EMBODIMENT AND ILLUSION

The Implications of Scale as a Cue for Immersion in Virtual Environments

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Abstract. This paper examines the extent to which the issue of scale impinges on our sense of immersion in virtual environments. We consider perception from the point of view of Merleau-Ponty's phenomenology, and describe a study involving extended interviews of a small number of subjects who were presented with static, moving and interactive images of spaces. We test a series of propositions about scale cues, and speculate on the wider phenomenological issues of expectation, metaphor and play.

1. Introduction

There are many factors that contribute to a sense of immersion in digitally mediated environments. We can be tricked into believing that the image or sensual stimulus before us is in fact "real," but this is only a minor motivation in artistic production, according to Bolter and Grusin: "Trompe l'oeil [optical illusion], which does completely fool the viewer for a moment, has always been an exceptional practice" (Bolter and Grusin 1999, p. 31). Photorealism is not the only determinant in the experience of immediacy, nor is it even necessary. In fact the potency of immersive environments often derives from exaggeration, selective abstraction, hyper-realism, and the play of scale. Looking beyond the visual we also see that new media present us with opportunities for haptic interaction, either imagined or actual. Furthermore, as attested by the captivating power of computer games at various levels of visual abstraction and sophistication, digital spaces are engaging, immediate, and immersive to the extent that they provide us with something worthwhile and interesting to do.

Interactive digital media provide an excellent means of testing, comparing, validating and challenging theories about perception, in our case aligning the phenomenology of Merleau Ponty and Heidegger with contemporary researches into "embodied interaction" (Dourish, 2001). Digital media provides an opportunity to work with scale as a variable, an idea brought to our attention in a provocative paper by (Xiaolong and Furnas, 2003). Dynamically changing the size of a 3d model, such as a building, or changing our own size in relationship to it, is perhaps beyond our usual experience, and so presents as a challenge to our perceptual apparatus. We are familiar with the effects of perspective as we move through a space, variable zoom lenses, digital zooming, and objects that grow and shrink before our eyes, not least in movie special effects — but what of variable scale in 3d virtual environments? Such effects include: experiencing an urban model at human scale as a pedestrian, then changing scale to that of a giant, able to step over buildings, or hold the model in the palm of my "virtual" hand. Perhaps then we could shrink to the size of ant and explore the interstices of the city model normally invisible to human-scale investigation. What difference would such scale changes make to our interaction with the environment, and what possibilities do they provide for design?

This investigation leads us to examine the cues by which we determine our scale in relation to an object or environment. These cues include the coordinates and view angle of the viewer in relation to the scene, speed of movement, distance between eye positions (if stereoscopy is employed), aerial perspective (due to atmospheric diffusion), focal length, and depth of field. If the eye position moves then we take cues from speed, inertia and pattern of movement. If there is interaction then the distance of our reach and the mode of interaction are important. The sonic quality of environments is strongly influenced by their scale. We might expect small objects to emit higher frequency sounds than larger objects. The object in view is important. A close up, surface level perspective of a fountain pen might suggest that either I am very small or the pen is very large. The presence of grime, surface imperfections, material properties and behaviours are also determiners of scale. The effects of scale are strongly influenced by imaginative metaphorical relationship (Johnson, 1987). To suggest that I am an ant or a giant already colours my perception of scale. Scale perception is also mediated by the legacies of visual representation: classical and romantic painting, scale drawing, physical model making, photography, film, special effects, computer games, and digital manipulation. To change scale dynamically in relationship to our environment or image adds further complexity to the experience of scale, and is abetted by metaphors of growth, inflation, and fantasy scenarios.

