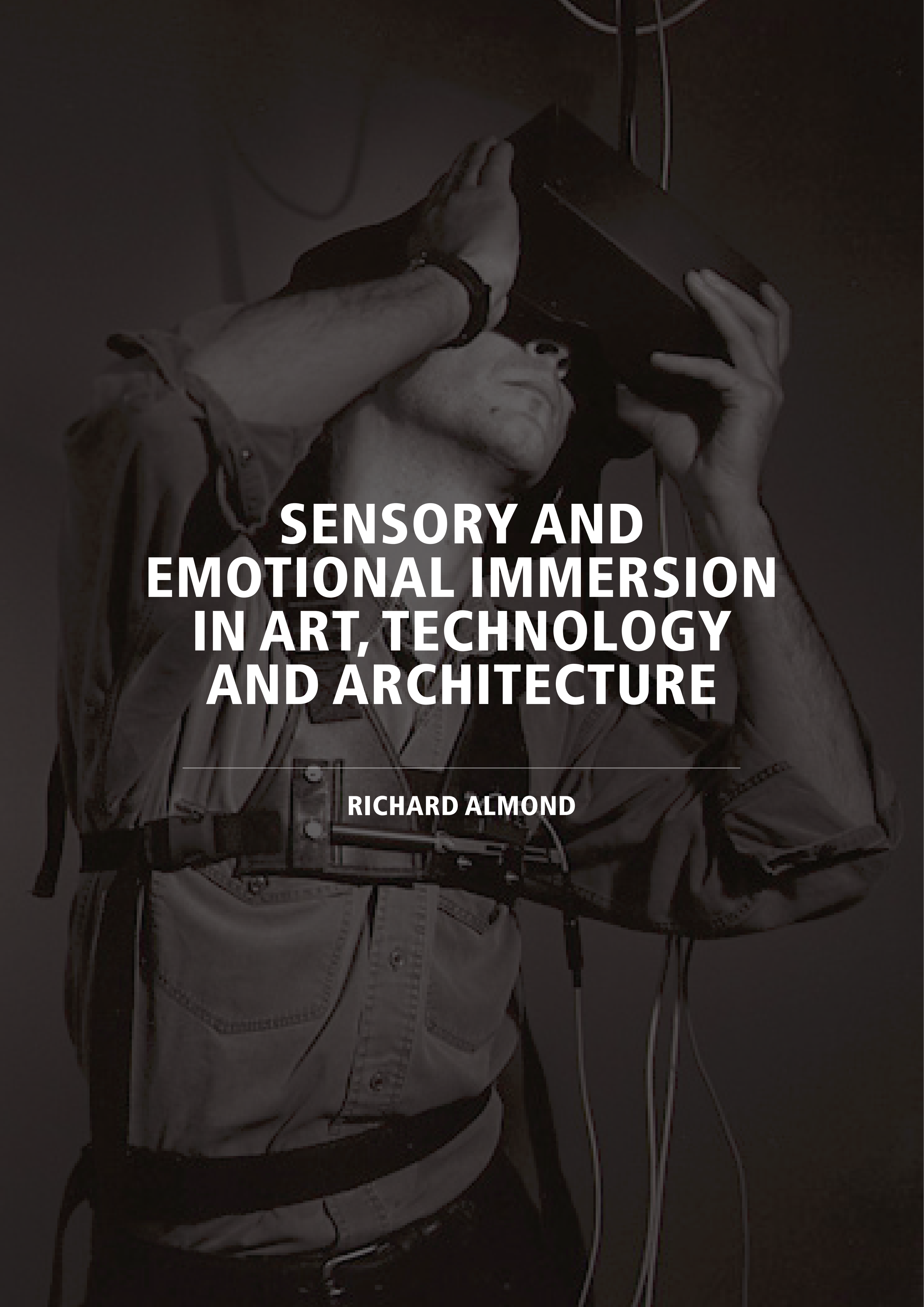

SENSORY AND EMOTIONAL IMMERSION IN ART, TECHNOLOGY AND ARCHITECTURE

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CONTENTS

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1

INTRODUCTION

This paper is concerned with the concept of the 'immersive environment', and its role in art and architecture, past, present and future. It will explore the many media in which immersion is said to take place. Beginning with some of the very earliest attempts of visual trickery from the Italian Renaissance, this research will look into how illusion has been explored through the centuries as a method of accurately replicating the much sought-after third dimension. The success of the 19th and 20th century devices thought to be the humble origins of the concept of virtual reality will be considered, before more recent examples of immersive environments are investigated, obtaining first-hand experience in order to give valid opinions of the level of their success. Comparing the various forms of immersive environment, the psychology of immersion will be examined in an attempt to understand why individuals respond differently to each. Finally, the philosophical and ethical considerations concerning total immersion into digital realms will be discussed.

There is an incredible amount of ambiguity surrounding the definitive meaning of an 'immersive environment', most likely due to the fact that the concept is somewhat subjective in that its validity and success is directly determined by the individual. What one considers an immersive environment is not necessarily what the next considers it to be. What can be defined however, are the terms 'immerse' and 'environment'. The Collins English Dictionary defines 'immerse' as *"to involve deeply"*, and 'environment' as *"the surroundings in which a person, animal, or plant lives"*. Therefore literally, the term 'immersive environment' refers to a person being involved deeply in the surroundings in which they live. From this literal interpretation, it could be assumed that there exists only one immersive environment, reality itself, however this paper does not aim to be pedantic over exact definitions. It is commonly accepted that when the term 'immersive environment' is used, it generally refers to an environment other than the physical world which we inhabit and experience on a day-to-day basis. An immersive environment can describe any environment in which the particular user feels immersed, from reading an essay to watching a film, if the individual feels involved deeply in the medium, it may be said that they are experiencing an immersive environment.

2

2

EARLY ATTEMPTS AT SENSORY IMMERSION

Sensory immersion has long been bound inextricably to the world of art and architecture. Referring to historical precedent, we may consider man's early attempts at creating a form of 'immersive environment' through the medium of paint. As painting and pictorial representation developed through the ages, people grew increasingly frustrated at their apparent inability to accurately represent the third dimension, depth, in two-dimensional form. This accurate depiction of the third dimension appeared key to achieving a level of realism that would dramatically enhance the viewing experience.

> *"But what an inadequate thing the image seems to be compared with the result! The visible scene has depth, distance and solidity, the image is flat."*
> (J.J. GIBSON)2a

2a — Gibson, J.J., The Perception of the Visual World (page 2)

AMONG ALBERTI'S CONTEMPORARIES, PIERO DELLA FRANCESCA, MASACCIO, FRANCESCO DI GIORGIO MARTINI, PAOLO UCCELLO AND DONATELLO OFFERED SOME OF THE MOST OUTSTANDING EXAMPLES OF HOW THE SCIENCE OF PERSPECTIVE BECAME ART.

(BERTOL)2c

2.1

THE DISCOVERY OF PERSPECTIVE

In the early fourteenth century, Giotto made what can be considered the first creditable attempt at representing the third-dimension in his paintings in Padua of the Arena Chapel, and the frescos at Assisi. The depiction of an architectural background helped achieve a sense of depth here, however the depiction of architectural form was still obviously flawed. Perspective was not yet understood, so discovery and application was therefore a key moment in history. Leon Battista Alberti was accredited with providing the first clear, written discussions on perspective in his 1435 treatise Della Pittura. The treatise included firsthand demonstrations and examples of his ideas, describing the laws of perspective in a methodological order, supported by the principles of geometry. Artists and scientists began to understand that it was necessary *"to treat the two-dimensional picture plane (the wall, or panel, or canvas) as if it were a window in which a three-dimensional scene appears (Gadol)"* [2b] in order to create a realistic impression of perspective. This analogy of looking into a virtual world through a window is rather compelling in that it can be applied successfully to today's forms of immersive environment in much the same way as it was being applied six hundred years ago. From the 15th century onwards, perspective became widely used in paintings, adding a great level of detail and realism that had not previously been experienced.

> *Among Alberti's contemporaries, Piero della Francesca, Masaccio, Francesco di Giorgio Martini, Paolo Uccello and Donatello offered some of the most outstanding examples of how the science of perspective became art.*
> *(BERTOL)2c*

In the general spirit of the cross-disciplinary learning of the Italian Renaissance, these developments excited both the world of science and art, but it was initially in the field of art where the new understanding was best showcased. Paintings began to portray a sense of three-dimensionality to a higher degree of success, and the discovery had as much influence on architecture as it did on art, with many intellectuals of the day practicing the disciplines simultaneously. Since the time of Vitruvius, architectural representation consisted simply of plans and elevations, but with the discovery of perspective, 3D space could be represented in 2D form for the first time. This can be considered the origin of the concept of 'simulation', with proposed space being described in the way that a human being would observe it if it were real. Brunelleschi, an architect and Alberti's contemporary gave what can be considered one of the finest examples of experimental proof of perspective in 1413, with his demonstrations (*fig 2.1a/2.1b*).

> *Brunelleschi's quest for realism and the use of gadgets to improve the sense of illusion reflects the trend of VR to integrate the various technologies of the computer-generated world to achieve the most realistic sense of 'immersion' in the artificial world.*
> *(BERTOL)2d*

The demonstration featured a representation of the Baptistery adjacent to the Cathedral of Florence, and consisted of two panels. The first featured a painting of the Baptistery as viewed from about three arms lengths inside the middle door of the church of Santa Maria del Fiore. Floor tiles and surrounding buildings were painted

fig 2.1a

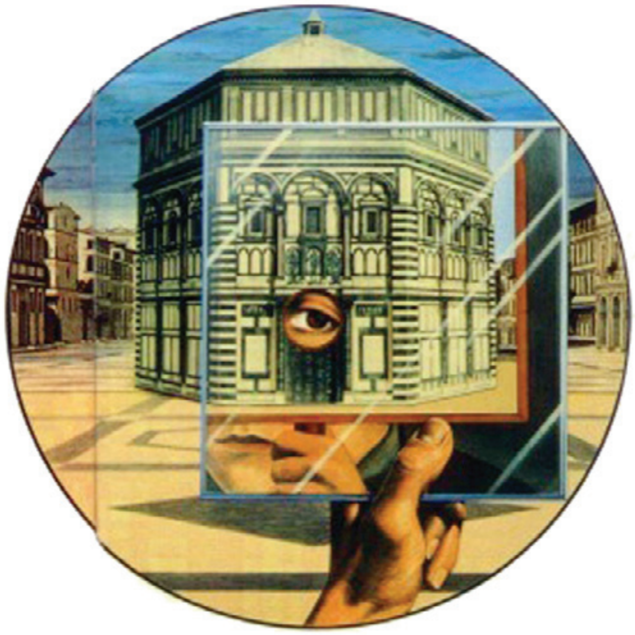


fig 2.1b

fig 2.1c

in detail, and the sky was painted with burnished silver, reflecting the real sky. A small hole was made through the panel at the vanishing point, and the viewer held this panel up to their face, painted side facing away, then looked through the hole into a mirror, the second panel. The mirror was held in the viewer's other hand and reflected the painted panel back to the their eye. The distance between the viewer's eye and the mirror was proportional to that between Brunelleschi's viewpoint and the Baptistery at the time of painting. Here we see an attempt at visual illusion from Brunelleschi. The aim was that the person felt they was looking at the Baptistery itself rather than an image of it, and from historical records, the effect was rather successful. This demonstration has remarkable similarities with the HMDs (Head Mounted Displays) of today which tend to act as the main interface between a participant and a digital virtual environment.

Towards the end of the 15th century, a trend developed which saw the use of perspective fresco painting as a means of enhancing building interiors. Many of these attempted to create the visual illusion of artificial space and again we see the concept of a window offering a view from real space into it. Raphael's example of the School of Athena (*fig 2.1c*) is one of the most prominent of these 'window' paintings. Paintings of this sort were carefully detailed to match the architecture of the building in which they were created, and at a glance were rather successful in their effect. Upon closer inspection however, it is obvious that the depicted space is not real, mainly due to the unusual scenes taking place within the painting, and the somewhat idealised depictions of figures interacting. In the case of the School of Athena, it is evident that unlike Brunelleschi's demonstration, Raphael did not intend to fool people into thinking that the painting was an actual extension of real, physical space, but an imaginary extension, a window into another world which although familiar in many ways, could not be physically encountered.

2b — Bertol, Daniela, quoting Gadol, Designing Digital Space (page 8)

2c — Bertol, Daniela, Designing Digital Space (page 12)

