Complex Pleasures:

Designing Optional interactions for Public Spaces

Ingi Helgason

2017

A thesis submitted in partial fulfilment of the requirements of Edinburgh Napier University, for the award of Doctor of Philosophy

Acknowledgements

I would like to express my gratitude to all my supervisors; Dr Michael Smyth, Prof Chris Speed, and Mr Chris Hand for their encouragement, support and practical advice throughout the highs and lows of the PhD journey, my panel chair Prof Jessie Kennedy, and my thesis examiners Dr Mark Wright and Prof Mike Phillips for their rigorous engagement with the thesis.

I also wish to thank all my colleagues at the School of Computing, Edinburgh Napier University, and especially those within the Centre for Interaction Design research group, along with all the many other researchers, academics, students and collaborators that I have had the good fortune to encounter over the duration of this project. This thesis would not have been possible without exposure to so many talks, presentations, discussions, ideas and inspirations shared by the wider academic community.

My thanks also go to the student interns who worked on the programming for some of the projects discussed in the thesis, and to the School of Computing for supporting these activities.

Lastly, but importantly, I would like to thank my all family and friends for their support and tolerance during these PhD years.

Contents

Abstract

This research aims to contribute to knowledge about the design of interactive systems sited in public spaces. In particular, the study concerns "optional interactions" where systems invite interaction from passers-by. These systems are action-orientated rather than goal-oriented, are designed to encourage engagement, and offer positive and rewarding experiences through the activity of interaction. This is in contrast to systems that provide functional services that are actively sought out by people, such as ticket vending machines or cash dispensers.

This thesis asserts that this kind of optimal, designed experience can be examined and understood through comparisons with approaches taken by new-media artists working in interactive, technological media. Artists have different priorities, and use different methods to those employed by Human-Computer Interaction researchers, and this study aims to further understanding of the potential of these artistic approaches for interaction designers.

The setting for these optional interaction systems is any public or semi-public environment, including museums, galleries, shopping centres, foyers and urban settings. As well as understanding the public and social context of these interactions, the experiential aspects of interaction are of primary importance in this study. The work is conducted with the aim of providing practical and theoretical resources to interaction designers tasked with creating engaging interactive systems that initiate and sustain experiences that are highly regarded by the participant. The thesis presents a design framework titled the Optional Interactions Design Framework.

Chapter 1: Introduction

1.1 Context: New Hybrid Public and semi-public spaces

This research is situated within the domain of Human-Computer Interaction (HCI) with a focus on Interaction Design (IxD), and is based on the premise that interactions are very different in many regards in the context of public space, in comparison to the context of workplace or private environments. In such public settings, users have to be enticed to engage in interaction, against a backdrop of competing activities and attention-grabbing communication channels. This research is timely because public and semi-public spaces, augmented with digital technology and media, are currently increasing in number and complexity. This presents a pressing challenge for designers of interactive systems, and this research aims to provide guidance for this community.

This thesis addresses the design of interactive systems that exhibit the following key features:

- They are sited in *publicly accessible* spaces
- The interaction is *optional*, from the perspective of the potential users
- They are *action-oriented* rather than goal oriented, in that the interaction experience is its own reward.

This research was undertaken with the aim of increasing knowledge about the nature of "optional interactions" with public installations and systems. Ideas concerning positively regarded, "optimal" experiences are examined in order to increase understanding of the sub domain of interaction design that is concerned with generating these kinds of experiences in public spaces. The knowledge gained from this research contributes to research into the design of interactive systems sited in publicly shared and social spaces. The research addresses computational systems that are not primarily task based, in that there is no driving motivation for the participant to interact with the system other than the experience of interaction itself. A key theme here is engagement; what this is, and how designers can create engaging experiences.

The primary question that is investigated in this research is whether this kind of designed experience can be better understood through comparisons with approaches taken by new-media artists working with similar technological media. The longer term aim of the research is to contribute to a fuller description of the nature of human experience in interactions with systems, through investigating what makes for satisfying or "optimal" interactions. It should be noted here that the emphasis is on this idea of optimal, or positively regarded experience. This is rather different from the idea of simply enjoyable interactions, as it is more complex, and it acknowledges the multi-layered nature of human experience.

1.1.1 Situating the work in the context of public space

The setting for these systems is any public or semi-public environment, including museums, galleries, shopping centres, streets and foyers. As technologies reduce in cost, interactive systems are increasingly appearing in these kinds of spaces, where the presence of the potential user is transient. The purpose of these systems can be practical; delivering information or entertainment based, such as during festival events, or they can be commercial, as in the case of advertising. Often these systems are situated in "liminal" or threshold, in-between spaces, where people are passing by rather than seeking out interactions, and so the interaction with these systems can be described as voluntary or "optional". This means that the systems themselves must invite and encourage interaction with the people who encounter them, rather than providing goal-orientated services that are sought out by people, such as in the case of ticket vending machines or cash dispensers.

As these systems increase in quantity and functionality in our shared public spaces, so the need to investigate and understand their effects on those who encounter them is increasing. In order to provide some background context to the main section of this research, the topic of proxemics will be examined, particularly addressing how this approach provides insight into how social interactions are played out in spatial contexts. Deriving from social science research, particularly that of anthropologist Edward T. Hall, (1982) the thesis argues that proxemics has become increasingly relevant to the study of interactive computational systems, where the system itself can be considered as another "conversant", or social actor within a setting.

1.2 Research contributions: Design Patterns and the Work of Artists

The conclusion of this research project is the presentation of a practical resource intended to be of use to interaction designers and researchers. In his text, "Designerly Ways of Knowing", Nigel Cross (2007) argues that design, incorporating technology, should be considered as a "third culture" in addition to the other two academic cultures of science and the humanities. The methods that are appropriate to the culture of design, Cross states, are modelling, pattern-forming and synthesis, while the sciences use controlled experiment, classification and analysis. The arts and humanities provide less consensus on appropriate methodologies, and this is unsurprising given the wide breadth of topics and viewpoints that the humanities encompass. It is fair to say, however, that rhetoric, reasoning and argument are given more emphasis in the humanities in comparison to the sciences, where empirically supported proof takes a greater priority. One thread that flows through this thesis is a call for the integration of a more "humanities" type of approach toward HCI and interaction design research; one that includes a greater acceptance of uncertainty and complexity, and is unafraid to take a more critical look at the bigger, societal and cultural issues that influence the practical work that is the product of the field of HCI. This resonates with a discussion that has been picked up recently by the CHI community (denoting the US convention for HCI, as used by the ACM - Association for Computing Machinery), with arguments and counter-arguments presented around the direction that the discipline should take (Blackwell 2015, Lui et al 2013). Part of this discussion centres around whether we are working within a scientific discipline or as a multi-disciplinary community, and whether one approach may be detrimental to the other. The position taken in this thesis is that inclusiveness and interdisciplinarity are essential if research endeavours are to be meaningful and impactful, even though this approach can be messy and fraught with methodological problems. Scientific over-simplification runs the risk of reductiveness and disconnect from the real world, which is by its nature a messy place.

