ul>
6	Couple lives here	<ul style="list-style-type: none"> <li>• <i>'two people live here, we've got the themes of two going on here i.e. two sets of hand weights, two tops, ladies and man's shoes on the floor next to the sofa, there's a mirror over the sofa as well definitely a couple'</i> Participant (1)</li> <li>• <i>I think its more than one person, a couple there's lots of stuff am someone who likes reading ammmm...'</i> Participant (2)</li> <li>• <i>'its still a couple living here am she still likes her bright colours this time I think the male partner seems more flamboyant because of the colourful gold stuff'</i> Participant (6)</li> <li>• <i>'It's yourself and Rhydian'</i> Participant (9)</li> <li>• <i>I would say the living room of a youngish couple who don't have kids yet...'</i> Participant (15)</li> <li>• <i>'there's female shoes and a teddy bear, don't know if that means children but looks like a couple'</i> Participant (21)</li> </ul>
3	A male and female lives here	<ul style="list-style-type: none"> <li>• <i>'I can see two pairs of shoes one man and one woman live here'</i> Participant (13)</li> <li>• <i>'am definitely a male I would say and a female you know living here, there's a pair of ladies shoes I'm sure a guy wouldn't wear them'</i> Participant (14)</li> <li>• <i>'definitely a guy and a girl, a pair of black shoes and a pair of red high heel shoes'</i> Participant (8)</li> </ul>
1	Two people live here	<ul style="list-style-type: none"> <li>• <i>'there's a stronger welsh identity as well as Irish'</i> Participant (10)</li> </ul>
0	A small family	

## Appendix C

Before Study A: Part 3 the following participants were...	Well acquainted with the author (i.e. colleagues)	Acquainted with the author (i.e. students)	Unacquainted with the author	The Visual-narrative environment	The Non visual-narrative environment
Participant 1	Yes			Female	Couple
Participant 2	Yes			Single person (male or Female)	Couple
Participant 3		Yes		Maybe Couple	Maybe Couple
Participant 4		Yes		Couple	Maybe Couple
Participant 5		Yes		Female	Female with male (other) influence
Participant 6	Yes			Female with male (other) influence	Couple
Participant 7			Yes	Female with male (other) influence	Female with male (other) influence
Participant 8			Yes	Female with male (other) influence	Male and Female lives here
Participant 9	Yes			Female	Couple
Participant 10		Yes		Couple with Female influence	Two people live here
Participant 11			Yes	Couple lives here	Maybe a Couple lives here
Participant 12			Yes	Female with male (other) influence	Couple with Female influence
Participant 13	Yes			Couple	Male and Female lives here
Participant 14	Yes			Male and Female lives here	Male and Female lives here
Participant 15	Yes			Couple	Couple
Participant 16		Yes		Small family	Maybe a Couple
Participant 17	Yes			Couple	Female with male (other) influence
Participant 18	Yes			Couple with Female influence	Female
Participant 19			Yes	Female	Female with male (other) influence
Participant 20			Yes	Female	Female
Participant 21		Yes		Female with male (other) influence	Couple