2d — Bertol, Daniela, Designing Digital Space (page 14)

fig 2.1a/2.1b — Images from The Arrow In The Eye website

fig 2.1c — Image from the Vatican Art Museum Online

fig 2.2a

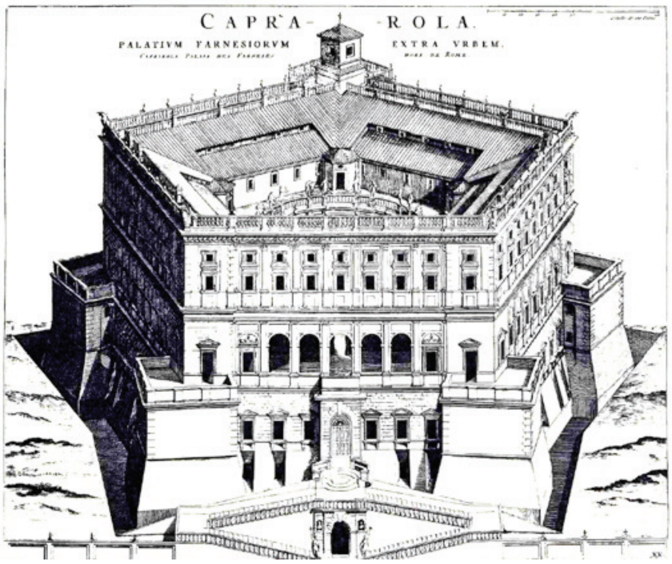


fig 2.2b

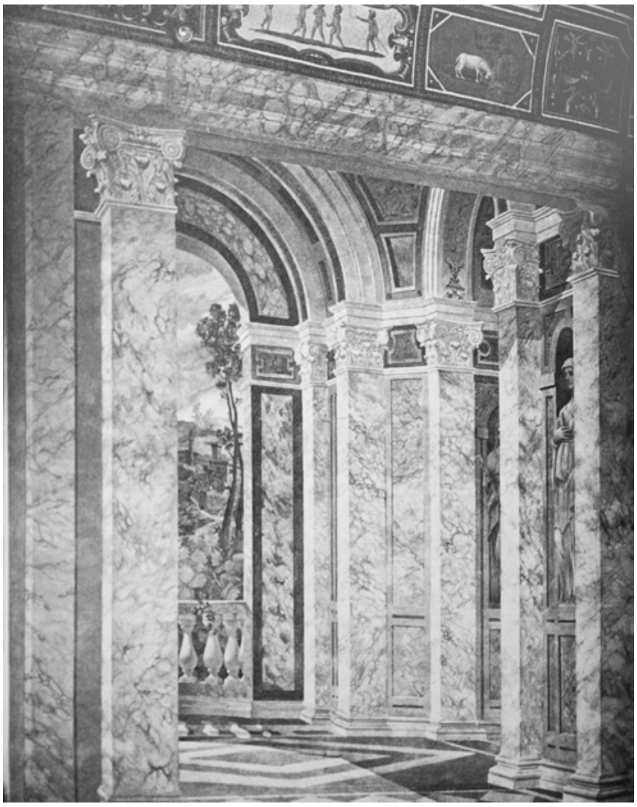


fig 2.2c

fig 2.2d

2.2
TROMP L'OEIL

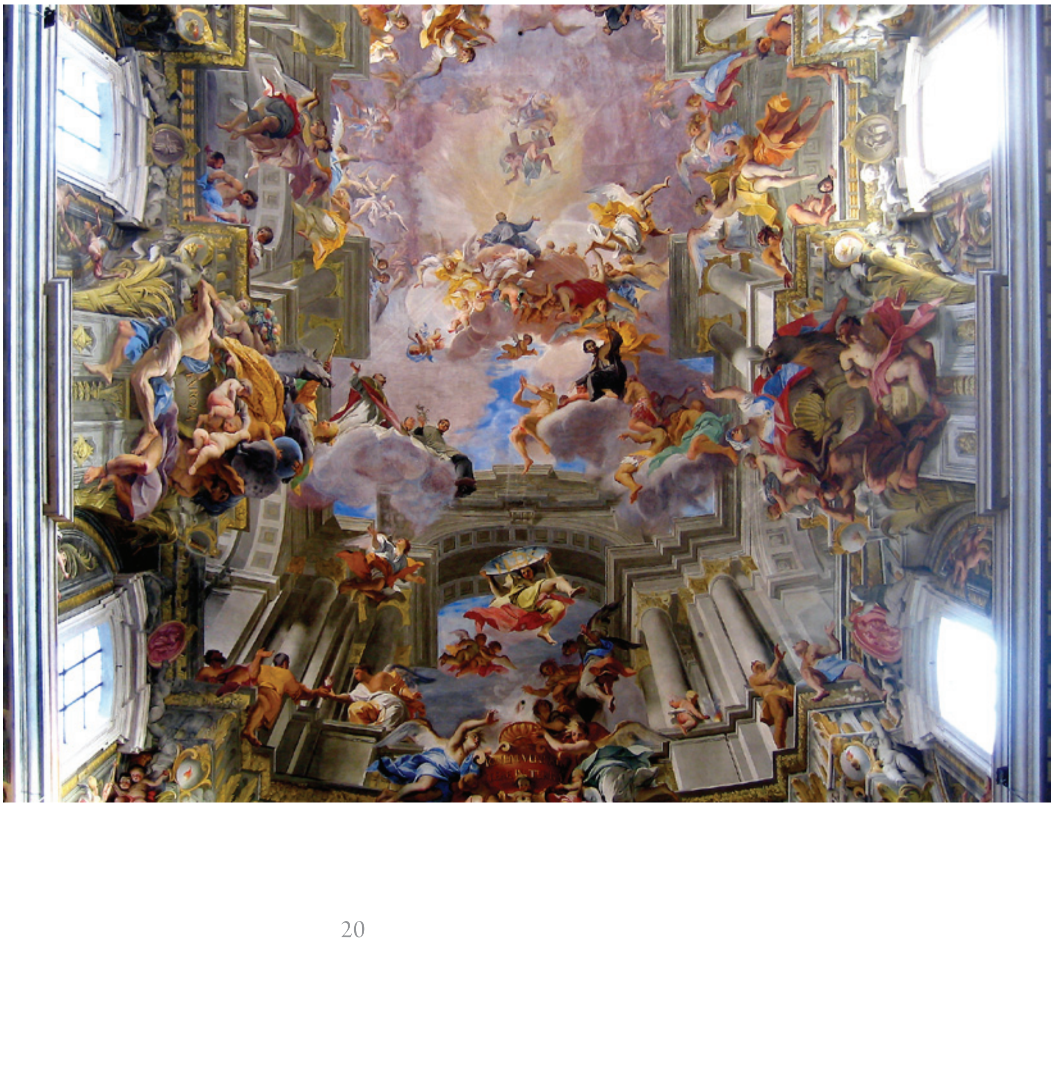
Increasing understanding of the rules of perspective triggered further exploration into visual illusion, where artists, architects and scientists attempted to exploit this new knowledge to create surprise, entertainment and delight. 'Tromp l'oeil', a French phrase translating to 'trick of the eye' was the next step. Walls and ceilings of buildings were painted with depictions of landscapes, skyscapes, gardens and other architectural spaces, but now the intention was very much to fool the viewer into perceiving, if only briefly, the space to be real. Tromp l'oeil fresco depictions were unique in that they portrayed an imaginary space which extended the actual space from the point of view of the observer. Vanishing points were located, unusually, outside of the painting, and the viewpoint was often set up in a way that when entering the room the fresco provided a view from the angle at which the monocular perception would be the same as the 3D perception of the imaginary space. Bramante's San Satiro Choir in Milan (*fig 2.2a*) is a key example of tromp l'oeil being utilised for purely aesthetic reasons. There was no space for a chancel, so a painting paired with a bass relief provided what was considered the next best alternative. During these early days however, the technique had not yet been mastered, resulting in a rather exaggerated and unrealistic effect, even when viewed from the intended observation point.

The Palazzo Farnese in Caprarola, Italy (*fig 2.2b*), by Antonio da Sangallo and Jacopo Barozzi Vignola provides a series of somewhat more successful examples. Built in the late 16th century, the palazzo features a unique pentagonal floor plan, lending itself well to the illusionary effects of tromp l'oeil. Mural paintings found throughout the palazzo are perfectly integrated into its architectural style, creating effects such as the extension of a room and the illusion of curvature. Vignola's Sala di Giove within the Palazzo Farnese (*fig 2.2c*) artificially extends a room into a vaulted colonnade overlooking a garden with distant views across a landscape. Here we see the vanishing point situated outside of the fresco, which is painted from the same perspective as the viewer's eyes as they enter the room. The effect of Vignola's example is quite striking, particularly as it is unexpected. It decreases dramatically however, as the viewer moves away from the key observation point.

In the same building we see a contrasting example of visual illusion in the Camera dell'Aurora (*fig 2.2d*). In this case the depiction is painted onto a vaulted ceiling, the focal point for the observer being directly beneath its centre point. Columns around the border of the fresco are painted in perspective and appear to dramatically increase the height of the space. Here however, the representation mixes accurate, realistic depictions of architectural form with images of heavenly beings and mythological beasts. It is clear that this representation is very much symbolic, yet the depiction of such imaginary figures within a realistic architectural environment is quite striking. Artists were beginning to experiment, using a newfound ability to depict 3D space in their own way. In a sense the Camera dell'Aurora example is again a progression from tromp l'oeil, in that it is depicting a form of parallel reality, and again the painting itself acts as a window into this artificial world.

This clear contrast in intentions becomes further apparent at the Sant'Ignazio in Rome. This church possesses two examples by Andrea Pozzo, the 'dome' and the vaulted ceiling. The 1685 'dome' (*fig 2.2e*), is actually a representation painted onto a flat canvas. The reason for the commission was financial, since a real dome was unaffordable, Pozzo was asked to create the same effect with a painting at a fraction of the cost. This example *fig 2.2e*

fig 2.2f



reflects Vignola's Sala di Giove in that its intention seems to be to truly deceive the viewer into perceiving the dome to be real. Again the perspective is set so that the effect is strongest at the viewpoint from which the painting is first observed, so that there is a perception, if only briefly, that the dome actually exists. The second example from the same church, the painted ceiling in the Aurora room (*fig 2.2f*) *"simulates the opening of the church to the sky, extending the existing walls to painted perspectives of arches. Angels and other symbolic figures populate the painted sky. Once again a fusion between realistic representation and allegory is presented, marrying the real world with the imaginary"* [2e] *(Bertol)*. Francesco Galli Bibiena in 1703 introduces characters at human scale into his tromp l'oeil frescos at Villa Paveri Fontana. Although the depiction of living things was usually unsuccessful, due to their lack of movement being an obvious indication of their fictionality, in Bibiena's example, we see people leaning out from behind artificial columns, aiding the creation of a genuine sense of depth.

Tromp l'oeil soon became used in stage design to create illusionary spaces, and furthermore in residential and religious settings as an attempt to add a degree of theatrical surprise and impress a visitor. The painted stage sets we find in our theatres today directly descend from these early examples. Commonly a series of painted landscapes are used as interchangeable background screens which give the audience visual cues to help them imagine that the actors are in fact not on a stage in a theatre, but in the space the performance is depicting.

2e — Bertol, Daniela, Designing Digital Space (page 25)

fig 2.2a — Image from Flickr, user "abschied"

fig 2.2b — Image from p'Arte d'Europa

fig 2.2c/2.2d — Image from Bertol, Daniela, Designing Digital Space, © 1975 Bonechi, Edizioni 'Il Turismo'

fig 2.2e — Image from Sights Within website

fig 2.2f — Image from Patricias Palette website

fig 2.3a

2.3
FALSE PERSPECTIVE

Moving away from painting, 'false perspective' is an illusion constructed from relatively flat, 3D forms, which create the same impression of the objects being of much larger scale. The technique is particularly effective in creating an illusionary sense of depth. As with tromp l'oeil, false perspective was used primarily to expand views and the sense of space in locations where physical construction was uneconomical or impractical. The effect is achieved by physically replicating the eye's perception of perspective. Perspective sees parallel lines appear to converge to a vanishing point, and this is simulated in false perspective by seemingly parallel lines actually converging, in all planes. In this way a shallow space can be mistaken for a very deep space. The effect works best in a parallelepiped 'room' with four walls perpendicular to the observer. It is essential that the view is linear and centred in the direction of the linearity.

The advantage over tromp l'oeil is that false perspective is constructed from real 3D objects, effectively one is creating a distorted version of the actual space, using the same materials, having obvious benefits to the success of the illusion. The 17th century Palazzo Spada Gallery in Rome, (*fig 2.3a*) is possibly the best-known example of false perspective. Designed by Francesco Borromini, the piece transforms a blind alley into a theatrical space, providing surprise and amusement in a composition with the spatial richness of typical Baroque architecture. By raising the floor and gradually reducing the size of the arches and columns as they recede from the viewer, a space only 8.6m deep is perceived as being 37m when viewed from the correct position. The floor plan seems rectangular, but in fact is trapezoidal, likewise the floor pattern is actually trapezoidal, although it appears to be square. The focal point is a statue at the end of the colonnade which completes the sense of perspective and helps the piece achieve its full effect. From the view point the statue appears to be larger than an adult, but when studied more closely it is actually smaller than a child.

Illusions like tromp l'oeil lack the sense of depth achieved with our binocular vision, so the illusion requires observing from a specific point, and generally with monocular vision (as with Brunelleschi's boards). Depth is the most subjective of the three dimensions and is strongly connected to the human visual perception. Philosopher Maurice Merleau-Ponty refers to depth as *"the most existential of all dimensions...not impressed upon the object itself, quite clearly belongs to the perspective and not to things"* [6]. Since the human eyes are on average 6.5cm apart, they receive two separate images of objects in the field of vision which converge to form binocular vision and supply depth information. Depth is also sensed monocularly via motion parallax and perspective. Motion parallax occurs when there is movement between the observer and their focus point, objects appearing to move more quickly the closer they are to the viewer. Farther objects, particularly when observing a landscape, appear to move more slowly. Perspective works on the perceived size of the image in the eye and how objects seem to reduce in size the further away from the viewer they are.

2f — Gibson, J.J., The Perception of the Visual World, quoting Maurice Merleau-Ponty
fig 2.3a — Image from Flickr user 'antmoose'

3

fig 3.1a

fig 3.1b

3.1

IMMERSIVE GADGETRY

Moving into more recent times, the pre-virtual reality 19th and 20th centuries saw the invention of a series of gadgets and devices which began to replicate binocular vision to create a more realistic illusion of 3D space. The Stereoscope, designed in 1833 by Charles Wheatstone (*fig 3.1a*) reproduces the effect of binocular vision by supplying two separate images, taken 6.5cm apart, which are converged using mirrors or lenses into one. The images are enlarged to fill the field of view, creating an accurate representation of real, 3D space from a pair of 2D images. Since the camera had not yet been invented, the images were perspective renderings. This device was the basis for the popular Viewmaster, and these innovations alongside the development of photography allowed people in the Victorian era to experience a new level of realism in image representation.

> *It can be considered the precursor of VR head-mounted display: A single apparatus containing the images as well as the devices to achieve the illusionary perception*
> (BERTOL)[3a]

The Sensorama (*fig 3.1b*), developed in the 1950s by Morton Heilig, was an attempt to consider the future of cinema and TV, with respect to increasing the level of realism and sensory stimulation. Heilig introduced touch and smell replication into the experience, alongside the conventional sight and sound. He carried out research on human perception, studying the differences in the perception of representation and the perception of reality, using his results to plan a complete sensory experience, a totally immersive environment. The prototype was developed in the '60s, offering a single observer a demonstration, although it was intended that eventually a group would experience the device simultaneously. The prototype simulated travelling through New York on a motorcycle. As well as the obvious stimuli of vision and audio from a recording of the ride taken from the position of the viewer's eyes and ears, the seat vibrated as the motorcycle seat would, and air movement and odour were also simulated. Unfortunately for Heilig, his vision did not sit well with the filmmakers on financial grounds. Although this device provided a new level of realism to the simulation experience, it still differed hugely from modern VR environments in that there was no interaction involved in the experience. It was purely passive, offering the user no input.