Ultimately, design is about practice and making, and is, therefore, an applied research field. It sits in the space between the two cultures of science and the humanities, drawing on knowledge about "things" and the physical world, but also concerning itself with people, cultures and the societies that those designed things and systems will be

used in. The research in this thesis is situated within the approach that Cross describes as belonging to design, and the culminating contribution of the thesis is in the form of a design framework that can be used to inform practice. This research direction is influenced by recent academic discussion on forms of "intermediate-level" knowledge that occupy the space between universal theory and specific design instances.

A recent workshop presented at CHI 2015, titled "Knowledge Production in Interaction Design" (Höök et al. 2015), addressed the perceived lack of shared understandings and articulations of intermediate-level knowledge in the HCI and interaction design literature, and this thesis aims to contribute to this timely discussion. In particular, the knowledge and discussion within this thesis is encapsulated in a form that is aimed at designers entering this field. Methodological framings and structurings, while potentially useful throughout the working life of any designer, can be particularly helpful in the early years, before a designer builds up an internal repertoire of methods and solutions gained through first-hand experience. Influenced by the design patterns approach originally proposed by Christopher Alexander (1977), a set of patterns for designing optional interactions in public spaces is used as a structuring tool in design workshops, and its use and implications are discussed. This is informed by the "Optional Interactions Design Framework", which was developed from the research in this thesis.

The journey towards the presentation of this "Optional Interactions Design Framework" includes an investigation into the approaches used by artists working in the medium of interactive and responsive computation. The types of designed systems that the framework is intended to address may include a partially utilitarian purpose, such as offering information to the participant; for example by providing access to digitised archival collections within a museum setting. However, it is the interactive experience itself that is the motivation for the user to engage with the system, and that is the main feature of concern in this research. Further, it is suggested that achieving a "better" or more optimally engaging experience should be an important aim for any practicing interaction designer, regardless of the purpose of the system itself. Along with the tangible offering of the design framework, the outcome of this research will be an discussion of the qualities of optional, optimal interactive experiences, along with descriptions of how designers could use this knowledge in their practice.

1.3 Art and disciplinary boundaries

As a way of questioning how to design for a good or "optimal" experience, this research looks at the intersection of the domains of Human Computer Interaction and interactive art. For a variety of reasons, interactive art has not been as rigorously scrutinised by the HCI community as, for example, consumer-orientated or safety-critical technologies. However, the value of artistic approaches is being increasing acknowledged by some traditional ICT research communities and agencies, for example the European Commission's Digital Agenda, which includes the new StARTS programme, (**S**cience, **T**echnology and the **Arts**). This initiative directly addresses the benefits of including artistic approaches in the technology agenda:

> *"The constant appropriation of new technologies by artists allows them to go further in actively participating in society. By using ICT as their medium of expression, artists are able to prototype solutions, create new products and make new economic, social and business models. Additionally, by using traditional mediums of expression and considering the potentials of ICT, they propose new approaches to research and education." (European Commission 2015)*

It has been convincingly argued that it is inappropriate to submit artworks to HCI-style user testing and evaluation in order to ascertain whether it is successful as art. Eric Paulos (2007), claims that the goals of HCI and art are different, that critique is not the same as evaluation, and that the work of artists is "*not up for re-design and modification at the whims of gallery users*". Artists, according to Paulos, must be allowed to fail, intentionally, and to make work that is vague. Their drivers are internal and personal, and this does not sit well with user evaluations.

For researchers within any particular academic domain, it can be problematic to venture outside the accepted disciplinary methods and understandings of that field. Both artists "doing research", and computer scientists "doing art", place themselves in vulnerable situations, exposing themselves to critique from outside of their own knowledge "comfort zones". This is one of the inherent difficulties of inter-disciplinary working, as it is usually more comfortable to work alongside those who share our own backgrounds and understandings. However, in a position statement, Phoebe Sengers

and Chris Csikszentmihályi (2003) claim that HCI has much to offer artists, including the design of creative tools, and in return, artists bring different sensibilities to collaborations between art and HCI. The most interesting things happen at edges and boundaries, and so this thesis ventures some way into that zone.

This thesis is situated within interaction design, and so, rather than scrutinising the qualities or merits of any particular artistic output from an art critique perspective, the focus of interest is the experience of interacting with artworks, and the mechanisms that artists employ as they create artworks that include interactivity. Even if interactive artworks may have no functional purpose aside from the generation of an experience, they can nevertheless be considered as a rich and interesting source of knowledge concerning human/system interaction, and design for engagement. The aim here is to uncover new information and generate fresh insight into the particular character of publicly-sited interactive artworks, in the hope that this will be of practical use to a broad range of designers and to those who commission them.

1.4 Research Questions

To summarise, the key questions addressed in this work are:

- What are the experiential themes and methods that interest contemporary artists working in the medium of digital interaction?
- How can the challenging interactions found in digital art be exploited in the design of engaging human-computer interfaces?
- Can insights uncovered in considering these first two questions be framed in a way that is useful to the designers of optional interactive experiences sited in public space?

The main work undertaken within this research project is:

- A qualitative analysis of textual data in the form of interviews with interactive media artists. This analysis identifies themes relating to concepts and strategies for the creation of engaging interactions.

- The construction of an "Optional Interactions Design Framework" informed and inspired by the design pattern approach. The framework is informed by the themes identified in the previous phase of work.

- Presentation of design case studies that illustrate the framework in use.