How does scale and scale-change, affect our sense of engagement, immediacy and immersion in a digital environment? In this paper we explore the propositions that changing scale is a further mode of interaction that can influence immersive experience. We consider whether working in an immersive environment where there is a sense of being at different scales can be useful in accomplishing certain design tasks. More significantly we explore the proposition that the sense of scale is a strong determinant in our experience of engagement in a digital environment. The "god's-eye view" is concomitant with a sense of distance and abstraction. The eye-level view brings us into the environment. On the other hand, the slow movement of our increased size or elevation can give time to reflect and establish distance. The faster movement of the small-scale participant sometimes suggests engagement (as for the frenetic computer game player). The process of "changing scale" also induces a momentary sense of distance from the digital environment. With the issue of scale manipulation there is an interaction between the two conditions suggested by Heidegger, of the "ready-to-hand" and "present-at-hand." Ultimately, we maintain that the designer needs to be able to alternate between these two positions of immersion and distance while working on a project, and dynamic scale manipulation provides a means of abetting this process.

Our investigation takes us into the realms of the phenomenology of perception, spatial representation, the nature of digital media and embodiment. We illustrate our paper with examples from a student design project investigating scale in virtual environments, studies of user responses and attitudes to scale issues, and research using interactive 3d environments.

2. Phenomenology of Perception

Scale is an important element of our perception as it often contributes to the logic, or the absence of logic, of the relationship between the human body and its surroundings. The body is the centre of our interaction and our mediation with the world (Johnson, 1987).

The conscious experience of the human body, from the subject's point of view, is the focus of study for phenomenology: a division of philosophy that considers both the structure of conscious experience, and its intentionality. As a method of investigation, phenomenology offers a human-centred account of knowledge, based on experience. For phenomenology, experience is constituted by the interaction of our bodies with other objects, and provides the general frame for our actions (Merleau-ponty 2003, p. 235). The background of this frame is perception. We perceive the vast field of

objects that surrounds us, being aware that, in turn, we are being perceived as objects by others.

The French philosopher Maurice Merleau-Ponty, in his *Phenomenology of Perception*, first published in 1945, emphasises the role of the human body in perception. He analyses different bodily attributes to account for this role: the body as object, the experience of the body, spatiality, motility, synthesis, the sexual being, and the body as expression.

As our body constitutes a first "frontier" when encountering the world, the way we structure space draw from it. Everything about our body is not only co-ordinated, but derives a functional value that we don't have to learn but is already known to us. His investigation leads him to assert that our consciousness is *embodied* in the world.

Merleau-Ponty maintains that "the perception of space and the perception of the thing, the spatiality of the thing and its being as a thing, are not two distinct problems." (Merleau-ponty 2003, p. 171). The determination of whether something is "real", to us, or not, is a judgment based on perception. He argues, that a perception of a relationship between:

- one object and another,
- one object and a memory of an experience whether related or unrelated to the object,
- two experiences that are related,
- two experiences that are not related,
- and two metaphors as a second level of relationship,

is neither purely sensory, nor the processing (reasoning) of facts. The decision of whether something is "real" or not is down to the perception of the relations between objects, a process of interpretation that is already embodied. Space features prominently in our narratives of who we are and our position in the world, and we tend to categorize spatiality as an element of our experience. Consciousness is a state that includes both sensing and reasoning. This state will draw on many experiences embedded in memory. For traditional empirical study (against which Merleau-Ponty positions his approach), it is only the pure sense experience that decides and gains our knowledge of every other thing in the world. For rationalism (to which he is also opposed), it is only reason that decides and gains our knowledge (Merleau-ponty 2003, pp. 30-60). Phenomenology attempts a way out of this problematic.

The German philosopher Martin Heidegger introduces two terms that are important to our research: '*ready-to-hand'* and '*present-at-hand'* (Heidegger 1962, pp. 135-144). The ready-to-hand refers to entities that we encounter first before any others, and those which are 'close by.' He offers the example of wearing spectacles. They are close in terms of distance, but they can also become immediate, available, inconspicuous and invisible. They are ready-to-hand. If something is present-at-hand, on the other hand, it presents itself in terms of functional values: with properties that can be measured (optical properties, weight, dimensions).

In a mode of interaction that is ready-to-hand we would expect scale to play a minor role. We just interact with, and react to, our environment as embodied beings. It is only in the event of some kind of perceptual breakdown that issues of scale come to light, and our encounter with objects has more the character of the present-at-hand. There are many situations in which space might present to us as alien, and fully present-at-hand: extreme sports, space travel, hazardous and life-threatening encounters, surreal landscapes, uncanny architectures, and digital interactions.