3a — Bertol, Daniela, Designing Digital Space (page 37)
fig 3.1a/3.1b — Images from Wikipedia

3.2

GAMES

Humanity has long been aware of the immersive power of gaming. The Greek historian Herodotus spoke of a great famine in the ancient kingdom of Lydia around 1200BC which led to the advent of dice games. So severe was the famine that the King had the very first games created, and put into place a kingdom-wide policy of eating one day and playing the next. The idea was that the games were so absorbing that people forgot their hunger, and the Lydians were thought to have survived for 18 years in this way. Eventually the king became so desperate that he decided to split his kingdom in two, playing one final game. The winners would travel in search of new lands in which to settle, leaving behind enough food for the remaining population. The winners are thought to have been the ancestors of the Roman Empire, immersion in games had effectively saved an entire civilization.

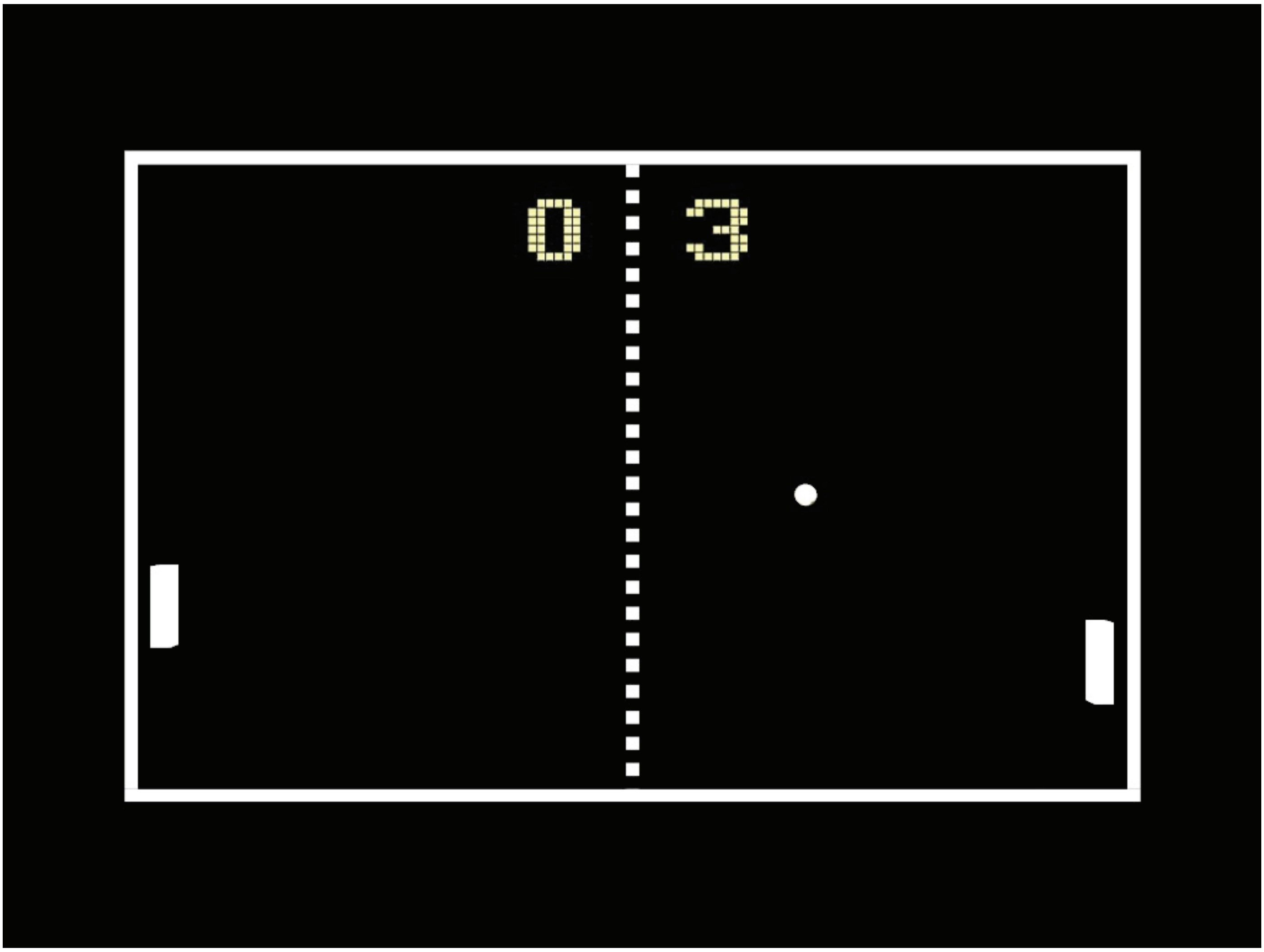


fig 3.2.1a

3.2.1

THE ORIGINS OF VIDEO GAMING

The 20th century saw the rapid digitisation of our lives, the advent of the computer bringing about intrinsic changes to how the world operated. Inquisitive students soon began to exploit this new technology for entertainment purposes, American universities becoming hotbeds for the development of digital gaming. The 1950s saw the murmurs of what would come to be known as 'video games', and by the '70s companies such as Odyssey and Atari had released, amongst others, the legendary 'Pong' *(fig 3.2.1a)*.

Initially arcade-format, the new craze for video gaming soon moved into the home as consoles became more affordable. Home video gaming was to eventually offer not simply a gimmicky illusion, but an entire parallel dimension in which players could exist. Although offering only audio-visual sensory stimulation, video games allowed genuine interaction to take place, the player was in control of their own digital destiny, and therefore a level of digital immersion deeper than ever before was available.

The technology behind Pong developed at an alarming rate into games such as Super Mario Brothers and Sonic The Hedgehog, which offered players an avatar through which to experience a virtual world. Players became emotionally attached to games as their characters and objects became increasingly life-like. By the mid 1990's consoles such as the Sony Playstation and Nintendo 64 were common in many households, and children were exploring the fantastical 3D world of Final Fantasy, driving super cars through the streets of Tokyo in Gran Turismo, and playing James Bond in Goldeneye's shoot-outs. Increasingly realistic graphics and absorbing game play led to a yet deeper state of immersion for the gamer, which in turn led to a dramatic rise in the time spent playing consoles. This insatiable thirst sparked a snowball effect in the video games industry, leading to its estimated value of $50 billion in 2010.

fig 3.2.1a — Image from moddb.com
fig 3.2.1b — Image from Photobucket user malibujew2

fig 3.2.2a

3.2.2

SIXTH & SEVENTH GENERATION CONSOLES

Over the last decade the pace of the video games industry has shown no sign of slowing down. The release of the Xbox and PlayStation 2, and most recently the Xbox 360 and PlayStation 3 have offered graphics so powerful that it is now difficult to decipher between a game and a film. With near-perfect graphics, developers have begun to focus their efforts into game play, and in particular the method in which we interact with our games. Successful as hand held control pads are, gamers now seek a greater level of interaction with their virtual worlds. In 2006 Nintendo started a revolution in the gaming industry with their Wii console (*fig 3.2.2a*). The Wii was not concerned with hyper-realistic graphics, although its power is currently surpassed only by the Xbox 360 and PlayStation 3, more it aimed to bring *"a revolution of motion controlled gaming to people of all ages and families everywhere"* [3b]. The console featured an innovative new control pad which was motion-sensitive, wireless, and crucially, intuitive for people of all ages. People could eventually act out the physical actions depicted in their games. A swing of a golf club or tennis raquette was no longer a click of a button, it was the swing of a controller. Sales were unprecidented, with gamers of all ages clambering to try the console. The timing of release is thought to have further aided its success, with many politicians and parents becoming increasingly concerned over the wellbeing of children playing video games for hours on end in isolation. Not only does the Wii excell in multi-player gaming for all to ejnoy, it allows for physical excertion, something clearly missing in tradional control-pad gaming. Titles such as Wii Fit and Wii Sport are best sellers, being praised by bodies such as The International Sports Sciences Association (ISSA) for allowing gamers to achieve their virtual fix whilst participating in healthy levels of excersise.

3b — from the Nintendo Wii official website

fig 3.2.2a — Image from media.canada.com

fig 3.2.3a

3.2.3

2010 AND BEYOND

In 2010, 24 million people of all ages in the UK play video games, each year British gamers spending £3 billion on their hobby. Half of homes have at least one console, with 66% of five to fifteen year olds owning their own[3c]. Sony and Microsoft have spent the past four years scrambling to catch up with Nintendo's revolutionary Wii, both releasing bolt-ons for their consoles by late 2010. Sony released 'PlayStation Move' for their PS3, and Microsoft released Kinect for Xbox 360. Each takes inspiration from the Wii, the Move can be seen as a dramatically improved version of the Wii itself, with increased accuracy and benefiting from the PS3's incredible graphics. Like the Wii, the Move system uses a wireless handheld motion sensitive controller (a wand) yet incorporates a glowing bulb which is tracked by a series of cameras to an accuracy of 1mm in 3D space. The system has received huge acclaim in the first few months since release, winning the 2010 Popular Science award for 'Most immersive game controller'.

The Kinetic (*3.2.3a*) system, however, goes one step further by placing the gamer, literally, inside the game. A full body 3D motion-sensing camera records up to 6 gamers, their bodies appearing in real time on the screen. Gamers are not bound by any controller, their bodies are the controllers in Kinect, which is capable of recording all four limbs as well as recognising voice, and even emotions based on players' facial expressions. The player observes themself existing within a virtual environment which responds to their body. This marks a compelling stage in the development of video games, which were historically played through an avatar operated by the gamer's fingers via a control pad. Playing Kinect, one becomes the player, the avatar and the observer simultaneously. This level of interaction, as Steve Woyach states in his article 'Immersion Through Video Games' means *"a person's acceptance of a virtual object as real becomes an easier, if not automatic, response". Players are genuinely experiencing an alternative, virtual, reality."* [3d]

3c — figures from BBC Panorama documentary 'Addicted to Games?'

3d — Woyach, Steve, Immersion Through Video Games, Illumin website

fig 3.2.3a — Image from kineticsgames.com

A SERIOUS THREAT TO THE MENTAL HEALTH OF YOUNG EUROPEANS

(The World Health Organisation)3h

3.2.4

MMORPGS & ONLINE GAMING

One video game category must be given special mention in relation to immersion – the 'MMORPG', or Massively Multiplayer Online Role Playing Games. Such is the level of absorption displayed by some individuals when playing games such as World of Warcraft *(fig 3.2.4a)*, the game is commonly referred to as 'addictive', many fearing that it can inflict deep psychological effects upon players. World of Warcraft (WoW) is described by its creators, Blizzard entertainment as *"an online game where players from around the world assume the roles of heroic fantasy characters and explore a virtual world full of mystery, magic, and endless adventure"* [3e]. First released in 1994, and now in its 6th iteration, WoW is thought to be the world's most played online game, with 12 million subscribers globally. The game has been heavily criticised due to many children playing for such long periods that they damage their health, relationships, and their education. As reported in BBC Panorama's 'Addicted to Games?' report of December 2010, one individual admits spending up to three days solid without sleep whilst gaming, subsequently being thrown out of university due to lack of attendance. Another recalls playing for 20-hour stretches and suffering from withdrawal symptoms similar to those of a drug-user when his internet connection went down.

Chris Dando considers himself a former WoW addict, and speaks of how he would refuse to attend school after all-night gaming sessions. Dando is one of many players who consider the game to be a replacement of reality *"It brought you into another world...you be what you wanted to be"* [3f]. Leo, another gamer interviewed in the Panorama report claims *"You substitute the real world for this one"*, and that he *"would never inflict this game on anyone, this game is just a disease"* [3g]. Despite world-wide concern over the intense level of immersion games such as WoW command, The Association for UK Interactive Entertainment deny that any sound medical evidence yet exists which prove such games to be 'addictive', claiming that video games in fact boost intelligence, reduce stress and are valuable learning tools. The World Heath Organisation, however, deems some MMORPGs to be *"A serious threat to the mental health of young Europeans"* [3h], a view shared by leading child psychiatrist Dr Richard Graham, who is treating cases of video game 'addiction' increasingly frequently, and Professor Mark Griffiths of Nottingham Trent University, who claims his research *"has consistently shown people seem to display the signs and symptoms you get with the more traditional addictions"* [3i].

With the UK government's plans to *"make sure the UK has the best broadband network in Europe by 2015"* [3j], precedent is being taken from South Korea, the country with the world's most advanced broadband network, where 85% of the population possess a high-speed connection, and 50% play online games [3k]. UK gaming culture is still predominantly console-based yet is currently swinging towards online play, similar to South Korea which has seen a surge in online gaming since installing their high-speed network, with video gaming now a national sport with professional leagues. The South Korean government, however, are now concerned about the effects this gaming is having on their population, with an estimated 2% of 11-16 year olds, and 3 million South Koreans in total thought to be *"seriously addicted to gaming"* [3l]. Such is the problem that twelve deaths have been directly attributed to video gaming since 2005, with causes such as blood clots from sitting still for prolonged periods being most common. Further more, video gaming recently contributed indirectly toward the tragic death of a baby from starvation, after her parents spent up to 18 hours per day playing 'Prius Online'. The aim of this game, disturbingly, was to protect a virtual child from harm. The mother was said to have completely lost all sense of reality by psychologists. South


Captured with the "FreeGameCam" (c) 2001-2004 www.freegamecam.com ...Captured with the "FreeGameCam" (c) 2001-2004 www.freegamecam.com ...Captured with the "FreeGameCam" (c) 2001-2004 www.freega
7.36 / 32.12
3:57 PM
0 17 69
The Green Belt
Raizor
1153 / 1153
100%
0 / 100
21519 / 31700
24
Rethiel the Green...
30
XP :: 67.9% to Level 25 :: 10,181 exp left :: Avg Exp per Kill 115.1 + :: 89 kills to level
Spirit Decay
9 minutes
Battle Shout
7 seconds
[15:56] You loot 54 Copper
[15:56] [1. General] [Druscilla]: lol
[15:57] Experience gained: 1250.
[15:57] Quest accepted: Fire Taboo
FPS: 23.2
Rethiel the Greenwarden
Level 30
Stormwind
PvP
Captured with the "FreeGameCam" (c) 2001-2004 www.freegamecam.com ...Captured with the "FreeGameCam" (c) 2001-2004 www.freegamecam.com ...Captured with the "FreeGameCam" (c) 2001-2004 www.freega
fig 3.2.4a

Korean authorities are now making efforts to overcome addiction to video games, setting up boot camps for children to help repair their relationships with their family and the real world.

3e — from the World of Warcraft website

3f/g/h/i /k/l — from BBC Panorama documentary 'Addicted to Games?'