- Discussion of workshops with novice interaction designers working in the field of responsive/interactive environments, using the themes and the framework to structure teaching activities and early concept generation.
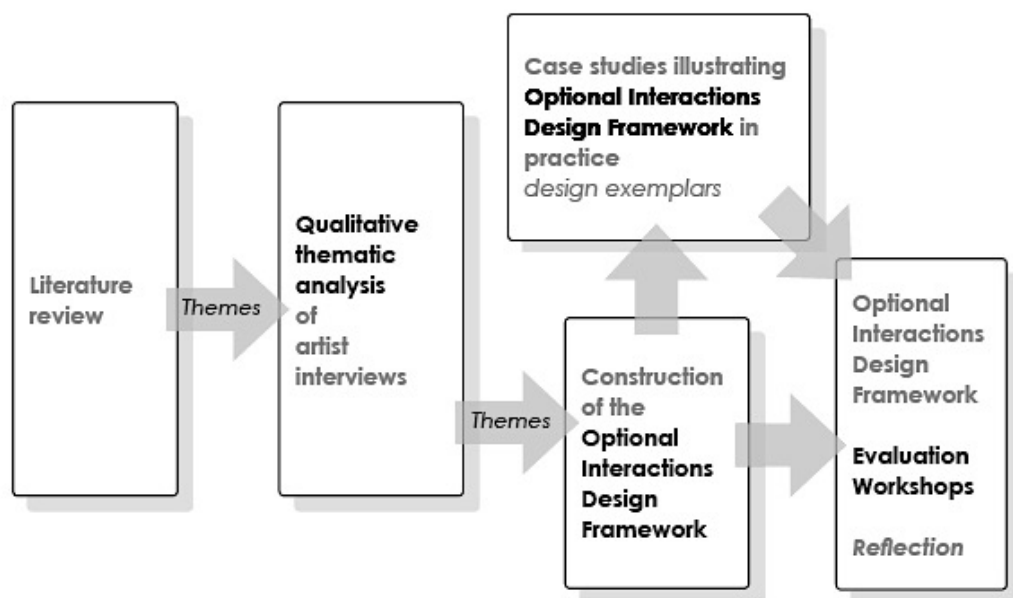
Figure 1.1 Overview of the thesis structure

1.5 Chapter structure and methodology

The literature review is presented in two chapters. Chapter 2 considers the background and motivation for the thesis, and it situates the work that follows within current developments in the domain of interaction design. Chapter 3 continues the literature review, with a focus on installations and systems that have been deployed in public spaces, including a discussion of representative interactive artworks. The conclusion of these two chapters is a summary of relevant and potentially useful themes that emerge from the literature review process.

Chapters 4 to 7 present the main research work of the thesis. The methodology is mainly qualitative due to the thematically-driven, exploratory and open-ended nature of the early research phase. This feeds into a second phase that presents design case studies, with a concluding study that demonstrates how the knowledge gained can be used with practicing designers. In summary:

1. The first phase, presented in Chapter 4, presents a qualitative thematic analysis of interviews with artists working with interactive media. This analysis identifies, defines and describes key emergent themes. These themes are compared with the themes identified in the literature review and, in combination, they form the basis of the first iteration of the "Optional Interactions Design Framework".

2. The next stage is based around case studies, and Chapter 5 presents a discussion of three creative works, developed as part of the research, that demonstrate the influence of the emergent themes identified in Chapter 4, showing that these themes, drawn from artistic practice can have relevance to interaction design practice.

3. The final research phase involves evaluation and reflection. Chapter 6 develops the "Optional Interactions Design Framework" further, drawing on the literature on design patterns. This framework is presented as a potentially useful "scaffolding" resource for interaction designers. Chapter 6 presents the findings and reflections from workshops where this framework was tested with student designers. Evaluation of the workshops was carried out using a variation of the "Creativity Support Questionnaire".

Chapter 7 presents discussion, conclusions and recommendations for further work.

Chapter 2: Beginnings: HCI and IxD

2.1 Introduction: Human Computer Interaction and Interaction Design

This chapter provides context for the work that follows in subsequent chapters by presenting a discussion of the trajectory of Human Computer Interaction as an academic domain, and its relationship with interaction design, which is more focused on informing practice. The chapter situates this thesis topic as residing within interaction design, whilst acknowledging the influence and legacy of HCI.

2.1.1 HCI and IxD: from the beginning

Traditional theories of Human Computer Interaction, developed from the structuralist disciplines of computer science, engineering and information technology, have placed great emphasis on the values of efficiency, usability and the achievement of defined goals. Much of this work addressed the shift that began around the late 1970s as computational technologies began to be used by, and designed for, people who were not primarily working in computer science or associated professions. Since those beginnings the domain has expanded outwards to include many related areas of interest, addressing newly emerging technologies and contexts of use. A look at the archive of the Association of Computer Machinery Special Interest Group for Computer Human Interaction (ACM SIGCHI www.sigchi.org) conferences reveals an evolving concern with sub-topics such as tangible, mobile, virtual and augmented reality, and ubiquitous computing, with a conference on spatial user interaction as a more recent addition.

The development of the discipline of HCI over the past few decades is well described and documented in papers, textbooks and articles, such as the overview of HCI by John M. Carroll (2014) in the online Interaction Design Foundation encyclopaedia. Carroll emphasises the evolving and disparate nature of the many strands of human computer interaction, describing it as an aggregation of semi-autonomous fields of research and practice. This breadth is presented as a strength, rather than a weakness, contributing to

a vibrant and productive field of intellectual endeavour. Carroll's view is echoed in this thesis, and it is hoped that the mixed-methods, qualitative approach used in this research is seen as a worthwhile contribution to this ongoing academic debate.

2.1.2 From CSCW to the third wave

In the decades since the 1970s, the design and study of computational systems has developed through several phases, or "turns" to borrow from social science terminology. In the early years of HCI, as computers became affordable enough to be installed in offices and factories, workplace productivity developed as a topic of interest, addressed through sub domains such as computer supported cooperative work (CSCW), human-factors engineering, and cognitive engineering. The physical settings and artefacts of office work became one of the dominant overarching metaphors for interface designers at this stage of the development of human-computer interaction, with the familiar desktop metaphor emerging as a robust and popular instantiation of this approach. Graphical user interfaces (GUIs), incorporating the windows, icons, menus and pointers (WIMP) format developed at this time are still commonplace design features.