3. Digital Media

Interactive digital media enable advanced investigation on themes of embodiment and perception, providing an excellent means of testing, comparing, validating and challenging theories about perception. Computers introduce an interesting mode of interaction deploying space as a major metaphor. The Capability of creating a 3D world and filling it with artefacts from our more familiar environments is possible due to the ever increasing power of computer processing.

Our own investigation of embodiment in the world starts with a simulation of the physical world using software such as 3D Studio Max, Maya and Form Z. These programs offer capabilities that range from creating a simple shaded model to creating a full photo-realistic environment, deploying optical effects, and offering the ability to animate this world in different ways. Translating this world from physical form to software constitutes digitisation, creating representations through various algorithmic and mechanical transformations.

There is as yet no efficient procedure for recording and simulating all plausible interactions with a digital environment. So interpretive interventions are required to orchestrate navigation, interaction and behaviours. Multimedia authoring tools such as Macromedia Director, and its ShockWave 3D functions, facilitate navigation through virtual

environments, and allow a degree of user interaction, such as being able to move objects.

In a sense we are working with two metaphors. The first metaphor is about a world or an environment that resembles a physical environment (computer model as physical model, digital world as material world), and the second metaphor is of the interaction between our bodies and the world (screen cursor as hand, digital avatar as body, virtual camera as eye). Metaphors work both ways. Our study into bodily interaction with the virtual world can inform our understanding of interaction in the material world. In the manner of action research, there is the potential to uncover many outcomes. Direct outcomes include insights into the way we understand and interact with space, and the way scale affects this understanding. Indirect outcomes include determining the importance of scale as a cue for immersion in virtual environments, and developing techniques for students to examine and investigate new aspects of their designs.

Space and scale feature prominently in narratives about everyday life, modulated by the spread of digital media to create ever-expanding narratives of communication, containment, boundaries, thresholds, and transgressions.

4. Perceptual Study

The study was conducted in two stages. The first focussed on a taught course for undergraduate students of architecture working for their first degree. The second stage involved research around the perceptions and observations of a small cohort of designers, using the undergraduate material as a resource.

4.1. STAGE 1

The first stage involved a course project on Multi-scale Virtual Environments, in which students were challenged to reconstruct a street of the city as a computer model. Then the unfolded printout of the street model was used to construct a scaled down physical model of the same street. Each student modelled a different street. So the models (digital and physical) could be assembled to create conceptual representations of the city. Students were then asked to use a version of the unfolded physical models to construct a means of transportation in the virtual model, a vehicle that they could use to navigate their virtual environment. The task of designing a vehicle was intended to provoke students to imagine mechanisms of transportation in a virtual environment, and the routes of travelling from one point to the other, and exploring techniques of spatial transformation: folding, bending and twisting surfaces, transforming an orthogonal street model into a folded origami vehicle. The digital models of the vehicles were

put up for auction and shared throughout the group. The next step was to create a computer model of a multi-scale virtual environment suitable for displaying, garaging, accessing, testing and navigating the folded vehicles.

Each student was then was required to provide a simulation of movement through the multi-scale space. The aim was for the students to experiment with different ways of interacting with their models, vehicles and environments. The fact that students modelled physical streets in Edinburgh city, gave them a chance to look at the city in a new light, and to create simulations and animation that question scale and bodily experience. By the end of this stage we had a model of the central area of the city of Edinburgh and a series of animations and simulations.

Not only did this phase of our research provide resources for what follows, but it gave us an opportunity to develop a series of interesting scenarios about scale (a kind of design research in itself), and to develop a sense of how designers think of scale, challenge it, and play with scale. Our research approach fits within the framework of participatory action research (Argyris and Schön, 1989).

4.2. STAGE 2

The second stage was a pilot study using the material created in the first stage. The research comprised a presentation of the material to subjects with a design background, in a room set up for that purpose, and was then followed by a questionnaire and an unstructured interview.

4.2.1. The Presentation

We structured various visual scenarios using Macromedia Director (*Figure 1)*. The presentation contained four categories, each of which had sub categories. Each of the sub categories had an image, an animation, a Quick Time movie or a 3D flash virtual environment. The discussions were recorded to tape.