3j — from Number10.gov.uk website

fig 3.2.4a — Image from worldofwarcraftscreenshots.com

3.3

3D CINEMA & IMAX

The medium of film has long been considered one of our most powerful and enjoyable forms of entertainment. It is widely accepted that a larger screen generally provides a better viewing experience, leading to many of us visiting the cinema to watch the latest blockbusters. Although the conventional cinema only stimulates two of our five senses, in vision and hearing, it is commonly deemed one of the most successful immersive environments. Along with the size of the screen, the quality and level of the sound, comfort of the seats and light levels in the surrounding environment dramatically enhance the cinema experience, all contributing to the viewer's sense of immersion in the film.

Recently the 3D film format has seen its latest resurgence, allowing many to experience a new level of sensory immersion. Although seemingly cutting-edge, 3D film has existed since the end of the 19th century in its most basic form. As early as 1894, pioneer William Friese Greene filed a patent for a 3D viewing system consisting of two screens side-by-side and requiring users to wear a cumbersome stereoscopic headset. It was to be another 30 years before the general public would see a 3D film, with Robert F Elder's 'The Power of Love' being screened in Los Angeles in 1922. The following 30 years saw an intermittent series of developments in 3D cinema technology, yet with few notable productions. The first feature length 3D film, 'Bwana Devil', led the first 3D cinema boom, yet was seen by many as a desperate attempt by the cinema world to claw back customers lost to a rapidly-growing television market. 'The Golden Age', which was to last until the mid 1950s, did see a number of cinema gems, mainly horrors such as House of Wax, but ultimately the fad was to be short-lived, and 3D cinema would not see another boom until the early 1980s. By the '80s, 3D film technology had advanced considerably, prompting a new wave of remakes such as Jaws 3D and Amityville Horror 3D, but again flaws in the technique led to the trend being short-lived.

The most recent 3D wave begun in 2003 with James Cameron's Ghosts of the Abyss 2003, an immersive documentary exploring the wreck of the Titanic in 3D. In 2004 the IMAX format, which had played only a demonstrative role for years, was allowed its first feature length 3D film in The Polar Express. 2009 saw Avatar, an epic 3D Sci-fi feature film set in the 22nd century on a fictional moon becoming the highest-grossing film of all time. Released to critical acclaim, not for its storyline or acting, but for its innovative and revolutionary use of 3D techniques, Avatar has been said to have changed the course of cinema. Although released in traditional 2D and standard 3D format, Avatar made specific use of the IMAX format to create a new standard in immersive cinematography.

"A filmmaker like James Cameron on Avatar really knows how to use 3D as a storytelling device. He isn't just throwing stuff at the screen like a 1950s sci-fi flick or a 1980s horror flick. He is using 3D in a sophisticated way that creates a real depth to his images that make Avatar such an immersive experience." [3m]

IMAX takes the cinema experience once step further, using the world's largest film format, which is ten times larger than the conventional 35mm format. This increased exposure area allows far more detail to be captured by the specialist camera, and therefore the resulting image can be projected at a far greater dimensions and resolution. As a result, the dimensions of an IMAX cinema screen can be ten times those of a standard cinema, a factor crucial

fig 3.3a

in the success of the cinema as an immersive environment. This simple principle relates to all five of our senses, the more something engulfs our senses, the more we are forced to concentrate upon it, and therefore the more immersed in it we become. Since the IMAX screen fills far more of the viewer's peripheral vision than conventional cinema, it absorbs more of our eyesight and therefore becomes more immersive. IMAX 3D further benefits from the simulation of binocular vision, the specialist camera records two versions of the same scene, taken by two lenses 6.5 cm apart, then both recordings are projected simultaneously through differently polarized projectors. The user wears a pair of polarized glasses which match the projectors, meaning they observe the recording taken from the left-hand camera with their left eye, and that from the right-hand camera with their right eye. These images converge in the brain to form a 3D representation. The screen is also coated with a special silver paint which reflects twice the amount of light that a conventional cinema screen does. A slightly curved screen, and a state-of-the-art 360° sound system further add to the experience and sense of immersion.

Although 3D film technology has advanced extraordinarily since its inception, many of the difficulties experienced by viewers in the earliest shows are still prominent in 2009. Many consider that 3D cinema will continue as a reincarnating fad until the need to wear polarized glasses is removed, with audiences often experiencing tired, strained eyes and even nausea in some cases. The Eyecare Trust claims[3n] that 12% of us suffer from a visual impairment leaving our brains incapable of correctly processing the two images offered to our eyes. Those affected cannot properly perceive the 3D information, confusing the eyes into straining in order to correct their focus. Furthermore, those who wear vision correction glasses are encumbered with the prospect of attempting to wear their 3D glasses simultaneously.

3m — Freer, Ian, assistant editor of Empire Magazine, quoted in The Independent article '3D: Cinematic Revolution or Just a Trick of the Light?'

3n — The Guardian, A History of 3D Cinema

fig 3.3a — Image from cbc.ca

A COMPUTER-GENERATED WORLD INVOLVING ONE OR MORE HUMAN SENSES AND GENERATED IN REAL-TIME BY THE PARTICIPANT'S ACTIONS

(Bertol)30

3.4

VIRTUAL REALITY

Virtual reality (VR), can be considered in many respects today's equivalent of tromp l'oeil and false perspective. Although there are very distinguishable differences, VR, like the past examples, is often considered an immersive environment. Bertol describes VR as *"a computer-generated world involving one or more human senses and generated in real-time by the participant's actions"* [3o]. The term 'virtual reality' itself is often considered a contradiction, an oxymoron, but it generally refers to the sort of environment described above. There are however two further key, but lesser-known points which must be considered when defining VR. The first is that the user must be able to actively interact with the environment for it to be described as VR. In other words the user *"being the perceiver and the creator simultaneously"* [3p]. Secondly, VR is technically not a form of illusion as such. An illusion is something that is or is likely to be perceived or interpreted wrongly by the senses, whilst in a VR environment, the aim is to create a parallel, albeit artificial reality, but one in which the objects exist in their own right and are not simply representations of real objects.

Regardless of the technicalities of defining virtual reality however, modern systems lend themselves to a myriad of uses. VR environments are particularly useful where visual feedback and a 3D model is required such as mechanics, structural engineering, geometry, molecular biology, fluid dynamics, and of course architecture. The most typical VR setup consists of a stereoscopic display, a computer-generated environment, an interaction device or controller and the software to make the interaction possible. There are a multitude of methods in which the participant interacts with the virtual world, at the most basic level a user may simply navigate through it, the most common architectural use is exploring cities and buildings. Further uses are in fluid dynamics simulation, where one may manipulate wind tunnels and heat flows. At the most advanced level a user can begin to create and edit the virtual world from within, scaling, transforming and adjusting components of a building simulation, for example. Here the VR environment becomes a design tool. The various uses of VR to an architect are explored further in section 4.

From its earliest days, VR has been exploited by the entertainment industry, its novel technology offering the perfect medium for games, films and rides. The system's ability to allow the exploration of a fantasy digital world results in a powerfully immersive technology. After benefiting hugely from military investment in Flight Simulation, VR was soon being used to create cost-cutting special effects in films, yet its increasing impact on popular culture, psychological and ethical implications soon led to it becoming the focus of the scripts themselves. Films such as Tron, Lawnmower Man and Johnny Mnemonic explored the potential dark side of the digital realm being constructed in the '80s and early '90s.

3o/p — Bertol, Daniela, Designing Digital Space (page 67)

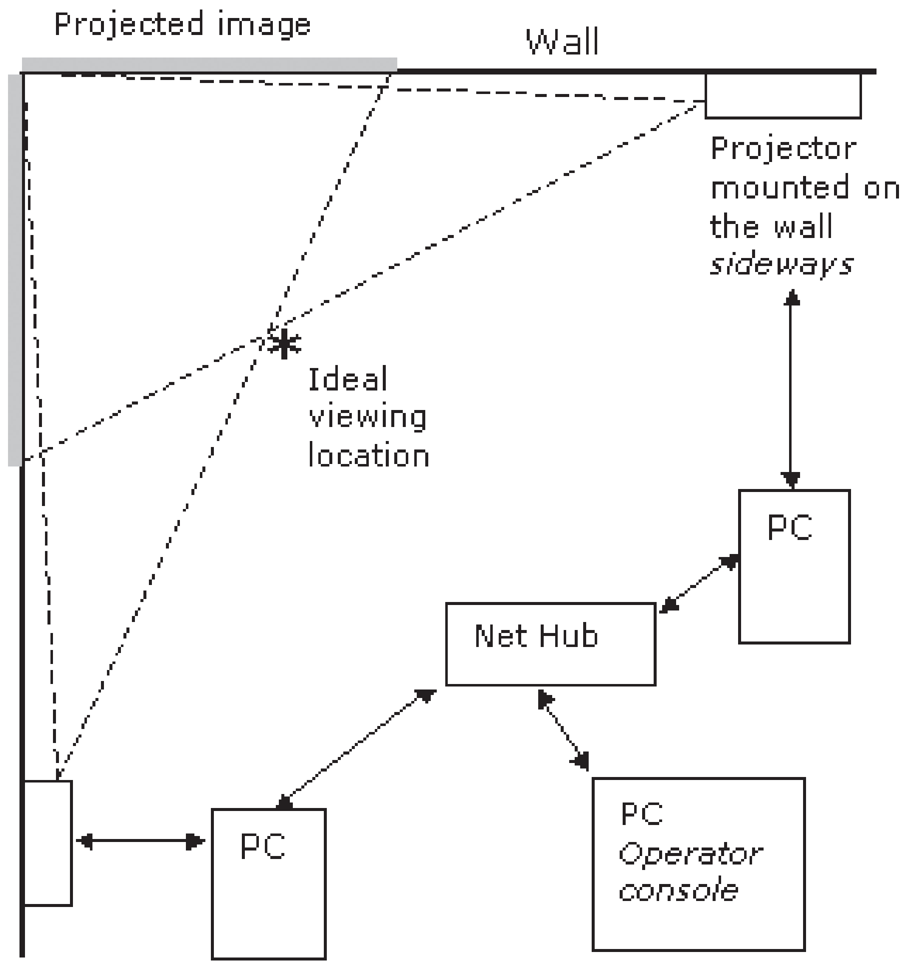

Projected image
Wall
Projector
mounted on
the wall
sideways
Ideal
viewing
location
PC
Net Hub
PC
PC
Operator
console

fig 3.4.1a

3.4.1

THE CAVE

One of the most successful and typically recognisable VR environments is the CAVE (Cave Automatic Virtual Environment). Inaugurated in 1992 at the NCSA (National Centre for Supercomputing Applications) at the University of Illinois by Tom DeFanti and Carolina Cruz-Neira, CAVE has seen numerous iterations throughout the world, but commonly a setup consists of a 10-foot x 10-foot x 10-foot room with three walls, a ceiling and a floor. A virtual environment is projected onto all five surfaces through a series of stenographic projectors, each of which project alternating polarized scenes from two different viewpoints, taken 6.5cm apart. The user wears LCD stereo shutter glasses which are also polarized, simulating 3D binocular vision inside the CAVE. The user is free to physically move around inside the room, and electromagnetic sensors in their glasses track their position, feeding it back through the computer system to the projectors, which respond by moving the virtual environment to reflect the movement of the user. The CAVE system, unlike many other HMD-based immersive environments, allows multiple users to experience the space simultaneously.

fig 3.4.1a — Image from publicvr.org

4

4

IMMERSIVE DIGITAL ENVIRONMENTS AS DESIGN AIDS AND THEIR ROLE IN ARCHITECTURE

Immersive digital environments, particularly VR systems offer enormous benefit to the architecture industry. All VR environments originate as simple 3D computer-generated models, the CAD models with which most architects are now familiar. Perspective renderings of design proposals are now near essential, but architectural practices are increasingly likely to offer screen-based walk-through animations to clients. The next step is to simply allow these walk-throughs to become interactive, offering the client the likes of a 3D headset and a control device to enable them to explore a design in an intuitive and thorough way. The interactivity and sophistication of VR systems mean they are incredibly useful in design evaluation, historical reconstruction and architect-client communication roles, but they also offer a powerful design tool.

4.1

IMMERSIVE DESIGN

Currently the least explored of its uses in architecture, VR offers the potential for a major revolution in the process of designing. The traditional methods of working with 2D drawings and sketches can now be complimented with immersive digital design environments where architects can create intuitively at 1:1 scale. The designer is inside the products he is designing, which offers him many new capabilities. From inside a virtual world, the architect orchestrates the creation of form and space like a magician, throwing up walls, piercing windows and defining the colour of the bricks. From his vantage point he may immediately assess and tweak his design decisions by passing around his proposed building or observing it from the other side of a street. The architect becomes a sculptor, chiselling away at a form, panning around it, checking for perfection from all angles before deciding it is suitable.

The unique nature of designing buildings at a 1:1 scale in 3D allows the opportunity to eliminate the false presumptions that are often made when designing in 2D. Symmetry, proportion and organisation take on very different values when simultaneously designing and inhabiting a space, an element of fluidity is incorporated into the design process. The technology required to design in a 3D immersive environment exists today, yet even in a rapidly-adapting architecture industry, the vast majority of practices have been apprehensive towards introducing what could become a monumental change in the way buildings are designed. It is becoming apparent though, that the architect must now consider the enormous benefits that the system can offer the design process.