Jonathan Grudin (1990), writing right at the end of the 1980s, presented a five-stage framework of the development of computing at that time. Beginning with a focus on hardware in the early 1970s, then shifting to a concern with software in the 1980s, due to the rise in products such as office productivity applications. The third stage is where Grudin placed computing development at the time of writing, and he described this as a focus on the interface itself, the display and keyboard, and the ergonomic issues that they presented. This, Grudin argued, is where HCI became a distinct discipline. At the start of the 1990s, the next, fourth stage was just beginning to appear, and this was a focus on the users and their dialogues with the system and applications. Cognitive issues were beginning to assume more importance in addition to the perceptual and physical, motor aspects. Grudin framed interaction with computers as a "conversation" (p262), and he went on in the paper to develop this idea of computation as a relationship or partnership, describing the computer as becoming an active agent, "learning" about its environment (p263). The fifth stage, he speculates, would concern

groups working together and an increasing concern with social and organisational contexts.

The pioneering work carried out during HCI's formative years in the 1980s and 1990s, at such research centres as Xerox Parc, Apple, Microsoft, the Stanford Research Laboratory, and the Massachusetts Institute of Technology, has largely shaped the way we still currently think about using computers in all their guises. Supporting Grudin's five-stage framework idea, this "second generation" of HCI research, discussed by Liam Bannon (1991) shifted the focus away from the system and the task towards the human, drawing on methods and theories from the behavioural sciences, particularly psychology and anthropology. Bannon made a call for alternative perspectives, particularly for more consideration of the underlying values and motivations of people involved in the work setting. He put forward a suggestion that the term "human actors" rather than the more conventional term "users", better describes people as having autonomous agency, rather than playing a rather passive role in the interaction. This term "actor", is a useful one, not only for describing people, but also for labelling elements of the system that display features that may be perceived as also exhibiting varieties of autonomous agency. This is a particularly relevant theme in this research thesis, and the ideas of "actor" and "agency' will be revisited later in this work.

Susanne Bødker (2006), used the term "second wave" HCI to describe this era in the lifetime of the domain. She defined this as the study of groups working with collections of software applications, within communities of practice. Theories such as distributed cognition, and situated action (Suchman, 1987) were important influences to HCI at this time, along with a turn to a more user-centred approach to design inquiry. By contrast, Bødker suggested that a "third wave" of HCI was emerging in the mid 2000s, in which broader contextual and cultural influences began to assume more importance. Technology at this point in time was becoming more mobile and more personal, blending home and work in a more complex, multi-layered way. Purpose and task achievement were less in the spotlight, making room for the emotional and experiential rather than the emphasis on the cognitive.

2.1.3 From HCI to IxD, the role of context and interpretation

From the discussion so far, we can see that the design of computer systems for human use has developed as a domain from its beginnings and has widened out to become an interdisciplinary field, appropriating knowledge and methodologies from the social sciences. There is no question that HCI has been hugely influential as an academic and scientific discipline in advancing understanding of the relationships between humans and technology. As computation has spread out into a multiplicity of design areas, those responsible for the creation of successful, and commercially competitive, interactive products and services have looked wider for knowledge and inspiration. In the late 1980s, Bill Verplank started working with Bill Moggridge at the design consultancy that would become IDEO (Baty 2010). They began to use the term "interaction design" to describe their work, which they saw as merging and modernising HCI and industrial design. This term reflects the more "designerly", applied and problem-solving approach of interaction design, in contrast with the more "scientific" and explanatory aims of HCI. In contrast, Fallman (2003) considers this design-oriented attitude as existing within the boundaries of HCI research rather than alongside it, and breaks it down further into three approaches. These are; a solution-focused view, that considers design as an engineering activity; a designer-focused view that places individual creativity at the fore; and a contextual, situated view where the designer is carrying out a process of interpretation of the particular situation. This latter view seems to be the most closely aligned with the work presented in this thesis, although the other two approaches also have relevance.

2.1.4 Designing for optimal, rewarding experiences

While there has been increasing interest in researching pleasure, enjoyment and ease of use in the interaction with products and services in the last couple of decades, less is understood about the nature of engagement with designed systems that offer complex, demanding and ambiguous, but perhaps ultimately more rewarding, experiences. The discipline of Human Computer Interaction (HCI) has invested a great deal of effort in the creation of "successful" user interfaces and this work has been informed by the study of both the computer system and its user, drawing on such domains as computer science, cognitive psychology, ethnography and anthropology. In this context,

17

successful interactions are generally seen as relating to efficiency and goal achievement, although there has been attention paid more recently to issues relating to the experience and perceptions of the user, such as affect, engagement, emotion and aesthetics. The recent focus on human emotional aspects within interactions with computers has lead to the rise of such fields as affective computing (Picard, 1997), and emotional design (Norman, 2005) as research areas.

While these developments have proved to be of great value to designers, they have tended to focus on goal and task orientated interaction, even when this is within a context that is not productively work orientated. That is to say that the pleasurable interaction remains as a means to achieve a focused and pre-determined goal. The ubiquitous and thoroughly discussed Apple products such as the iPod and iPhone are essentially functional items even though their interactive qualities provide their owners with a great deal of satisfaction and pleasure. Much of the success of these products seems to be attributed to such perceived qualities as intuitiveness, naturalness and simplicity in use. These qualities make the goals of playing music, sending emails and making phone calls pleasant and satisfying rather than difficult or aggravating.