4.2.2. The Questionnaire

There were nine questions.

1- What do you think this is an image/movie of?

2- Which of the following best describes your impression?

(1= totally disagree, 2= disagree, 3= not sure, 4=agree, 5= totally agree)

2.1-The space is large

2.2-The space is small

2.3-The scale of the space is ambiguous

2.4-I feel lost in the space

2.5-The space is confusing

2.6-The space has a clear structure

2.7-I feel small in the space

2.8-I feel large in the space

The main issues canvassed in the questionnaire were: the scale of the body, the scale of the environment, and the scale of the body compared to the scale of the environment.

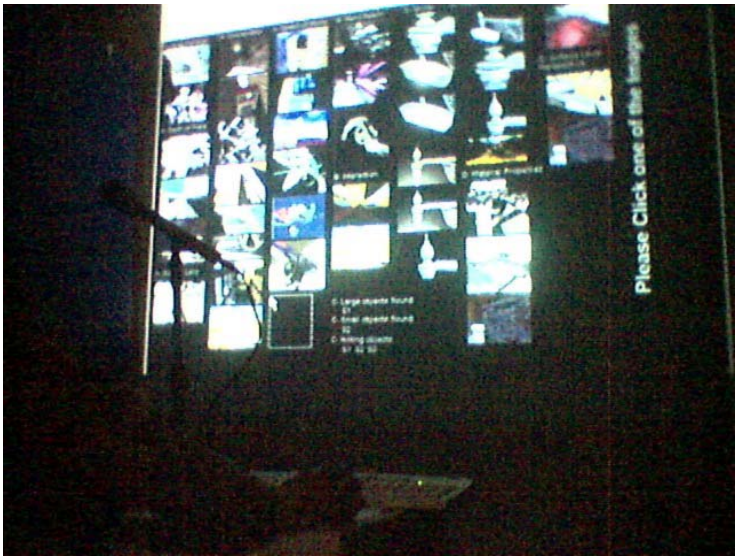

Figure 1. Various visual scenarios using Macromedia Director.
(Photograph by *Aghlab Al-Attili)*

4.2.3. The Unstructured Interview

The unstructured interview explored the motivations behind the answers in the first part, and the way designers articulate their narratives about scale. Below is an extract from one of the interviews, and the way it was analysed to extract codes. Figure 1 shows a frame from the animation presented to the user.

4.2.4. Extract from the First Interview

What do you think this is an image or a movie of?	
	I perceive it some how like a game environment.
But how do you perceive the depth of field?	
	I cannot understand the figures and the shapes, and all of that. I can understand that they are 3D objects. So I see the depth, but I do not recognise the space. So this is why I feel this is, more or less, a virtual space or a game Environment. I do not know something that I do not recognise. And I feel a little bet disturbed by the motion, because I cannot understand the space, and it makes me feel a little bit as though I lose my orientation maybe, and …
So you perceive the depth of field because of the objects basically, and because of that you feel that they are 3D, and therefore, they have to be in a 3D environment that has depth	
	Yes
How do you perceive the scale of your body? I mean, when you go across this motion (points at the animation) for sure, you move and you feel that you have a body, I assume. Do you feel that you have a body?	
	Yes. In the first part, mainly I feel that.
Do you feel this body is large or small?	
	It is both of them but mostly small.
Why?	
	I think because of the details of the environment. There are a lot of things.
How do they give you the feeling that you body scale is small?	
	I could not say.
What makes you feel that you are small?	
	(Pause). Maybe the way that the camera is moving, and the way it is left up and down, and the details of the environment. So I think that before the camera did something like that I perceive it as being my eyes. So I am down. Then and looking up.
So when the camera turn up you perceive yourself as looking at something that is higher than your view.	
	My height, yes.