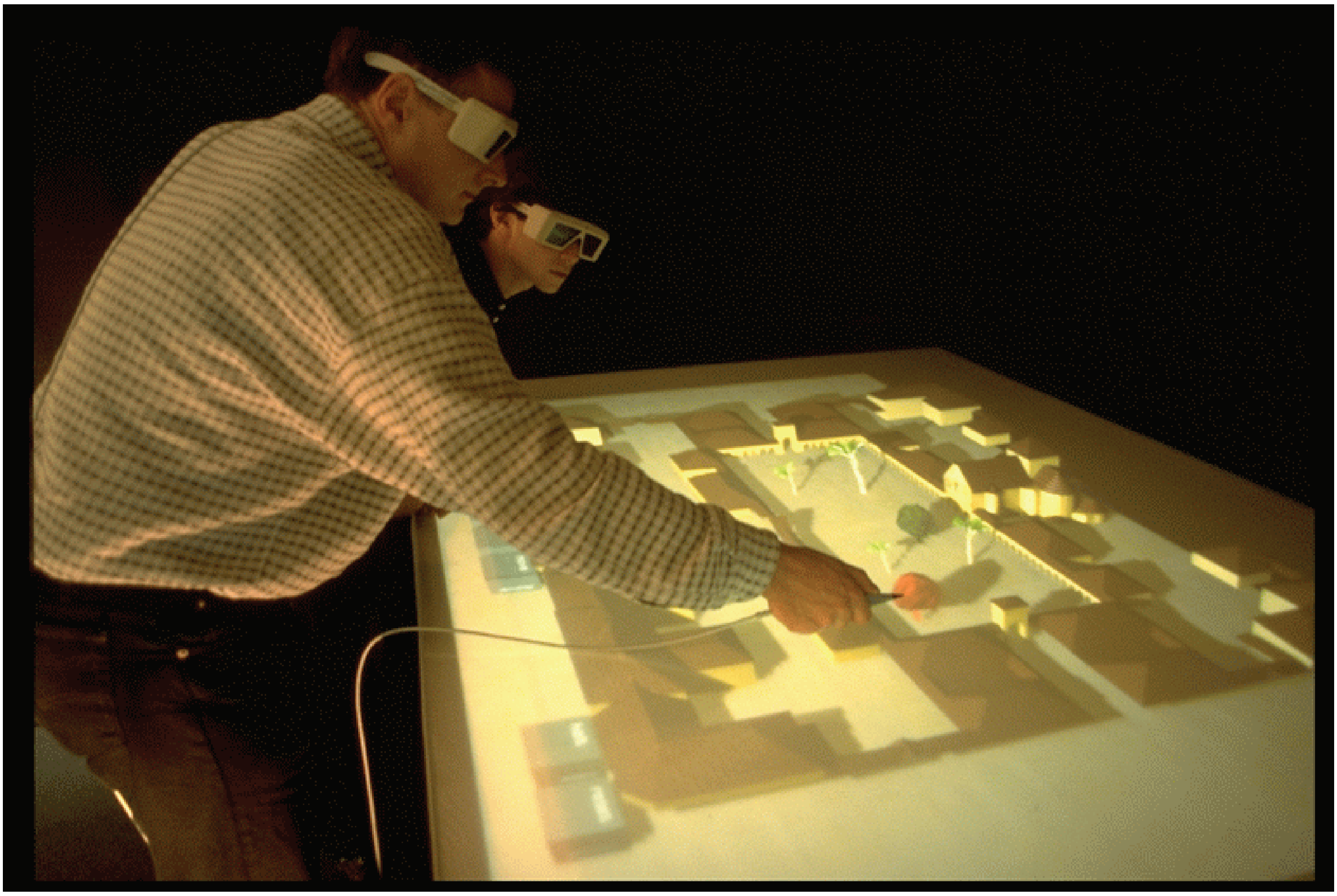


fig 4.1.1a

4.1.1

THE RESPONSIVE WORKBENCH

Developed by Wolfgang Krueger in 1994, the Responsive Workbench *(fig 4.1.1a)* was a 3D interactive workspace which marked a transitionary point between traditional desk-based working and designing within a VR environment. Developed specifically for users such as architects who require desk space, the workbench simulates a 3D digital model above its surface via a stereoscopic projection. Wearing LCD shutter glasses and holding a stylus, the architect can zoom, rotate, amend and move through a digital 3D model, demonstrating to several observers. They may manipulate scale, texture, colour and form amongst other things. This system is not considered to be fully immersive design as the operator is developing the digital model from a traditional desk-based environment, as opposed to designing from within an entirely virtual space. It does however offer the architect the chance to operate in an environment they are likely more comfortable with, and allows for cross-media integration. The workbench can augment traditional media such as sketches and 2D drawings placed upon it, digitising them and enabling the manipulation of them in the virtual model. The system therefore seems to be the perfect digital extension to the architect's traditional working methods, an all-encompassing tool allowing the seamless integration of digital and physical media.

The Responsive Workbench was unfortunately never adopted into the mainstream architecture industry. A huge shame for a profession that over the past 15 years has all but given up its traditionally tangible working methods for the monotony of the common PC, interacting with our designs via exactly the same peripherals as an accountant interacts with his figures or a lawyer interacts with his word processor. Peculiarly, the industry seems to have missed the natural evolutionary step forward in design methodology, and has instead opted for a distinctly sideways step.

fig 4.1.1a — Image from graphics.stanford.edu

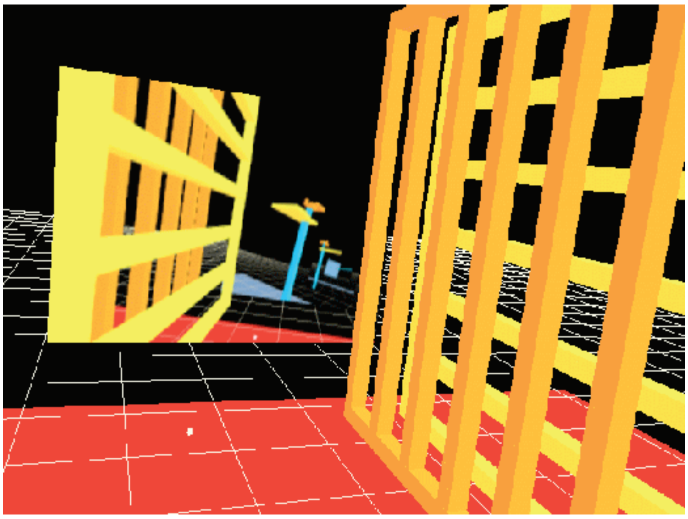


fig 4.1.2a

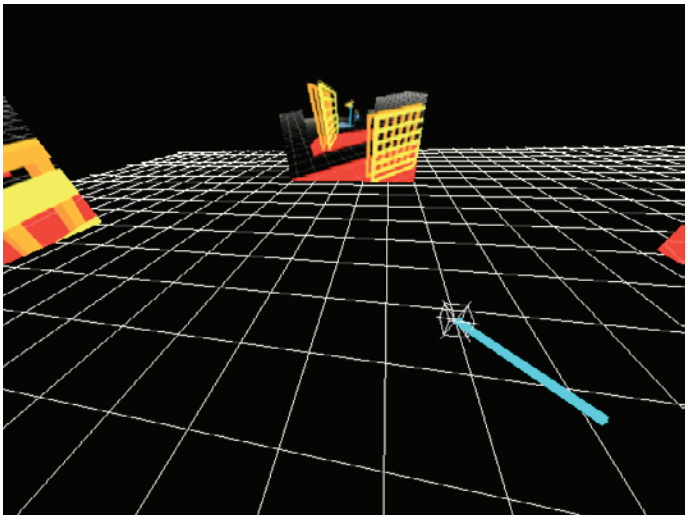


fig 4.1.2b

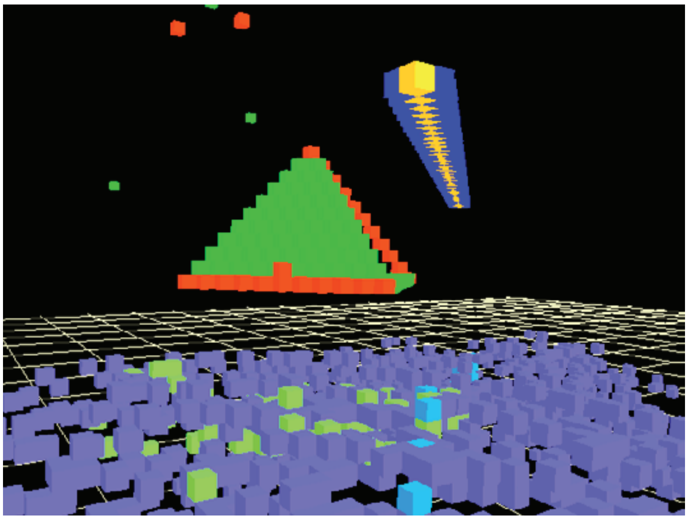


fig 4.1.2c

4.1.2

VOXDESIGN

VoxDESIGN (1994) was a seminal project by Holger Regenbrecht and Dirk Donath referred to as *"computer aided design using the methods of virtual reality"* [4a]. The project aimed to utilise an immersive VR environment as a design tool, offering new digital means for the model-making and sketching techniques that architects are so familiar with. VoxDesign provides a physical 'room' into which a VR environment is projected, allowing the participant to inhabit a digital environment, observing and designing at 1:1. The hardware set up is essentially the same as that for a CAVE, with a stereoscopic head mounted display and motion tracking equipment. The difference is in the voxDesign software which allows for the creation of the virtual environment.

This pioneering project brought together experts in architecture, computer-science, psychology and product design to discuss virtual reality, its uses and methods of interaction and navigation, its ethical implications and social responsibility, and its techniques of data display and communication. The resulting desire was to create an environment for 3D digital sketching, brining some of the fluid, experimental nature of pencil sketching into the binary digital realm. The environment was to be intuitive to operate in, and provide both private space in which the architect could design, and public space in which they could present their model. Initially the user had simply a single building component at their disposal, a uniform sized 'voxel', the virtual equivalent of a Lego brick, and the option of 16 colours. The user could import CAD files or images into the virtual environment, which also benefited from an audio system for further immersion. The modelling process could be recorded and the results saved or printed.

The system was tested on a number of senior architecture students, with the intention of offering them a new means with which to express their architectural ideas. They were assigned the simple task of designing a personal virtual student room, the design process to be carried out entirely within the voxel virtual environment. Upon entering, students had a basic knowledge of CAD programs and experience in traditional design techniques such as sketching and model making, but no experience of VR. Each student had a limited time of 7 hours to complete their task, and tended to work on average in one-hour long sessions. In a third of participants, sessions longer than an hour led to 'simulator sickness'. The result of the students work was both surprising and very different to results obtained through traditional design methods. Most opted not to adhere to the metaphors of our physical world (chair, table, bed, etc), and instead explored the oddities of a realm not governed by gravity and the laws of physics we expect. Although the system was very primitive both technically and in terms of its abilities, the students felt immersed into the VR environment. The actual length of each session was usually considerably longer than the student estimated, showing deep focus and concentration. The method of creating form with a stylus pen was also deemed successful and intuitive with students noting an association with traditional sketching.

This project was deemed to be a success by all involved, and as a positive move towards the creator's ambitions of seeing architecture students being educated in the use of virtual environments as design tools. Those behind the project felt that the practice of architecture would inevitably sway towards immersive digital design, yet in 2010 few practices have moved on from the traditional PC. The major fault with VoxDESGIN was considered to be its lack of multi-user design ability, however the preceding years have seen little further development in this area.

4a — Bertol, Daniela, Designing Digital Space (page 156)

5

5

PERSONAL CASE STUDIES

In order to appropriately comment on the success of the various environments that can be considered immersive, I experienced a range first-hand, documenting my findings overleaf.

fig 5.1a

5.1

FILM (IMAX)

Because of the recent revival of 3D cinema, I decided to experience the London Science Museum's IMAX 3D. After researching the technology behind 3D IMAX, I visited with a small group with which to compare findings. The film was a documentary on Ancient Egypt, featuring animations of historical tombs and buildings, alongside conventional film footage. The screen size is instantly impressive, so big that it is essentially one of the walls of the cinema, in fact the height of five double-decker busses. Once the film began, the screen filled an abnormally large proportion of the one's field of vision, considerably more than a standard cinema screen. The group suggested that approximately 70% of their field of vision was filled, quite striking considering the average 17-inch monitor fills maybe 25%. The group also found the sound system to be incredibly effective, loud yet crystal-clear, the sound fully surrounds the audience and can be made to emanate from any point in the room. The effect of sound moving with its source across the screen was as genuine as in reality.

The common complaint for members of the group arose with the binocular vision simulation. Firstly there was the issue of the representation of 3D objects filmed very close to the camera, at certain stages the two images splitting, meaning it was necessary to strain one's eyes in order to re-focus. Although in a sense this adds to the effect of realism in that the eyes must naturally refocus on objects at different depths, the effect of the images separating appeared very unnatural. The second issue was that the polarized glasses were rather uncomfortable and showed signs of heavy use, most notably the scratching to the lenses. This did create a recognizable reduction in the quality of the film, which was especially frustrating as the IMAX projectors are some of the highest resolution available. Another unfortunate effect of the glasses is that one can not tilt one's head by more than a couple of degrees from horizontal, as doing so misaligns the polarization of the lenses and the screen, and the three-dimensional effect is lost.

Landscape shots and fly-throughs were however generally deemed to be very successful in the effect they created. There was a real sense of depth in such scenes, and certain points on the landscape appeared clearly closer to the viewer than others. Overall, although the IMAX 3D cinema has its flaws, the group came to a consensus of surprise at why 3D cinema had been exploited so rarely in recent years. Beside the obvious reasons of cost, there is possibly a reason in the undesirable effect that the experience has on some members of the audience. Before the film began, the attendant informed us that some can find the experience a little 'overwhelming', and that we should remove our glasses or leave the cinema if necessary during the film. While initially succumbing to the viewpoint that the cinema was perhaps acting a little over-cautiously with such warnings, two of our group did claim to feel slightly nauseous during the early stages of the film. The effect seemed to be due solely to the 3D vision simulation, as when the glasses were removed the sensation began to subside. There was an opinion that this nauseous sensation was the reason that the vast majority of 3D IMAX demonstration films last little longer than 40 minutes, yet in recently we have seen the influx of 3-hour+ films using similar technology, albeit with similar complaints from a small percentage of the audience.

fig 5.1a — Image author's own

fig 5.2a

fig 5.2b

5.2

THE CAVE

Next, I explored one of the more obvious examples of a modern, digital immersive environment, the CAVE virtual reality system at UCL. I visited with much enthusiasm, as the system is one of the world's most advanced, and again as part of a group in an attempt to provide a fair assessment of the system's success. The initial impression was of just how small the physical room actually is. Although the user is free to move around, its size means that only a few steps span its floor plan. This is an immediate obstacle for a system which attempts to represent a world realistic in its spatial sense, as one has to use a hand-held controller to navigate through virtual space by more than a few steps. The binocular vision simulation is reasonably successful, but like the IMAX featured a pair of glasses, this time LCD stereo shutters, which felt uncomfortable and clumsy. Most felt that there was a good sense of depth and perspective, and the head tracking sensors worked effectively, the projections following the direction in which one was looking. The effect of walking through a doorway was especially impressive and realistic – as one became closer to the wall in which the door was situated, there was a strong sensation to lean back to avoid walking into the frame. Unfortunately however, the walls were not solid in that your virtual body could pass through them. Because of the size of the CAVE, problems were posed with certain types of display. When representing a small virtual environment, for example a room of similar dimensions to itself, the CAVE is rather effective, yet when displaying a large, open landscape, the corners of the physical space were clearly visible through the virtual projected environment, and there was considerable warping of this environment at the corners of the physical room.