It is recognised that there is a lot of work still to be done in describing and defining user experience as Hassenzahl and Tractinsky (2006) have asserted:

> "*while UX is well discussed on conferences and symposia, it only rarely enters the relevant academic journals. We believe that the lack of empirical research is one of the reasons for this.*"

This lack of research may, in part, be due to the problematic nature of studying and defining qualia; the subjective nature of individual experience. Löwgren and Stolterman (2004) point out that:

> "*usability engineering's focus on measurable usability has also been the target for increasing criticism. There is always the danger that a measurement-oriented development process is drawn towards aspects that are easy to measure-such as superficial questions concerning the user interface or time efficiency for contrived test tasks in lab environments that do not have much relevance for real use situations.*"

2.1.5 Creativity as a design resource

Creative designers and innovators have become increasingly occupied with the experience of interaction itself, rather than with the ergonomic aims of reducing the barrier between human and technology. As computation has spread out beyond task-oriented, work-focused situations into domains such as entertainment, education and social communication, new opportunities to consider interaction in different ways have presented themselves. In interaction design (IxD), and its close relative, experience design (UX), the experience of interaction itself can be deliberately and carefully designed for, rather than being seen as a potential irritant or inconvenience to be mitigated against and diminished in the drive for efficiency and productivity. IxD and UX practitioners are looking to a range of creative disciplines, such as communication theory and graphic design, for new perspectives on the development of enjoyable and satisfying interactions. Professional designers of visual, aural and haptic experiences have become respected as authorities on the creation of pleasing human-computer interfaces for the communication of information, the completion of tasks and for entertainment. In the context of public, social spaces, these elements have already been creatively exploited by designers creating systems for the presentation of information to a general audience. An example of this kind of experience is the Floating Numbers temporary exhibit created by art+com (2004) for the Jewish Museum in Berlin:

> "*floating.numbers is a 9 x 2 meter interactive table on which a continuous stream of numbers is floating. Individual digits appear randomly at the surface and, once touched by a visitor, reveal their meaning in text, pictures, animation and small interactive applications. The significance of the numbers materialises from the various perspectives of sociology, religion, history, mathematics, art or one's outlook on everyday life.*" *(https://artcom.de/en/project/floating-numbers/)*

Figure 2.1: Floating.Numbers, interactive tabletop museum exhibit, art+com

This exhibit offers information to the visitor in the form of small self-contained texts with images, and the visitor can read these if they so choose. However it is the interaction itself that is the attraction of the exhibit, enticing visitors in on a more visceral level. In this way, the museum draws visitors into the "interaction zone" in order to present them with selected information that they might miss if presented on a less engaging system. As a research question it would be interesting to investigate how much more, or less, of the texts the visitors read and absorb in an exhibit such as this compared to, for example, posters on the walls. Furthermore it is worth considering how, and to what degree, to measure the success of an exhibit such as this; perhaps by information remembered and retained, by encouraging personal reflection, or by favourable subjective responses to the interaction process. Clearly the different stakeholders in these projects will have varying priorities in terms of measurement of success, be they museum curators, artists or audiences themselves. This presents challenges for the working design team who must define their measurable success criteria in collaboration with the commissioning client. This is a rather different relationship than would be seen between artist and client, although the field of interaction design is increasingly producing examples of hybrid or crossover practice between art and design, (Rodgers and Smyth 2010).

2.2 Seams and difficulty

2.2.1 Visions of ubiquitous computing

To appropriate a famous opening line, it is a truth universally acknowledged within HCI, or at least in some sections of the discipline, that interactions should be as unobtrusive as possible. This is a particularly dominant viewpoint in pervasive or ubiquitous computing, as encapsulated in Marc Weiser's oft-quoted opening line to his influential 1991 article; "*The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.*" (Weiser 1991). In this beguiling vision, hardware and software form a seamless backdrop to daily life, responding to our needs and wants without us even noticing that they are there. Technological and scientific developments have taken a couple of decades to catch up with the vision, but recently technology companies have been producing appealing envisionments of exactly what this kind of technology might mean for the consumer in the near future, for example in Microsoft's "Productivity Future Vision" video series. These short film scenarios show a range of attractive professional people, effortlessly managing their work and domestic lives through undemanding encounters with numerous interactive, data-reading, familiar objects. Phrases like "friction free", "fluid mobility", "interact naturally", and of course, "seamless", are sprinkled through the accompanying text, echoing the sentiments in Wieser's vision. In this world, computing does not intrusively demand our attention, instead it "*invisibly enhances the world that already exists*" (Weiser 1991).

Since this vision of our relationships with new forms of technological systems was first expressed, it has attracted a great deal of interest due to the considerable implications on interaction design. Chalmers and Galani (2004), explain that Weiser intended that interaction with a mixed media, heterogeneous system should feel seamless - that is, that the whole system of physical objects and software can be conceptualised as a single entity during use. This is not to say that the boundaries between the objects should not be perceivable - the technology itself is "seamful", but the experience of interaction in the moment is seamless.

2.2.2 From Technological to Social

Dourish (2001 p18) addresses similar themes, and presents the idea of embodied interaction as a contrasting approach to the positivist, cognitivist view that separates the conscious, rational mind and the objective, external world. In the cognitivist model favoured by many in the HCI and engineering domains, the thinking, rational mind makes decisions about how to act upon, and affect, the external world. This view enables the construction of experiments to observe and evaluate the effects of various differences between systems, as the resulting behaviours are likely to be fairly stable according to particular rules. The embodied interaction approach, on the other hand, emphasises the tight connections between our constantly changing, lived experiences, and our social and physical presence in the world. In this model, we explore the specific physical and social settings that we find ourselves in, and we construct interactions in response to this environment in a participatory way. This introduces the idea of parallels and similarities between person/system interactions and person/person interactions, where two or more "actors" have agency within the interactive situation. In the same way that human, social conversations are jointly constructed in response to the particular situation they occur within, so interactions with technology are often highly influenced by their contextual, temporal and environmental conditions. Chalmers and Galani (2004) describe this circular process of interpretation, where perception and activity are both influenced by, and also change, understanding of the use of a given system. In this way, the actors within the interaction can be working consistently with each other, but not necessarily aligned with the intention of the designer, or with any other instance of interaction that may occur at another time. The authors suggest that designers may consider utilising limitations of systems in order to support this social interaction, and they term this "seamful" design. This theme of modelling technological interaction on social interactions will be explored further in this work.

2.2.3 Problems as design resources

An important aspect of the idea of embedded interaction is the notion of the system's continuous awareness and implicit monitoring of conditions and situations. Feedback and visibility of the state of the system are key design principles for HCI and

interaction designers, as outlined in Jakob Nielsen's (1995) important usability heuristics for user interface design, presented in 1995 and still useful and widely used today, two decades later. This attitude reflects the aim of cognitive clarity and the smoothing out of effort that was at the heart the human factors and engineering domains, at least in the formative years of HCI. There are, however, questioning and dissenting voices, who claim that difficulty, and aspects that could be framed as "problems", can potentially become useful design resources. This thesis addresses what these voices have to say about interaction design, specifically within the context of public, socially sited interactions.