And the level of your eye view? That is why you thought you were small? But why did not you perceive the objects as being large objects rather than your body being small?	
	Because I do not recognise the objects, I do not have a reference point for the objects.
What about the floor [texture]?	
	My eyes stopped at the flooring, because I could recognise it I suppose. It was familiar.
Still, the floor was not enough to give you a sense of scale. So what you are saying is, generally, because you are mostly looking from your eye level, and you were looking in front of you, or up, that is what made you feel small.	
	[nods agreement]

4.2.5. Extract from the Second Interview

Now you have seen this animation, do you think that the visual field is deep? Do you think it has depth?	
	Yes.
How did you decide so?	
	There are various objects in various parts in the environment.
And how do you perceive the scale of your body in this environment?	
	I am not sure. The way I walk through it, I appear to have a normal size, because I don't feel I am very high up walking over the ground, and I do not feel so close to the ground.
So you decided the size of the scale of your body is normal because of your point of view…..	
	Yes
While the depth of field did not affect your decision. What about the objects, the scale of objects in this visual field?	
	They appear large.
And why did you decide so?	
	Because when the movie enters and I go through objects, they appear to be at least twice the size of me.
Twice the height?	
	Yes, twice my own height.

And that is why you perceive them as big objects and you perceive your body still to be of a normal size?	
	Yes.
Did you try to have any frame of reference on this occasion? As though you can look at the ground and say that the texture of the ground is something I am used to and I can judge myself to be little bit smaller or a little bit larger. Or maybe it is the wall that is on one of the sides, the texture of the wall, relating to that texture.	
	Oh, I get dizzy.
Why?	
	Because it is turning too fast.
I see.	
	Well the floor, it has a pattern. But they could be any size to me. They do not make me change my mind. And the walls do not either.

5. Comparing Both Interview Fragments

Unlike many experiments that aim to detect patterns of interaction, or perception, without looking into details, this study was designed to elicit both. The study raises question about the nature of immersion and how some people report a sense of being immersed when their scale is changed, or ambiguated, in a virtual environment. As the subject of the experiment is a user of the environment, and scale cues are changing dynamically, issues of immersion rise to the surface. How much of what we do in our being-in-the-world entails continuous attempts to fit our bodily scale into the environment, or set our own dimension against the dimensions of other objects? In fact, considering the whole project, this could be seen as a commentary on designing a functional space on the one hand, and adapting the functions of a space to our particular uses on the other hand. Beyond that, the study examines issues of embodiment and interaction.

In the first case we play the role of the designer, and we create environments for exaggerated and fictionalised versions of our bodies. Although that might initially sound like a simple task, it is complicated by the fact that the designer must “re-invent” herself as multiscale inhabitant of different environments. Certain consistencies in these designed environments are called for. In the second stage, subjects were faced with surreal worlds. The usual spatial references to daily life embodiment were distorted or absent.

In the second part, the subjects were not specifically invited to speculate that they may be in some sort of distorted reality, but, like Alice in wonderland, they try to make sense of what is in front of them. During this process, it seems that they give up their basic perception of their embodiment and, step by step, they seem to develop fixations (or obsessions) with different kinds of embodiment. They rediscover their environment in new ways. We will examine these hypotheses through further studies. In the mean time our study provides evidence for the factors that influence our sense of scale, at least amongst spatial designers.

6. Elements Affecting Scale

The interviews corroborated the following scale cues in digital environments.

6.1. VISUAL ELEMENTS

6.1.1. The Oblique Perspective

Among the visual elements affecting perceptions of scale, the oblique perspective, or distant aerial view, has a strong impact. We may feel that our bodies are small and insecure, or huge and looking out over a vast landscape. Where there are familiar scale referents, the body draws on the metaphoric associations between objects and defines its scales depending on its relationship to them. In the absence of a clear frame of reference, there is a fine line between perceiving one's body as huge and overlooking a small environment under its control, and perceiving one's body as a small entity floating over a huge environment *(Figure 2).*

Figure 2. Screen shots of frames showing an environment changing from an oblique view (right) to an elevation view (left). (Model and animation by *Masumeh Geranpayeh)*

6.1.2. Depth of View

When the visual field is extensive, subjects tend to believe that their scale is smaller than normal, while the size of the environment is very large, but the presence of a kind of reference for a scale in the environment will always enhance this feeling *(Figure 3).* The absence of this reference on the other hand encourages the subject to think she is very large and is only observing a very small object.