Overall, most felt that although they were very much aware that the environment being experienced was artificial, and that they were standing in a physical box wearing LCD shutter glasses, the experience itself did feel rather immersive in that almost all of one's concentration was given over to this virtual environment. The most peculiar experience was when coming to the edge of a ledge in the virtual environment which overlooked a long drop into another room. Although fully aware that the environment was artificial, there was a huge instinct for most not to step forward over the ledge, and without thinking, they took half a step backwards. It seems that although it is very difficult to create an accurate representation of reality, it is fairly easy to trigger a human being's natural reflexes.

fig 5.2a/5.2b — Images author's own

WHEN IT IS JUST YOU AND SEVERAL OF THESE PAINTINGS IN ONE ROOM, IT IS AN INCREDIBLE EXPERIENCE

(Brice Marden)5b

5.3

THE PAINTINGS OF MARK ROTHKO

A much less obvious example of an immersive environment is the work of Mark Rothko. As a contrast to the aggressive sensory stimulation of VR devices, the medium in question is simply paint on canvas, there is no trickery or deception, yet his paintings are considered by some to be powerfully immersive. Whereas the immersive qualities of Rothko's work are well renowned within the art industry, and amongst fans and critics, to those who were not overly familiar with it, myself included, there was an amount of apprehension and doubt. Aware that this was likely to be the most subjective and personal of all of my case studies, I visited the Rothko Exhibition at the Tate Modern with an open mind, and left surprisingly captivated. On entering the first room, there was an instantaneous sense that I was looking at simply painted blocks of colour, as the curator Achim Borchardt-Hume writes *"On first encounter, Rothko's works often appear as seemingly immaterial painterly surfaces."* [5a] This certainly rang true with my own experience. In Room 2 I spent time making a conscious effort to observe the Four Darks in Red paintings, and after a few minutes my eyes begun to pick out forms within the blocks of colour. Figures, doorways, and most notably, windows.

Upon entering Room 3 I became a fan of Mark Rothko. This room contains The Seagram Murals (*fig 5.3a*), a collection of huge, and truly epic paintings in deep, dark, yet somehow vibrant reds, maroons, browns and black. Sitting in this huge, hushed space, dimly lit as desired by Rothko, and surrounded with these titans of the art world, it was difficult not to feel moved. There was an almost overwhelming sense that I was alone with the paintings, although there were many other visitors in the room. Brice Marden states *"When it is just you and several of these paintings in one room, it is an incredible experience"* [5b] and I can only imagine the experience this must be. Continuing through the exhibition, the first dissemination was the sense that the paintings were pulsing, as if alive. The previously hard to distinguish boundaries between dark hues of colour became more and more obvious, like the eye adjusting to a dark room upon turning off a light. This was particularly palpable with the darker works, such as No 8. (*fig 5.3b*) The depth of the black seems to draw the viewer, as well as light itself into the painting, engulfing everything within its boundaries. Of personal interest was the small section of the exhibition explaining the UV light studies that were carried out on the paintings. These studies reveal immense amounts of detail that one would doubt could be perceived by the human eye under the dim light Rothko preferred his paintings to be viewed in. The multitude of layers that form the paintings are quite extraordinary. Rothko built up each with a daunting amount of hues, brushstrokes, and even paint types, creating strongly defined individual areas of colour with paint so similar in appearance that one must use UV light to reveal the difference. This level of effort seems pointless when the resulting detail is hardly noticeable, however I believe that the eyes do begin pick up these subtle boundaries, even if sub-consciously. Furthermore it is well documented that Rothko himself became completely immersed and obsessed with his work as he created it, living in his studio for weeks on end whilst painstakingly perfecting every square inch of paint and denying anybody a glimpse of his creations until he deemed them to be complete. This obsession has been said to have led to his suicide.


fig 5.3a


fig 5.3b


fig 5.3c

Leaving the exhibition, there was an intense impression of the paintings revealing themselves as a series of openings. Some, like the Black on Gray series, clearly appeared to be lunar landscapes, a snapshot of a horizon, with the viewer looking into a vast, empty space. The effect is truly absorbing when viewing three of the series side-by-side. One feels they could be standing in a moon base, peering out across a celestial surface through these portholes. Whereas the Black on Gray series (*fig 5.3c*) posses a definite sense of the viewer looking outwards, the Seagram Murals are quite the opposite. I experienced a definite sense that these murals, although depicting openings, were very much openings looking inwards, as if the paintings were watching you, rather than the opposite, observing you quietly and relentlessly, almost haunting you. It was impossible to escape their gaze, and the sensation can become slightly overwhelming.

"The room is one of the strangest, most compelling and entirely alarming experiences to be had in any gallery anywhere. What strikes one on first entering is the nature of the silence, suspended in this shadowed vault like the silence of death itself - not a death after illness or old age, but at the end of some terrible act of sacrifice and atonement. In the dimness the paintings appear at first fuzzy, and move inside themselves in eerie stealth: dark pillars shimmer, apertures seem to slide open, shadowed doorways gape, giving on to depthless interiors. Gradually, as the eye adjusts to the space's greyish lighting - itself a kind of masterwork - the colours seep up through the canvas like new blood through a bandage in which old blood has already dried. The violence of these images is hardly tolerable"

(JOHN BANVILLE)[5c]

Marden further explains his experience of Rothko's painted environments: *"an indefinable space, but it is having an effect on you physically. You feel engulfed, totally surrounded by it"* [5d].

5a — From the Rothko Exhibition guide leaflet, Tate Modern, London

5b/d — Brice Marden on Rothko, Landscapes of the Mind, from TATE Online

5c — John Banville on Rothko, Temple of Mysteries, from TATE Online

fig 5.3a — Image by Max Mulhern

fig 5.3b — Image from The Tate Modern website

fig 5.3c — Image from The National Gallery of Art, Washington DC website

6

6

PSYCHOLOGY OF IMMERSION

Looking now at the psychology of immersion, the obvious question to consider is why people respond differently to immersive environments. How can one feel completely immersed by a painting yet another feel little stimulation from the same piece? Likewise why are some more perceptible to a virtual reality experience such as the CAVE? It is clear that immersive environments exist in many different forms, and most crucially, in different methods of execution.

fig 6.1a

Factor	Low Immersiveness	High Immersiveness
Visual		
Rich graphics	The environment looks cartoony or avatars look strange or move in a disconcerting way.	Realistic-looking lighting, shapes, textures, avatars, plants, etc. At the high end, graphics are photorealistic. Or, for abstract experiences (e.g., chemistry and mathematics) the visuals contain a high level of detailed information.
Avatars	Users do not have graphical representations of themselves in the environment.	Users have configurable or customizable avatars with which they identify.
3D environment	Much or all of the environment comprises 2D images.	The environment uses three-dimensional representations of geometric data. Avatars and objects take up and can move in 3D space.
Ability to control viewpoint	The user's viewpoint into the environment is static or limited to a few pre-selected perspectives.	The user has full control over their visual focus in the environment. They can zoom and pan in all directions.
Physics	No physics engine, or a very basic one	A sophisticated physics engine that simulates properties like mass, velocity, gravity, friction, and wind resistance. The environment weather and collision detection.
Size of display	The display fills only part of the user's computer screen	The display fills the user's entire computer screen
Tactile		
Haptics	No support for haptic devices	The user experiences the environment through the sense of touch, via a controller or input device. Through a handheld device, glove, etc. the user feels vibrations, forces, pressure, or motion. An example of this is the Wii controller.
Auditory		
Voice	No built-in voice over IP. Or if the system has VoIP, it is not spatialized; instead, it sounds similar to a phone call.	Spatialized, 3D audio. When an avatar is standing to your avatar's left, you hear that person's voice in your left speaker. Voices of those whose avatars are closer to yours are louder than those who are farther away. At the high end, voice colorization allows users to modify the way others' voices sound to make it easier to differentiate among speakers.
Non-voice sounds	Sound is mono.	Sounds are stereo and spatialized.
Collaboration and Interactivity		
Integrated collaboration, communication, and productivity tools	The environment lacks functionality like built-in voice, screen sharing, collaborative document editing, etc., requiring people to leave the environment (e.g., using the ALT-TAB key combination on a PC to switch applications) to get their work done.	Within the environment participants can communicate with each other via public or private voice chat, local or group or private text chat, messaging, document and object sharing, screen sharing, etc. The applications and information the user needs to complete a task (e.g., have a meeting, deliver a presentation, collaborate on a model) are accessible from and can be displayed within the virtual environment (e.g., via screen sharing or real-time document editing).
Gesture and emotion	Avatars do not lip sync. Ability to express emotion visually is limited. Gestures are basic.	Avatars lip sync while users are talking. Users can express emotion visually through their avatars. Today this usually is done by clicking on a menu of icons but in the future it will become more natural through the use of cameras, which will project the user's movements and expressions onto an avatar.
Interactivity	Objects in the environment are static.	Using the mouse or other input device, the user can click on an object to display an item or change the way an item behaves). The user can flip switches to rev up a turbine, sit in the driver's seat and operate a vehicle, etc.

6.1

IMMERSION IN TRADITIONAL ARTISTIC MEDIA

There are contrasting properties between the sort of immersive environment of the CAVE and that of Rothko's work. For example, although Rothko's work can be very powerful in its immersive qualities, it is not the sort of 'aggressive' form of immersion induced by the digital technology of the CAVE and IMAX environments. Rothko's work could be described as passive in its immersion, a quick glance at one of his paintings is unlikely to engulf the viewer, whereas when experiencing the CAVE and IMAX one struggles not to devote all of their attention to that environment. There are two contrasting ideas regarding the psychology of immersion within these environments, and in particular as to why individuals respond differently. As stated, Rothko's work can be considered passively immersive, but this argument is not true for all cases. An individual either finds the work immersive or does not, but if one does, it seems there can be two very different reasons behind this. One argument states a susceptible individual may be simply more prone to immersion. We have all experienced the common nuisance of 'daydreaming' absorbing our precious time, but for some this 'dreaminess' can possibly lead to simple triggers engaging deep attention, such as an unusual painting. Likewise someone of a creative nature with a vivid imagination could be more susceptible to immersion in these pieces than say a straight-thinking, rational Mathematician. Conversely it could be argued that individuals who reach a state of immersion in this sort of work do so due to a concentrated effort, an attempt to see past the superficiality of the paint and the canvas. In this case the individual is demonstrating a willingness to feel immersed, rather than a susceptibility. The table titled 'The Immersiveness Continuum' (*fig 6.1a*) was devised by Erica and Sam Driver and assesses the criteria they consider constitutes a successful virtual immersive environment. The more areas a virtual experience scores 'high' in, the more immersive it can be considered, yet if we apply this table to the work of Rothko, there would be a resounding conclusion of 'low immersivity', highlighting the ambiguity in defining these contrasting forms.

fig 6.1a — Driver, Erica & Sam, The Immersiveness Continuum, from thinkbalm.com

6.2

AGGRESSIVE DIGITAL IMMERSION

There seems far less ambiguity with the psychology of immersion in such environments as the CAVE/IMAX, both of which commandeer two of the most prominent senses in vision and hearing so powerfully that it is difficult not to feel immersed. This can be considered enforced, or aggressive immersion, yet it is not to say that the successful immersion in these cases relates to a successful representation of reality. In both the IMAX and the CAVE, however immersive the environments are in terms of controlling one's senses, one is always fully aware that the environment is artificial. Bertol considers the success of an immersive virtual reality environment to be dependant on the user feeling that they are inside the virtual environment that is being projected to their senses. She considers a sense of presence to be important to achieve immersion, a theory I would agree with to a large extent. Whilst other authors such as Mitchell[6a] and McCullough[6b] imply that for a VR environment to be successfully immersive it must commandeer as many of the senses as possible and attempt to replicate reality, I do not think it is necessary for the viewer to consider an environment realistic in order to feel immersed in it. In fact quite the contrary. When viewing a film about the Pharaohs of Ancient Egypt at the IMAX, the viewer experiences an undeniable sense of immersion, even though they are aware that they are not actually walking around North East Africa in 2000BC. Likewise when playing computer games, the gamer is fully aware that the environment and characters depicted are not physically real, yet for the purpose of the entertainment they develop a symbiotic relationship with the avatar they control, imagining it to be a virtual extension of them self. Furthermore, Rothko's work is an obvious example that an immersive environment does not require the depiction of reality to be successful, as well as a further seminal VR project, OSMOSE.

6a — W.J. Mitchell, ME++ The Cyborg Self and the Networked City
6b — McCullough, Malcolm, Abstracting Craft/Digital Ground

PERCEPTUAL AMBIGUITY AND SLIPPAGES BETWEEN FIGURE AND GROUND, NEAR AND FAR, INSIDE AND OUT

(Char Davies)6c

6.3

THE OSMOSE PROJECT

OSMOSE (1994 – 95) was a seminal art project by Char Davis concerned with how consciousness in enveloping virtual space *felt* to those immersed, at a time when the technology was gaining prevalence. OSMOSE did not set users any form of task, it simply allowed them to explore a 3D virtual world and recorded their psychological responses to it. The system used a typical stereoscopic headset, and a three-dimensionally localised sound system, but it differed to most systems in its control mechanism. OSMOSE's virtual environment was navigated via the user's breath and balance, creating an embodying experience.

The virtual environment itself consisted of twelve different realms, some philosophical reconstructions of nature such as a clearing, a forest, a tree, a leaf, a cloud, a pond, subterranean earth, and others philosophical texts and software code. In sharp contrast to video game graphics, these realms are fantastical interpretations of natural places, possessing no solid forms, simply semi-transparent and luminous objects clouded with abstract foreground 'flecks' to create *"perceptual ambiguity and slippages between figure and ground, near and far, inside and out"* [6c]. Davies was challenging the conventional approach to VR, desolidifying it and creating clear distinctions from the real world.

The navigation method was particularly effective, although participants required a head mounted display, they were not encumbered with having to point any sort of hand held device in order to move their body. Breathing in lifted the participant in virtual space, breathing out lowered them, and altering their centre of gravity moved them in the corresponding direction. They floated through the virtual realms at the pace that pleased them. The physical body here is incredibly important to the success of the system, as its entirety is used as the controller, in contrast to conventional VR systems where solely the eyes and a single hand are active. Paradoxically, however, once immersed in the virtual environment, there was no physicality to the user's body, it was as translucent as any other object. The environment's soundtrack responded to the user's location, direction and speed.

Over 25,000 people experienced OSMOSE and the effects were profound, often even powerfully emotional. For most, the initial state of immersion saw frantic 'doing', hastily flying around in exploration, yet within ten minutes or so, upon acclimatising to the navigational method, the experience shifted to one of simply 'being'. Users slowed down, their bodies and facial expressions relaxed and they became mesmerised by their own consciousness in virtual space, they slowly 'free-fall'.