## Appendix D

Study B	Quotations from the Visual-narrative Environment	
10	Female lives here	<ul style="list-style-type: none"> <li>• <i>'Definitely a woman, its real easy just like the flowers and the painting on the wall which are not things men have, it's really, there is a bag, definitely a woman here...'</i> Participant (1)</li> <li>• <i>'a female definitely...'</i> Participant (5)</li> <li>• <i>'I would say definitely that maybe a girl lives here'</i> Participant (6)</li> <li>• <i>'Female I would say, just because of the bag, the bag is a female bag definitely the clothes...'</i> Participant (7)</li> <li>• <i>'Maybe its female there is a bunch of flowers on the flower... ya, I would probably say a girl...'</i> Participant (9)</li> <li>• <i>'I would probably say the same young female'</i> Participant (10)</li> <li>• <i>'em maybe a girls room because it looks clean if a boy maybe it would be dirty'</i> Participant (11)</li> <li>• <i>'still the clothes hanging on the rack in front of the radiator seems to be a girls ... like a girls room'</i> Participant (12)</li> <li>• <i>'I think it's a girls room am I think I can see female clothing lying around but then when I think the colours I immediately felt female'</i> Participant (13)</li> <li>• <i>'I would say a girl... seems a girl to me am sure it's a girls room'</i> Participant (14)</li> </ul>
0	Single	
1	Female lives here with male (other) influence	<ul style="list-style-type: none"> <li>• <i>'a girl, not definitely sure, because I see a bag'</i> Participant (3)</li> </ul>
0	Couple lives here with female influence	
2	Maybe a couple lives here	<ul style="list-style-type: none"> <li>• <i>'I suppose just a couple probably'</i> Participant (2)</li> <li>• <i>'its male and female, probably a couple'</i> Participant (4)</li> </ul>
1	Couple	<ul style="list-style-type: none"> <li>• <i>'A couple because there is a picture'</i> Participant (15)</li> </ul>
2	Male & female lives here	<ul style="list-style-type: none"> <li>• <i>'I believe it's a man or woman...'</i> Participant (17)</li> <li>• <i>'am ya male and female ...'</i> Participant (18)</li> </ul>
2	A male lives here	<ul style="list-style-type: none"> <li>• <i>'Its difficult to say am male...'</i> Participant (19)</li> <li>• <i>'I think its just a single person I think its possibly male'</i> Participant (20)</li> </ul>
1	A small family lives	<ul style="list-style-type: none"> <li>• <i>'it seems that its more a family, in fact apparently there are family pictures a maybe a child, there are toys around'</i> Participant (8)</li> </ul>
1	Not sure	<ul style="list-style-type: none"> <li>• <i>'I don't know for the person but I think this room just one or two people'</i> Participant (16)</li> </ul>

## Appendix E

Study B		Quotations from the Non Visual-narrative Environment
4	Female lives here	<ul style="list-style-type: none"> <li>• <i>'maybe a woman there's a hand bag maybe a student'</i> Participant (8)</li> <li>• <i>'I think it's the same female student'</i> Participant (9)</li> <li>• <i>'I would say it was sort of feminine so a female student'</i> Participant (10)</li> <li>• <i>'probably a girl because of the bag, the flowers the chair that sort of thing maybe'</i> Participant (12)</li> </ul>
0	Single	
3	Female lives here with male (other) influence	<ul style="list-style-type: none"> <li>• <i>'I would say a single female with a boyfriend possibly a partner that would stay quite often'</i> Participant (5)</li> <li>• <i>'Still a girl just because of the bag and shoes... I'm not sure we don't know if it's a girl or not maybe it's a guest'</i> Participant (3)</li> <li>• <i>'I'm not sure there is still a girl but more likely a boy'</i> Participant (11)</li> </ul>
0	Couple lives here with female influence	
1	Maybe a couple lives here	<ul style="list-style-type: none"> <li>• <i>'it's probably a couple, probably not a very old couple'</i> Participant (2)</li> </ul>
6	Couple	<ul style="list-style-type: none"> <li>• <i>'It's obviously a couple: Welsh and Irish'</i> Participant (4)</li> <li>• <i>'It seems a bit more couply than just one person'</i> Participant (6)</li> <li>• <i>'I still think it's a couple because there seems to be a mixture of male and female things around so I reckon a couple'</i> Participant (13)</li> <li>• <i>'a couple because I saw the picture here'</i> Participant (15)</li> <li>• <i>'there is still the couple'</i> Participant (17)</li> <li>• <i>'it looks like a young couple'</i> Participant (20)</li> </ul>
4	A male and female lives here /two males or females	<ul style="list-style-type: none"> <li>• <i>'well still a girl ya but could be ... there's definitely a man living here'</i> Participant (1)</li> <li>• <i>'I think there are two males'</i> Participant (14)</li> <li>• <i>'I would say both male and female am simply because of the golf clubs but there is a pair of high heeled shoes on the floor'</i> Participant (18)</li> <li>• <i>'maybe its two guys and a girlfriend or whatever'</i> Participant (19)</li> </ul>
1	A male lives here	<ul style="list-style-type: none"> <li>• <i>'Could be a guy or a girl but I guess lets say a guy this time'</i> Participant (7)</li> </ul>
0	A small family lives	
1	Not sure	<ul style="list-style-type: none"> <li>• <i>'I don't know because there's a boys suit and a girls suit but I think just one person but he or she has a boyfriend /girlfriend'</i> Participant (16)</li> </ul>