Figure 3. The element of a stair case acts as a strong reference to the scale of human body and the environment, but when this element is repeated in various scales and in the middle of nowhere, it questions this sense of scale. (Model and rendering by *Armeet Panesar).*

6.1.3. Coordinates and View Angle

The proximity to the ground level is a cue for the subject to seem smaller as proximity to the ground is generally associated with shortness of stature *(Figure 4)*. It seems the reverse is not the case. Having an elevated point of view is insufficient to engender a sense of inflated scale, as elevation is mostly associated with flying, or being elevated on a plane. In most cases, it is sufficient to have a point of view close to the ground, to generate a sense of being small *(Figure 5)*, but it takes more than an elevated point of view to achieve a sense of being large.

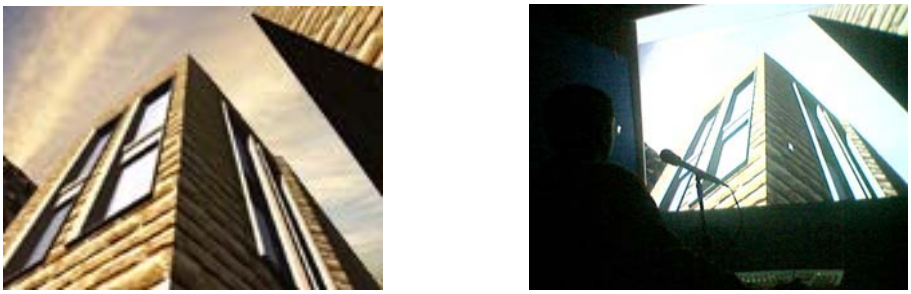

Figure 4. A building from what seems to be an ant eye perspective (left), and a subject looking at it (right). (Model and rendering by Matthew Murphy)

Figure 5. A normal human eye view but with proximity to ground level (left), and a subject looking at it (right). The juxtaposition creates confusion of whether the scale of the viewer is small or big. (Photograph and digital processing by James Whitaker)

Figure 6. Familiar objects at exaggerated scale, like a cup or a beaker, give the impression that the viewer is small. (Model and rendering by *Elizabeth Westmacott*)

6.1.4. Focal Length

Many rendering programs can simulate variable focal length, from wide angle to telephoto. With the absence of a referent, subjects reported confusion about scale where a wide angled lens setting was deployed in the rendering. Yet, a wide angle lens with high curvature is more likely to trick people into believing they are small *(Figure 7)*. A narrower lens creates the feeling of being close to far objects, while objects that already have strong reference to scale appear larger than their normal size.

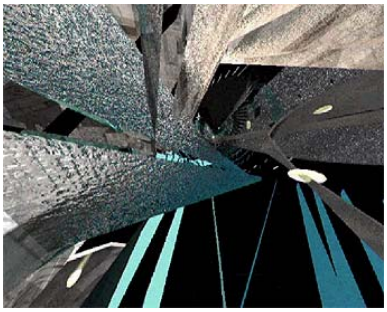

Figure 7. If the objects extend to the edge of the screen then the viewer tends to report that she is small compared to the environment. (Model and rendering by *Bonnie Chu*)

6.1.5. Speed of Movement

Speed of movement of the camera is stronger than many other elements in dictating the size of the subject *(Figure 8)*. Fast speed seems to suggest that the subject is large, but in the absence of other scale referents, fast movement can suggest that the objects encountered are large.

a) Up. *b) Down.*

Figure 8. A subject *(a)*, looking at the motion described in the series of frames *(b).* (Model and rendering by *P. Wang)*

6.2. SONIC QUALITIES

6.2.1. Sound Emitted By Large Objects

Low-pitched sounds suggest that objects are large, but it still means that the subject might be small.

6.2.2. Sound Emitted By Small Objects

High-pitched sound in this case appears to be the best sonic cue for scale. Other low-pitched sounds perceived by the body from the surrounding environment suggest a small scale.