Upon leaving the system, users had lost track of time in a similar way to the VoxDESIGN system. A thirty minute session, for example, was always experienced as only ten. There was also a definite sense that they had been in another place, although of course they had simply stood in the same physical room. A deep sense of relaxation of mind and body was also common, as well as a sense of freedom from, yet awareness of their physical body. An inability to construct a logical sentence was also common upon leaving the system. Many users became intensely emotional, experiencing an overwhelming sense of loss upon the session ending, which caused them to cry. Some even proclaimed that they were no longer afraid of dying. The project resulted in participants 'finding themselves'.

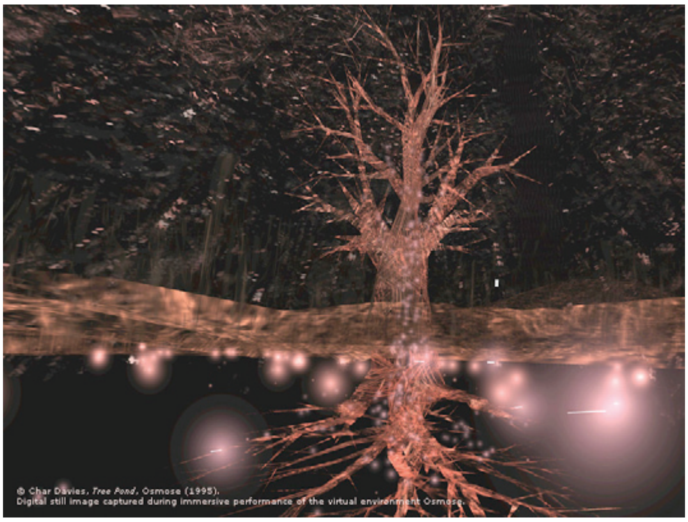


fig 6.3a

fig 6.3b

fig 6.3c

fig 6.3d

OSMOSE transcends the physical/virtual boundary, replacing our Cartesian notions of space with a surreal immersive medium in which we can explore our own being. A multi-user experience is not necessary here as the artist's intention is for immersants to connect with their self, rather than with others.

6c — Davies, Char, Changing Space: Virtual Reality as an Arena of Embodied Being, part of The Virtual Dimension by Beckmann, John (ed.) (page 150)

fig 6.3a/b/c/d — Images from immersence.com/osmose

6.4

STIMULUS

Stimulus is a key concept to consider in this discussion. It would be logical to expect that the more sensory stimulation one receives from an environment, the more one is likely to feel immersed in it. However, through the research carried out to inform this paper, it is clear that for some individuals at least, the number of senses stimulated is not so important as the quality of stimulation.

For a successful VR simulation, a sense of perception is crucial. The Head-Mounted Display is a device which in itself directly stimulates arguably our most important sense with regard to immersion – sight. Like Bramante's boards, the Stereoscope and the Viewmaster, the HMD seeks to elude our sense of sight and exploit our understanding of vision. For most however, the shallowness of the sense of immersion soon becomes tedious. J.J. Gibson talks of how even a surface itself is a stimulus, as long as it possesses some sort of texture, edges and contours[6d], and those immersed in Rothko's work are essentially immersed by a simple surface, the canvas. The difference is that this surface acts as so much more than a flat plane, it is an opening into another world, a window into our imagination. In this respect the paintings, although only directly stimulating a single sense, do so powerfully that effectively all of our senses can be at once stimulated.

As with the Seagram Mural room at the Tate Modern, the paintings are such an intoxicating stimulant that the room itself becomes the immersive environment, and therefore anything sensed within that room whilst in a state of immersion can be considered a direct result of the paintings. A shiver down the spine, the hushed whispers of other visitors, and the musky smell of the old canvas, these sensory stimuli can all be attributed to the paintings. Whilst the IMAX can be considered to provide a higher level of stimulus, most VR environments struggle to induce the emotion that Rothko's work can. The idea of 'emotional immersion' appears vital in the participant forgetting, or at least replacing the physical world in favour of the virtual one. Here the importance of the OSMOSE project and certain video games becomes particularly evident, managing to induce real emotion via digital means.

6d — Gibson, J.J., The Perception of the Visual World (page 8)

YOUR BODY IS YOUR FIRST AND LAST SITE, YOUR CENTRE AND YOUR SCALE ... UP IS DIFFERENT FROM DOWN, FRONT FROM BACK.
THE WORLD UNFOLDS BEFORE US AND RECEDES BEHIND US

(Malcolm McCullough)6e

6.5
EMBODIMENT

Embodiment is a further concept that has substantial effect on immersion. McCullough in his book Digital Ground states *"your body is your first and last site, your centre and your scale"* and that *"up is different from down, front from back. The world unfolds before us and recedes behind us"* [6e]. Naturally we have a deeply embedded association with and recognition of the human form. We experience the world from our bodies. In his book Abstracting Craft, McCullough talks about the problems in linking the virtual world with the physical [6f]. Because of our association with our bodies, when we experience an immersive environment we usually do so in relation to this body. Again looking at the work of Rothko, many immediately associate the paintings with doorways or landscapes which we imagine ourselves passing through. In an environment like the CAVE, which attempts to simulate reality, we expect to experience the virtual environment in relation to our bodies. We expect to possess the same field of vision as in reality, we expect our viewpoint to be at the eye level of an average human being, and we expect to be able to decipher left, right, up, down, front and back. In effect we require a virtual body. Our experience of a virtual environment as a replication of reality is limited therefore, due to our desire for a sense of embodiment.

Experiencing an environment in absolute terms would be uncomfortably unusual however, according to J.J. Gibson's hypothetical man experiment [6g]. In this theory a man is at the centre of a sphere of pure air, in an environment of *"empty visual space"* [6h], consisting of only atmosphere, with no opaque objects. Gravity does not exist so the man could not *"maintain a posture or change his location"* [6i]. If the sphere is lit from external sources, but is large enough to diffuse the light evenly, and the man opened his eyes, what would he see? Gibson suggests the man would see everything, and nothing. All points would appear identical and the man would not be able to focus on anything, because there would be nothing to focus on. The man could see only the colour of the light. He would not see in 2D nor in 3D, as although the space he sees is not flat, its depth can not be sensed. The space has no texture, no objects inside it, and no axis. The man may as well be in complete darkness as he has nothing to see.

"The suggestion is that visual space, unlike abstract geometrical space, is perceived only by virtue of what fills it."
(J.J. GIBSON) [6j]

This theory goes further, stating the man would have no impression of near or far, nor up or down. Since gravity does not exist he would have no equilibrium and would therefore float. Although the man could look at his left hand and right hand, and at his feet, these cues would have lost their traditional meaning in terms of orientation. The man would be totally disorientated, having never experienced the visual stimuli given by axis such as the horizon and objects in his field of view, and therefore it can be further suggested that he could not even perceive an abstract geometrical space. Gibson's hypothetical man possesses a body, yet his body is effectively inept, serving only as the machine which keeps him alive. If one turns the theory around and imagines an environment, but with no body to experience it from, the problems are clear. How would we see, hear, feel, taste and smell something if we had no body or senses to do so with. Here the environment itself becomes inept.

It can be considered impossible for man to ever experience an environment in absolute terms, with no reference at all to his physical body, and so an immersive environment cannot exist without the concept of embodiment. In

fig 6.5a

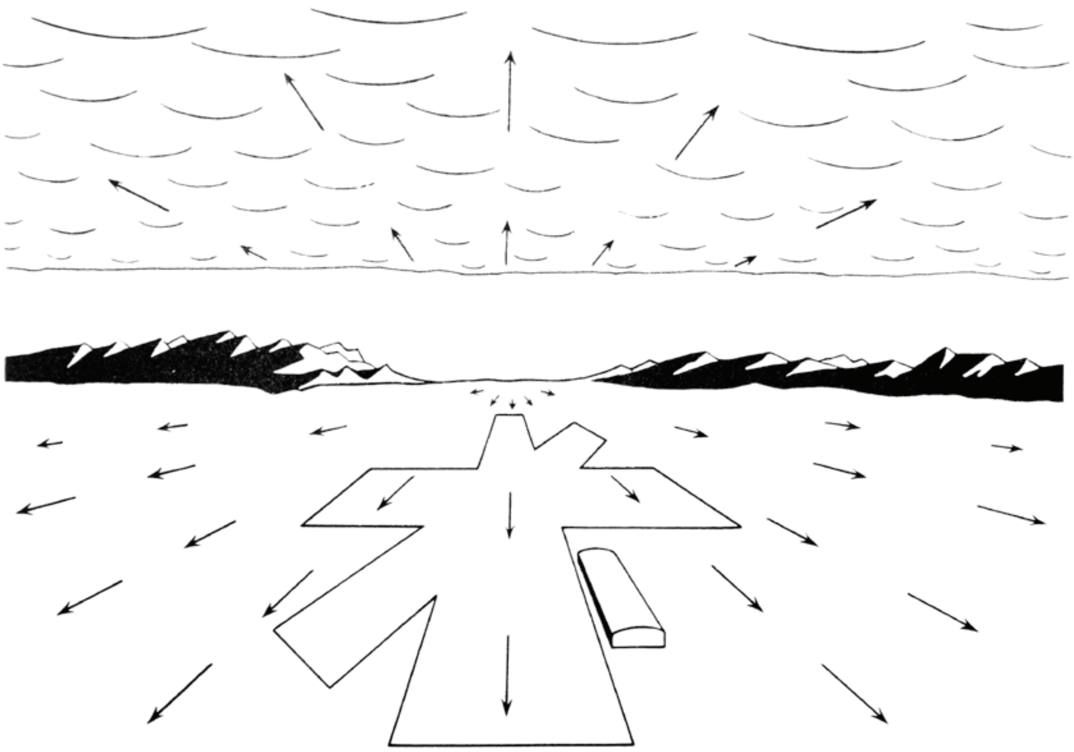


fig 6.5b

some digital realms however, the laws of physics and time that effect our physical bodies are modified to our liking to further enhance the sense of immersion. In the online MUD (Multi-User Domain) game Second Life *(fig 6.5a)*, users participate in a virtual 3D world through a virtual body which they create. Often these virtual bodies share no similarity to their creator's physical body, and are commonly even of opposite sex. With their virtual bodies users are able to teleport and fly through the virtual world. Second Life is an example of basic sensory, yet extreme emotional immersion, with users literally spending hours per day, not playing, but actually living a second life. This immersion seems only enhanced by the fact that users experience the game through a virtual body which possesses abilities that our physical bodies do not. It is interesting that in a world which is so focused on physicality and image, and with a race that has such a deeply embedded psychological association with their own physical form, culture is beginning to move into the virtual realm, where the importance of the physical body becomes greatly diminished.

Embodiment is heavily related to perception, which is another concept determining the success of an immersive environment, particularly a VR environment. J.J Gibson states *"The spatial character of the visual world is given not by the objects in it but by the background of the objects. It is exemplified by the fact that the airplane pilot's space, paradoxical as it may seem, is determined by the ground and the horizon, not by the air through which he flies"* [6k] (*fig 6.5b*). He discusses how our perception of the world actually consists of two different perceptions, one of the substantial or spatial world, and one of the useful and significant things which we experience daily. The first is *"the world of colours, textures, surfaces, edges, slopes, shapes and interspaces"*, and the second *"is the more familiar world with which we are usually concerned, a world of objects, places, people, signals, and written symbols"* [6l]. A VR environment stimulates our 'first' perception reasonably well, but struggles to stimulate our 'second' perception. Passively immersive environments such as the work of Rothko conversely are rarely successful in their representation of spatial perception, yet can be incredibly successful in triggering thoughts, memories, emotions and feelings.

Again the OSMOSE project must be recited due to its unconventional association with embodiment. The physical body here is not described in virtual space, nor do any of the physical attributes that apply to the real world apply to the digital environment. The realm's mystical translucency and lack of gravity allows the immersant to float without consideration of the laws of physics, and in many respects the experience can be compared to the hypothetical man. The physical body does however enable this floating navigation, and so is vital to the success of the experience. The immersant is both disembodied from and entirely reliant on their physical self. The key to the success of OSMOSE appears to be due to its depiction of an other-worldly environment. It does not seek to replicate reality and is therefore a true parallel reality with its own idiosyncrasies to explore, as a result immersants beginning to simply *experience* their own presence in virtual space. Hence emotional immersion occurs.

6e — McCullough, Malcolm, Digital Ground

6f — McCullough, Malcolm, Abstracting Craft — page 122

6g/h/i/j — Gibson, J.J., The Perception of the Visual World — page 5

6k — Gibson, J.J., The Perception of the Visual World — page 6

6l — Gibson, J.J., The Perception of the Visual World — page 10

fig 6.5a — Image by Tom Feran

fig 6.5b — Image from J.J. Gibson, The Perception of the Visual World © 1950

PEOPLE DON'T UNDERSTAND HOW POWERFUL SOME GAME MECHANICS CAN BE … SOME GAMES ARE DESIGNED IN A MANNER YOU JUST DON'T WANT TO LEAVE

(Adrian Hon)6n

6.6

THE DANGERS AND OPPORTUNITIES OF IMMERSION IN GAMING

Video gaming has received much negative criticism for its intensity of emotional immersion, particularly the effect it has on many younger gamers. Heavy gaming is often frowned upon and carries a stigma of causing ill health and anti-social behaviour, impressions usually held by the parents of younger gamers. These parents grew up in a generation where video games were primitive, and therefore often struggle to comprehend the desire to play so much. It is surprising however, that a love of gaming does not seem to be related to young age. In 2008, the average video gamer was 34 and had been playing games for 12 years, according to the Entertainment Software Association [6m]. This generation of gamers therefore began playing the '5th Generation' consoles such as the Sony PlayStation and Nintendo 64 during their early 20s, continuing to play subsequent consoles. The 5th Generation consoles were responsible for possibly the greatest boom in home video gaming. The introduction of '3D' gaming (the depiction of a 3D game worlds, rather than actual 3D vision simulation), along with the relative affordability of these consoles led to video games being played in an unprecedented number of homes. The PlayStation and Nintendo 64 consoles alone sold 135 million units worldwide.

The quality of 5th Generation games of course matched the capabilities of the new consoles, and home gaming was no longer a replication of simple arcade games. Gamers could now explore the rich, colourful and detailed worlds of Tomb Raider and Mario 64, games so revolutionary that even by 2010 standards offer a fantastically immersive experience. It appears that many of the 30-somethings whom the ESA refer to as the 'average gamer' therefore sympathise with the current teenage generation and their apparent obsession with video games.