2.2.4 Alternative views on Interaction Design: Introducing complexity

Moving from the engineer's and the computer scientist's view of HCI and interaction design to a more creative and art-informed perspective, it is possible to trace an alternative timeline of the development of thinking around this domain. Trained as an industrial designer, and until recently the head of the Design Interactions programme at the Royal College of Art in London, Anthony Dunne, writing in the late 1990s, criticised the views of the human factors community. They treated all technical design, whether domestic or workplace oriented, he claimed, as problems to be solved in a rational manner, lacking an understanding of nuance and human quirks (Dunne 2005 p2). Making a plea for research in the realms of metaphysics, poetry and aesthetics, Dunne (2005, p23) stated that designing objects that will not confuse or disappoint is not an adequate aim. He described this as an attempt to make systems understandable to users and was critical of the value of this pursuit. To quote:

> "*In the human factors world, objects, it seems, must be understood rather than interpreted. This raises the question: are conventional notions of user-friendliness compatible with aesthetic experience? Perhaps with aesthetics, a different path must be taken: an aesthetic approach might subsume and subvert the idea of user-friendliness and provide an alternative model of interactivity.*" *Dunne (2005, p23)*

In this book, "Hertzian Tales," Dunne went on to propose that design research should explore new roles for electronic objects, in an age where optimal levels of performance are already attainable at moderate cost.

23

> *"In a world where practicality and functionality can be taken for granted, the aesthetics of the post-optimal object could provide new experiences of everyday life, new poetic dimensions." (p20)*

In a later text on the emerging field of interaction design Moggridge (2007) Dunne, working together with Fiona Raby, elaborates on this approach:

> *"I think what we're researching, really, is the idea of complicated pleasure. The pleasures you get from reading a book or watching a film are the kinds of things we're exploring in relation to products. How can you design products that provide complex and complicated pleasures, that stimulate our imaginations, create dilemmas, make us think, and rather than smoothing out our lives, actually create glitches?" (Dunne p595)*

It is this intriguing juxtaposition of complexity and pleasure that is one of the underpinning ideas in this research, and is the inspiration for the title of this thesis. In the introductory author's note to the short story collection, "Einstein's Monsters", Martin Amis states that the stories have no purpose at all, except the usual purpose of fiction writing, to give pleasure, "*various kinds of complicated pleasure*". This thesis is addressed to interaction designers, not to authors of fiction, but the motivation is similar in that it concerns how to increase understanding of this design aim: to better understand how to design for experiences that go beyond the simple.

2.2.5 Designing difficulty

This thesis argues that designing a difficult interactive experience, one that embraces seemingly negative or counterintuitive qualities, can be appropriate in situations where interaction is both optional and action-orientated, rather than where it is prescribed, necessary or goal-orientated. In other words, "walk by" rather than "walk up". This area of interest has received attention recently in the HCI research community, as discussed by Hespanhol and Tomitsch (2015), particularly in relation to urban spaces, a domain that closely overlaps the realm of "public space". The authors provide an overview and analysis of the current state of the field, and claim that, despite increasing interest and activity in recent years, "*a more focused discussion regarding strategies for intuitive interaction in interactive public spaces is still lacking in the field.*" Despite the design

motivation of fun and pleasure rather than task completion, they claim that the goal of intuitive interaction should be a priority. The authors present strong arguments for this emphasis:

> "*public spaces pose challenges regarding crowd management and scalability that beg for intuitive approaches in order to ensure the smooth flow of the experience while also taking into account broader norms of behaviour in public and the transient nature of these interactions*."

We can see here the idea of smoothness appearing again as an important goal in order to deal with the problem of managing dynamic and unpredictable, social and collective situations, very much in line with accepted HCI wisdom. To examine this further, intuitiveness is defined largely as drawing on the user's previous familiarity with similar features, and also with internal consistency thereby reducing cognitive load. Evoking the ideals of ubiquitous computing discussed earlier, Hespanhol and Tomitsch (p8) assert that "*such interactions should thus be a seamless process, immediately learned and performed almost unconsciously*". While accepting that there are robust and defendable reasons for this viewpoint, this thesis puts forward an alternative view, questioning the premise that smoothing out the interaction wrinkles is always the most appropriate design approach.

2.2.6 Difficulty, intuition and exploration; finding the sweet spot

As an example to illustrate the discussion so far, it may be useful to compare the experience of interacting with two websites, each exhibiting very different design approaches. The site of the Nielsen Norman group (www.nngroup.com) follows the rules for excellent usability and information structure as would be expected from the public face of a service offering evidence-based user experience research, training, and consulting, from highly acclaimed experts in the field (the group's principals are Jakob Nielsen, Don Norman and Bruce "Tog" Tognazzini). The high-level menu is clearly placed following website conventions, near the top of the browser window. Sections of text that are hyperlinks are indicated with the conventional light blue colour, turning red and becoming underlined as the curser hovers over them to communicate interactive functions. They also change colour once the page has been visited to assist the user in their navigation in accordance with accepted rules on interface design. Most

people familiar with viewing websites on a desktop or laptop browser would easily be able to navigate the site, comprehend the structure of the content, and find the information they are looking for. As an aside, the site does not, in 2015, seem to have a responsive or mobile version online.

As a contrast we can look at the site of actor Jim Carrey (Figure 2.2). Superficially this website serves some of the same functions as the Nielsen Norman group site in that it is a source of information that seems to be aimed at a fairly broad demographic, although the N N Group is more overtly concerned with selling of services through the site. Jim Carrey's site primarily presents news relating to the activities of the actor. Designed by 65 Media in 2009 (www.65media.com), the Flash-based site has received several awards from the interactive media industry. A richly visual and cinematic site that reflects the darkly comic roles that Carrey is known for playing, the site breaks with usability conventions and encourages exploratory behaviour from the visitor. The graphics are constantly animated and evolving on the screen, even in its resting state. Objects move and float around the screen, appearing and disappearing from behind other objects. Items animate as the curser move over them, but it is not always clear whether these are clickable objects or not, the user has to try it out to see. Web Designer magazine (2010) describes the design as;

> "*bizarre, imaginative and enchanting… like a guessing game*" *going on to state*, "*this site isn't going to win any prizes for usability. Navigation is hidden within the imagery on the page, so the user is often left feeling like they've stumbled across a section by accident.*"

This statement raises questions concerning the measurement of the success of this design in comparison to the N N Group site (Figure 2.2). Questions concern the merits of qualitative versus quantitative metrics. In planning an evaluation we could presume that the high-level goal of the NN Group's site is to generate a high level of sales, but sub-goals would involve the removal of any barriers to task completion. The severity of these barriers could be quantitatively assessed using usability metrics, such as time taken to complete tasks, and percentage of tasks completed successfully.