6.2.3. Sounds Giving Hints With or Against the Environment

All sounds that give hints by being associated in real life with large or small objects lead the subject to adapt his scale to suite the size of the object of the sound. For example, associating movement with the sound of scuttling encourages subjects to think that they are small.

6.3. DETAILS

6.3.1. Details of Grime, Rust and Dirt

They suggest equally being close to an object and being small in size. The subject decides his scale depending on the perspective *(Figure 9)*.

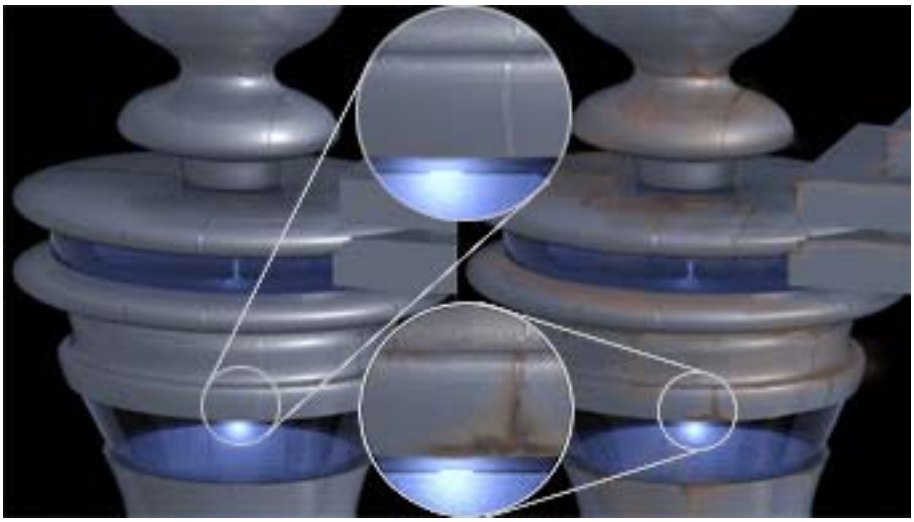

Figure 9. Grime, rust and dirt are not necessarily elements confusing to perception of scale. (Model and rendering by *K. Tong*)

6.3.2. Material Properties and Behaviour

With the presence of photorealistic materials, the subject seems to perceptive the details and properties of these materials. But with the absence of these material properties, the subject perceives the environment as a 2D flat image or a series of flat frames *(Figure 10)*.

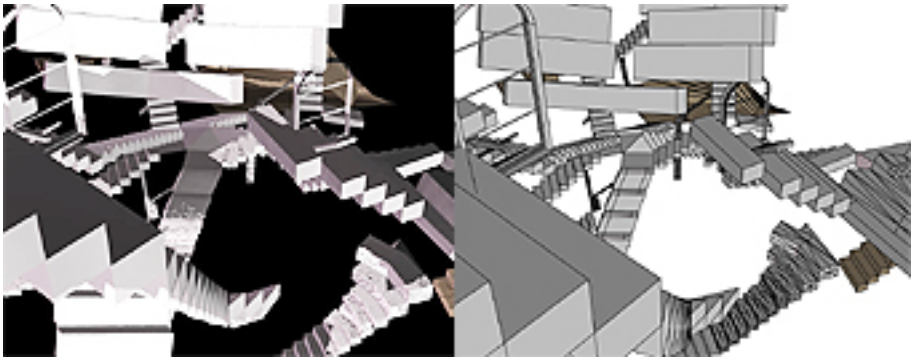

Figure 10. Material properties give the illusion of involvement in space and increases the sense of change to scale. (Model and rendering by *Armeet Panesar*)

6.3.3. Details of Surface Imperfection

Surface imperfection is a major source for confusion. Any details that cannot be seen by the eye at normal scale will be seen, but still not be recognised, if the size of the subject is reduced and the subject is interacting with it.

6.3.4. Details of Surface Level Perspective

Surface level perspective is again a strong cue if the surface is the ground, but if the surface is a wall, and unless coordinates of view take the wall surface as the lower part of the screen, it will not affect the scale of the subject *(Figures 11 and 12)*.