If technology 12 years ago was able to hold the attention of young minds so fiercely, then today's consoles, which can be 10 times more powerful than a modern PC, are likely to command yet greater attention. The intensity of immersion in these games can be seen in the faces of the young gamers photographed by video artist Robbie Cooper, placed high-resolution cameras in the screen to capture their expressions as they played. Their faces show absolute, unwavering concentration, in one case a boy begins to cry during playing as he loses his blink reflex, such is his absorption in the game. (*fig 6.6a*)

The success of the technology of course is crucial to the success of a video game as an immersive environment, yet referring back to the idea of video games being considered 'addictive', there is evidence to suggest that it is the actual mechanics of the games which cause excessive playing. In BBC's Panorama documentary 'Addicted to Games?', award-winning game designer Adrian Hon admits *"people don't understand how powerful some game mechanics can be ... some games are designed in a manner you just don't want to leave"* [6n]. Hon speaks of the powerful psychological techniques fine-tuned over years of development to keep us transfixed. A method known as 'variable rate of reinforcement' has seen particular success in games such as World of Warcraft. The concept was


fig 6.6a

initially discovered during rat testing where it was observed that if a lever randomly dispensed food when pressed, a rat would obsessively press it. The concept was also found to work on humans, leading to the tendency of games requiring players to collect items such as coins or rings in order to achieve points, extra lives or hidden features. This simple but powerful idea is to establish a 'compulsion loop' which rewards the gamer for their efforts and therefore keeps them craving more. It is thought to be the reason behind addiction to slot machines.

Tom Chatfield, a game theorist, talks of a similar concept he calls 'The Reward Schedule'. Chatfield explains how MMORPGs are particularly effective at using the internet's capacity to record data from millions of gamers and using it to fine-tune the difficulty of challenges to keep people interested. He goes on to list 7 principles which he considers contribute to successful immersion in video games [6o].

1) Experience bars measuring progress (*The gamer's avatar being seen to progress incrementally throughout the game)*
2) Multiple long term and short term aims (*Achieving a number of different goals simultaneously introduces a desirable complexity to the game)*
3) Reward Effort (*Players expect to receive some form of credit for their efforts)*
4) Rapid, Frequent, Clear Feedback (*the game linking consequences to actions, and the gamer learning a lesson from their actions)*
5) Uncertainty (*the possibility of the gamer achieving something so rewarding that they were unsure it was even possible)*
6) Windows of enhanced attention (*humans have a natural desire to learn about and perfect something that they enjoy)*
7) Other people (*the most effective neurological turn-on, cooperation between people in the virtual world)*

In marked contrast to the tone of Adrian Hon, game designer Jane McGonigal suggests provocatively, that humanity must in fact play many more games in order to solve the problems facing the world. McGonigal's argument is rhetorical, yet the driving ideas are compelling, she believes that when we play video games we become the *"best versions of ourselves"* [6p], such is our concentration and will to overcome challenges. McGonigal talks of how WoW gamers have amassed almost 6 million years of playing time since 1994, solving problems in a virtual world, often in collaboration with strangers. These 6 million years spent gaming, she argues, are just an important on the evolutionary scale as the 6 million years of human evolution since primitive man first stood upright, in aiding our development into a more *"collaborative an hearty species"* [6q]. She goes on to reference Malcolm Gladwell's 10,000 hour theory which states that if any child has spent 10,000 hours of effortful study in a particular area by the age of 21, they can be considered virtuosos in that field. The average young person in a nation with a strong gaming culture spends 10,000 hours playing games by the age of 21, and therefore, McGonigal argues, the world has an entire generation of 500 million virtuoso gamers, a vast resource of brain power which could be put to use for the good of humanity. Her concern is firstly to discover what exactly are these 500 million virtuosos so good at, and secondly, how can their talents be put to use in the real world, and her conclusions are that gamers are *"Super-Empowered Hopeful Individuals"* with an ability to cooperate and problem solve, and a desire for hard work, so long as it is the right kind. Gamers are eternally optimistic and capable of saving virtual worlds, McGonigal wants to empower them to help save the real world through immersion.

6m — statistics from ESA website

6n — from BBC Panorama documentary 'Addicted to Games?'

6o — Chatfield, Tom, '7 Ways Games Reward the Brain' (TED talk)

6p/q — McGonigal, Jane, 'Gaming Can Make a Better World' (TED talk)

fig 6.6a — Image from robbiecooper.org

THE DESIRE TO BE WIRED

(Gareth Branwyn)6r

6.7

REAL SPACE VS CYBER SPACE

The virtual worlds we create have become so immersive that we are now tempted to step through the screen and inhabit them as an alternative to reality. What currently prevents us is our physical body, and the cumbersome stimulation apparatus it needs to trick our senses. If our unquenchable *"desire to be wired"* [6r] is to be satisfied via an entirely immersive virtual environment akin to those found in films like Tron and The Matrix however, we must consider the architectural implications. Currently architects design the physical world and programmers design the virtual world, yet if this virtual world becomes as real to us as the physical world, can digital architecture be considered 'real'? Must the role of the architect adapt? Is there a fusion in the roles of architect and programmer? What are the implications of designing in a virtual realm which lacks the laws of physics that we are used to?

Bertol imagines how in a digital world the architect could create through the movement of their bodies, each step forward could generate an endless series of spaces, moving upwards could twist the world and moving downwards could stretch it. Entering a fully immersive digital realm for the first time is surely an epoch in anyone's life, but for the architect it is a rebirth.

"In virtual architecture we become children discovering new perception and learning new ways to orient ourselves" [6s]

Since virtual worlds may only exist through creation by an interacting participant, they are not static as our real world, but are continuously in flux, evolving and responding to those who experience it in endless possibilities. The physical world may be simplified to a solid-void, or positive-negative argument, solid architecture separated by space. Our physical bodies move around solids and through voids, as no two solids may occupy the same point in the universe at the same time. Traditionally the solids, our buildings, are constructed from stone, brick, steel and glass in ways which satisfy the laws of gravity, friction and temperature. Solid 3D forms enclose voids which humans inhabit, separating us from the outside world and its elements. Our roofs are pitched and tiled to deflect the rain, our walls are load-bearing in order to prevent gravity bringing our roof down upon us. These characteristics become redundant in a virtual world. Walls serve only as a screen, elements require no thickness as they have no forces exerted upon them, there is no rain unless we create it, and most importantly our physical bodies are no longer solid. We may freely pass through whichever perceived solids we choose to, we may occupy the same point as any other solid as we wish.

It is not however, only the simple assemblage of elements that creates solid architecture, it is the emotions and psychological responses which we experience within the physical realm. The memories we have of a place are often more powerful than the solids themselves, but it is the continual associations we make that enables physical

architecture to transcend the boundaries of the solid. In our memories real architecture exists in nonmaterial form, prompted into being via various triggers in a way similar to a theatre transporting its audience to the realm of the imaginary through stage props. It is because the digital realm is now beginning to be capable of inducing these deeply emotional, psychological responses from humanity that we are at a pivotal point in history. Cyberspace is becoming real, as perfectly described in digital media inventor Michael Highland's monologue video 'As Real as Your Life'. Highland describes how his Nintendo games console became a parallel existence, a virtual reality which grasped him with an addiction he has never shaken off. Now he lives part-way between reality and fantasy, the differentiating boundary in his brain beginning to crumble away, yet he still craves more. He speaks of how he has had life-changing experiences in virtual space, so powerful that reality in comparison is mundane. In virtual space Highland has flown planes, driven super cars, participated in WWII beach landings and even killed a man. These things instil more emotion in him than he experiences in the real world.

> *"I have fought in wars, feared for my own survival, watched my cohorts die on beaches and woods that look and feel more real than any textbook or any news story. The people who create these games are smart. They know what makes me scared, excited, panicked, proud or sad. Then they use these emotions to dimensionalize the worlds they create."* [6t]

He has come to expect the same level of interaction from the physical world as he does from his games, and admits that without it, the importance of such problems as war, poverty and disease blend *"into the sensationalised drama of prime time TV"*, mirroring the views of Jane McGonigal. Highland describes how his brain has been programmed through years of exposure to gaming to be ultra-emotional, admitting now even an insurance advert can bring a tear to his eye. The theme of emotion is again suggested, something surely critical to the success of any immersive environment, but a concept that the gaming industry in particular seems to be mastering. Highland goes on to suggest that it is critical that game developers begin to realise their responsibility and influence.

6r — Branwyn, Gareth, The Desire to be Wired, part of The Virtual Dimension by Beckmann, John (ed.) (page 323)

6s — Bertol, Daniela, Designing Digital Space (page 305)

6t — Highland, Michael, As Real As Your Life (TED talk)

7

7

CONCLUSIONS

Clearly an immersive environment can manifest itself in many forms, from a simple painting to a high-tech VR environment and its various sensory stimulants. The success of each form depends on the individual, and of course each experience is entirely subjective. The first conclusion derived from this paper however, is that an environment does not require the depiction of reality to be successfully immersive. Secondly the level of sensory stimulation is not necessarily decisive, what is important is the quality of stimulation, and the evocation of emotion from the immersant. This research has aimed to provide an overview of the history of immersion in virtual environments, as well as assessing the current and future digital technology that we have at our disposal, considering its implications upon architecture.

7.1

DIGITAL IMMERSIVE TECHNOLOGY AND ITS ROLE IN FUTURE ARCHITECTURE

Much of the technology described in this paper can only aid the development of the architecture industry, streamlining the design and evaluation process into a transparent, collaborative system offering instant feedback and dissolving ambiguity. It is confusing as to why this next wave of digital technology has struggled to make the impression it should have since its inception nearly twenty years ago, yet it is inevitable that it will eventually experience widespread integration. With the failure of the Responsive Workbench there still remains a huge possibility for the creation of an alternative input peripheral for the architect, the mouse and keyboard considered counter-creative by many. Here the gesture recognition technology developed for recent games consoles and laptop computers must be exploited to allow a more intuitive digital design experience. The next leap forward comes through projects such as voxDesign, which hinted at a revolutionary new way of design by putting the architect inside virtual space. Clearly successful in its immersive qualities, systems of this kind can be put to use both as a replacement of conventional 3D CAD programs whilst designing physical architecture, and as a means to create the virtual realm itself. In the near future VR design environments will surely gain popularity as students of high digital competence filter into practice, potentially establishing architects at the forefront of digital realm, doing what they specialise in doing – designing space. It is the implications of the digital becoming a rival to the real, and the subsequent impact on architecture that is the genuine interest heading in to the second decade of the 21st century.

7.2

DIGITAL IMMERSIVE TECHNOLOGY AND ITS PHILOSOPHICAL IMPLICATIONS

At this definitive period in world history, as humanity fluctuates between the realm of reality and that of virtuality, we as architects must reconsider our roles. Long has man been able to create the illusion of untouchable parallel realities. We have longingly observed these realms through windows, yet now we stand on the verge of passing through these windows and *inhabiting* virtual space. The considerations to be made today, therefore, are of the consequences of such a digital occult.

7.2.1

PEERING THROUGH WINDOWS: IMMERSION

For centuries man has strived to replicate reality in various forms, deceiving, enchanting and delighting audiences with an apparent obsession for the depiction of the artificial. Virtual environments, digital or otherwise, have however always been experienced through *windows*. The frescos of the Italian palazzos, the Stereoscope and even video games have offered us an untouchable glimpse of another realm. However immersive each of these media is, the viewer is generally acutely aware of their artificiality. Of course the surreal has always intrigued the human psyche, and this combined with an inability to truly replicate the real led to the likes of Raphael's fantastical ceiling paintings. Here the window is embraced, offering observers a view into a mystical, heavenly place, recognisable in form yet clearly unattainable.

7.2.2

STEPPING THROUGH DOORWAYS: INHABITATION THROUGH EMOTION

Recent projects such as OSMOSE begin to allow us to actually pass into digital space, to a realm which shares little in common with our physical world, they act as a *doorway*. At this point our experience of the digital space is more than simply immersion, it is *inhabitation.* For immersion to reach a state of inhabitation the key appears to be emotional absorption – the replication of reality itself and the level of sensory stimulation are again insignificant, as long as the virtual environment can induce the intensity of psychological and emotional response that we experience in our physical world.

> *An architectural environment is also associated with certain feelings and psychological reactions to its physical shape. Walking through the street after a lover's first kiss can give us joy or perhaps evoke sadness. The complexity of our memories continuously creates associations, allowing us to transcend the properties of a place which define its physical organization. It is this spatial character - not the material input - that extends architecture beyond its solid characteristics. The theatre is one of the most familiar examples of non-material spaces: The place created by the drama happening on stage transforms the physical properties of the actual space of the theatre. In this context digital spaces arise as another example of places whose definition goes beyond the solid architecture they are made of. The realm of the imaginary becomes integrated with physical reality*
> (BERTOL)[7a]

7a — Bertol, Daniela, Designing Digital Space (page 57)

7.2.3

THE CONSEQUENCES OF INHABITATION: PHYSICAL VS VIRTUAL SPACE

The most successful early examples of visual trickery such as Borromini's false perspective arcade generate some interesting debates. Since the effect of the pieces are often so successful when viewed from a specific point that they are confused with reality, can the space they depict not be considered *real* space until the point that the viewer becomes aware that it is illusion? Likewise, once we begin to inhabit virtual digital space, however 'realistic' in the conventional sense, can we not now consider it to be real space? Since all space is simply our brain's interpretation of the information our senses record, if the brain is interpreting a space to be real, if only for a second, surely it is real. Referring back to Vignola's Sala di Giove, as the viewer first observes the depicted virtual space from the optimal viewing position, it can feel as genuine to them as the physical room in which they stand, and therefore in that moment, it is irrefutably real.

Our digital realms are beginning to rival reality in their immersive capacity, as demonstrated by OSMOSE and many video games. Whilst we are a still long way from the reality-replacing worlds depicted in films such as Tron and The Matrix, we must now, as architects begin to consider digital space as an equivalent to physical space. Game designers today possess huge responsibility, such is the control they have over the worlds so many of us are willing to immerse ourselves in, yet if these digital realms become as immersive as the real, surely the role of the architect must adapt to suit. The expertise, knowledge and responsibility toward the physical environment that architects acquire through many years of education should now be adapted to the digital realm. The role of architect and programmer will therefore, eventually, fuse.

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Fig 5.3a — The Rothko Room, Tate Modern
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