Figures 2.2 a & b: Screenshots from www.jimcarrey.com (downloaded July 2015)
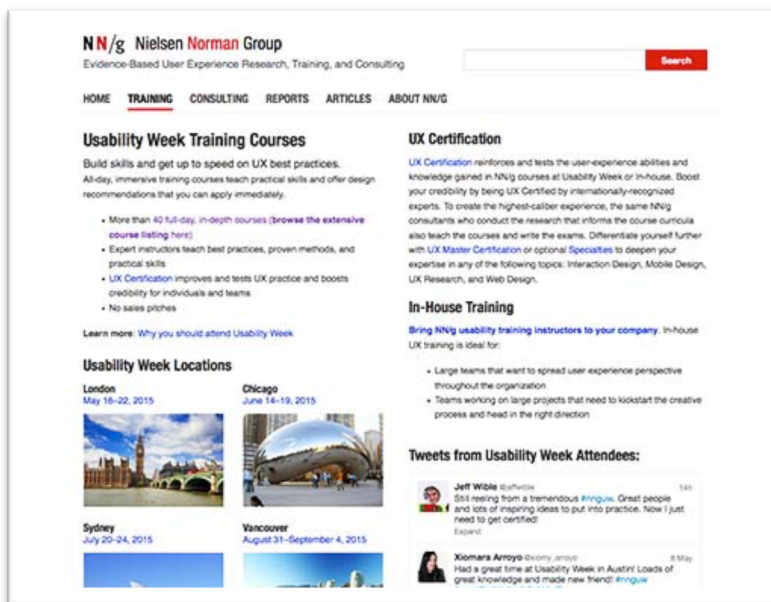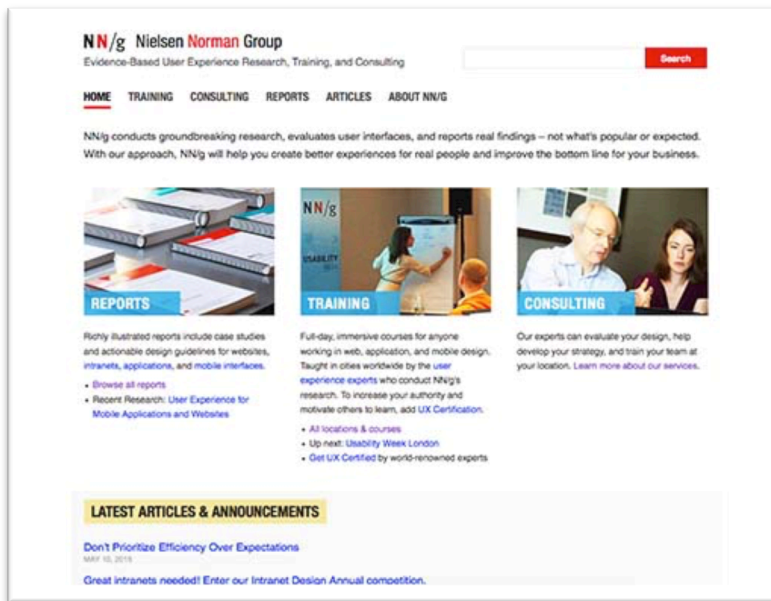
Figure 2.3 a&b: Screenshots from Jakob Nielsen's www.useit.com (downloaded July 2015)

In contrast, looking at Jim Carrey's site it would seem that the primary aim of this work is to interest and excite the visitor, creating a positive disposition towards the actor, and reinforcing perceptions of his identity and character. There is certainly information to

be found on this website, but deriving pleasure from the journey towards finding it seems to be of greater priority than the destination itself. Evaluating the success of this endeavour is a more problematic task, although website analytics could certainly show how many sections of the site were visited, and by how many users, and questionnaires could test for such aspects as satisfaction ratings. Some studies have shown that satisfaction and usability are perhaps not always as closely linked as may be assumed, as discussed by Lindgaard and Dudek, (2002). They found that a website with high appeal, but very low in perceived usability could nevertheless be rated as highly satisfactory. Low usability, therefore does not always seem to be a barrier to positive engagement, which might explain the apparent success of the Jim Carrey site. A further question would be whether the poor levels of usability, according to the conventional definition, may actually enhance the interactive experience by presenting some kind of engaging challenge to the user.

Jim Carrey's website is evidently a "design" rather than an art piece, as it has been commissioned as commercial work, but the visual aesthetic of the site is clearly influenced by the work of artists such as Hieronymus Bosch and Salvador Dalí. It may be that investigating this further will elicit insights into the design of engaging interactive experiences, in particular how best to combine "art" and "design" methodological approaches.

2.2.7 Commuting or flânerie

It would be an oversimplification to suggest that all interactive systems should be designed to prioritise fun over efficiency, but introducing a journey metaphor might be useful as we compare the aims of designing for the action and designing for the goal. While a busy commuter may only be concerned with arriving at a specific destination in the shortest time while expending the least amount of effort and cost, the flâneur and the psychogeographer by contrast, see the urban streets as a rich medium to immerse oneself in for the sake of the experience itself. Writing in 2010, Elizabeth Churchill, of Yahoo! Research, expresses concern about the potential of emerging mobile and location-based services as she addresses the sites of control and agency within the human-technology relationship. She concludes her piece by asking a pertinent question:

"…should we worry about the provenance of the algorithms and services that underlie our location-based recommendation systems and the value systems that are embedded therein? As I continue to muse, I suppose I should also ask who is the actual flâneur: Is it me or is it my trusty iPhone companion? Or are we so much a networked cyborg hybrid that it is not worth making the distinction?" (Churchill 2010)

In 2015, as this thesis is completed, it is very noticeable how enticing, media-rich technologies are spreading across our urban and public settings. What is also evident is that these are largely driven by commercial interests. The vision portrayed by advertising companies such as JCDecaux (www.jcdecaux.co.uk), who describe their work as "out-of-home media", is becoming difficult to distinguish from the dystopian future visions presented by films such as Bladerunner (1982) and Minority Report (2002). Both of these films trace their origins back to science fiction writings by Phillip K. Dick. The argument presented in this thesis is not anti-commerce, but it does call for balance in the representation of interests when introducing new technologies into our shared environments. While issues of control, negotiation and ownership of public space may be complex, all of us deserve to experience our physical environments in varied, engaging and inclusive ways. Each of us should be able to enjoy the rich experience of being a flâneur at times without the feeling that we are reduced to being categorised simply as a target market.