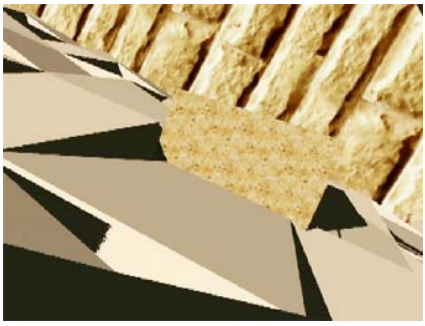

Figure 11. Surface level perspective of a wall. Yet the angle of view suggests movement perpendicular to the wall. This suggests a change in scale. (Model and rendering by Matthew Murphy)

Figure 12. Surface level perspective of a wall but with no change to the angle or scale. (Model and rendering by *Naomi Harris*)

6.4. INTERACTION

6.4.1. Interaction with Objects within Arm's Reach

Having objects within arm's reach is a major contributor to immersion. Once an object is felt to be touchable, it can affect the determination of the subject's scale. The fact that the object is within arm's reach, helps the subject judge the scale of the object accurately. This seems to reflect on the sense of scale of the object *(Figure 13 (a,b,c))*.

a) Moving around an object. (Model and rendering by *P. Wang*)

b) Looking around the space from one point (Model and rendering by *P. Wang*)

c) Having the object rotate in front of the viewer. (Model and rendering by *K. Tong*)

Figure13 (a,b,c) . Screen shots of frames showing the nature of movement

6.4.1. Mode of Interaction with Objects within Spaces

In this section, the subject had the chance to interact with objects in a virtual environment. The subject had the chance to get close to objects, far from them, look at them from different points of view, move in different speeds, and had different versions of the environment with different focal lengths *(Figure 14)*. This showed how the combination of all these elements could affect the perception of scale in virtual environments.

Figure 14. A Shockwave 3D interactive virtual environment of a physical space within the University: the Playfair Library, with small scale (right), and normal scale (left). (Model, rendering and programming by *Aghlab Al-Attili*)

7. Conclusion

This preliminary study indicates that perceptions of scale vary according to a range of factors, and these are interrelated. Presumably concepts of scale already have fairly sophisticated expression in the practices of architectural designers, draftspersons, geographers, and cartographers. Technically, scale is a fixed ratio between the dimensions of the representation and the object being represented: 1:1, 1:50, 1:100, 1:10,000, etc. It is most comfortably discussed in the context of orthographic projection (plans, elevations). In the case of perspective projection, however, scale refers more to the size relationship between the viewer and the viewed object. None of the subjects interviewed had difficulty discussing scale, and change of scale, in this context.

The background experience and training of the subject plays a major role in perceptions of scale. Expectation is a significant theme of perceptual studies in phenomenology. If an object that has the shape and texture of a beer glass or a slice of cheese enters the perceptual field then that triggers

expectations about the size of the viewer in relation to the environment. But as attested by fantastical painting, from Hieronymus Bosch to the Surrealists, familiar objects in unfamiliar contexts create ambiguities that excite the senses in new ways. Most of the imagery presented to the subjects exaggerated the issue of scale in some way, provoked interest, and evoked interesting responses. Designers at least seem to enjoy, and are engaged by, visual imagery that presents ambiguities of scale.

Much of this engagement by the subjects had the character of play. Subjects enter into the "experimental" situation as if participating in a game. They played along with the theme of the study. According to one participant: "I feel like I could crawl into that piece of cheese." We assume that such assertions, and the expressions of feelings of vertigo or dizziness in some cases, were analogous to the putative emotions recounted in the case of watching an engaging film. We are not easily fooled into believing that the images before us are real, but we enter into the experience as in play. The play element was also evident as we observed how respondents would adapt their expectations according to what had already transpired. Each situation in the study further consolidated the rules of play for the next stage. The subjects spontaneously discussed issues, problems, misgivings, and confusions about the images being presented in terms of the theme of the study: scale. To a subject whose experience is being framed in terms of scale, everything becomes an issue of scale. On the one hand this vindicates the issue of scale as a major determinant of our immersion and engagement in digital environments. It is also testimony to the importance granted within phenomenological study to the roles of projection, metaphor, and imagination in perception.

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