2.3 Interactivity and experience

2.3.1 Defining Interactivity

"Ce sont les regardeurs qui font les tableaux" – It is the onlookers who make the paintings. (Marcel Duchamp)

As the background topic of this study is interactivity, it would be useful at this stage to briefly interrogate that term and consider how it has been described and framed to date. It would seem that this is a concept that is conceptually familiar but it is nevertheless

one that remains contested, and it is rather difficult to pin down and describe. The aim of the discussion that follows is to consider some of the ways in which it has been defined to date, and to assess which of these might be the most useful to inform the work that follows.

Downes and McMillan (2003) provide a helpful starting point, suggesting a conceptual definition drawn from a qualitative study of how individuals perceive interactivity in the context of computer-mediated communications. Articulating a human-focused perspective, the authors describe some uncertainty in attempting to express a clear definition, and they suggest that interactivity is a multi-dimensional construct, with each dimension represented on a continuum. Although they also recommend the user to be the main focus of study, Rafaeli and Ariel (2009) propose an alternative approach, treating interactivity as a uni-dimensional variable rather than a multidimensional construct. This is an attempt to address difficulties around ambiguity by presenting a well-defined and measurable definition. The authors aim to reduce the diversity of definitions in order to handle interactivity as a streamlined concept that is more amenable to study and investigation, and one that can be generalised beyond specific situations. The performance of participants can thus be measured, with consideration of both the participants' perceptions, and their process of interaction in order to assess levels of interactivity. In their survey of studies from various fields, Rafaeli and Ariel also identify a distinction between the focus on system functionality and a focus on users. Authors who present the system view of interactivity tend to discuss the quantity and quality of features that the system offers to the user, while the user view tends to emphasise the degree of control that the user can exercise over the system.

Manovich (2001, p55) goes as far as to state that interactivity is in fact not a useful term to use when applied to computer-based media as this is inherently interactive, and therefore the term is simply too broad to be useful. Modern computing enables the user to control and manipulate representations of information and media in real-time, and therefore the concept of interactivity is a fundamental fact about computers. Manovich prefers to deal with particular sub-types of interactive structures and operations individually, and he claims that these are relatively easy to specify. Much more difficult, according to Manovich, is to apply theory to users' experiences of these interactive structures. He alerts us to the danger of interpreting physical interactions

between user and system too literally, at the task and action level, at the expense of considering psychological processes. These internal, mental processes of analysis and synthesis, essential for comprehension, are private processes and therefore are resistant to investigation. To design for interaction, claims Manovich (p61) is to force the user to externalise these processes and is asking the user to follow the mental trajectory of the designer, rather than allowing individuals to follow their own paths. This theme of presenting interpretative freedom to the user (visitor/spectator) is one that emerges in discussions of interactive art.

In considering playful experiences that are satisfying in their own right, Polaine (2005) is dissatisfied with Manovich's evasion of the physical aspects of interaction, and proposes a simpler model. He suggests a recursive feedback loop of action and reaction cycles as an interaction model, drawing on the theories of play and gaming. Successful interactivity, he claims, needs simple rules in order to sustain a playful and absorbing experience. This approach would seem to be of more practical use to the designer, but Polaine adds a cautionary note in his conclusion, reminding us that extracting out the interactivity from the other elements of a finished work is a substantial challenge. In attempting to analyse the success of the interaction design aspect of an entertainment system in terms of engagement and immersion, he says, it is difficult to separate the interactivity from the visual and sound design, the usability, and so on that comprise the whole experience.

Moving closer to the domain of technological art, Frank Popper (2007, p181) also favours a rather specific definition; "*Interactivity can be interpreted as the ability of the user to manipulate and affect one's experience of the media directly, and to communicate with others through media*". This view places the user firmly in the controlling role, driving the technology for a particular purpose. He elaborates on this (p220) in a discussion of participation and interactivity, to explain that in an artistic, interactive work, the artist makes a calculated decision concerning the level of freedom to present to the user/spectator. Through the design and structure of the work, the artist chooses to delegate a certain level of control in order to enable reciprocal creative activity.

Lister et al (2009 p21), in their attempt to define key concepts relating to new media, acknowledge the variation in viewpoints on interactivity, and also assert that to describe a system as interactive is to designate it as having some kind of added power, lacking in "old" media. As this was written several years ago, it would be fair to speculate as to whether this "specialness" still holds to the same degree. Anecdotally, it seems that "interactive" is losing its impact as shorthand for novelty and excitement in the marketing of digital products and experiences. Interactivity is becoming increasingly taken for granted in new generations of products and services, and is becoming less useful as a differentiating concept.

2.3.2 Interaction as Dialogue

We can see from the discussion so far that interactivity can be considered broadly from two perspectives, the system-centric and the user-centric, but it is also important to remember that, like all other forms of human activity, interacting with technological systems is never separate from the particular situation or context in which it takes place. A particular context can comprise of physical, temporal and social elements, and this latter topic will be addressed further as it is an obvious metaphor for interactivity. In his reflective essay, contemplating the theory behind the field of interaction design, Kolko (2010 p11) begins his opening chapter by stating that, "*Interaction Design is the creation of a dialogue between a person and a product, service, or system.*" He elaborates on this by explaining that the dialogue is usually found in the world of behaviour, and in order to shape this behaviour, an "understanding of the fluidity of natural dialogue, which is both reactionary and anticipatory at the same time", is required by designers. This brings us back to the previous discussion of actors and agency, and how these roles may be distributed within the interactive situation.

So, in this thesis, dealing as it does with creative artworks, open and public spaces, and serendipitous encounters with interactive systems, it would seem that a social, contextual and experiential perspective on interactivity would be appropriate. This perspective considers interactivity as dialogue or discourse between human (or humans) and systems, with the entire technological system and its physical situation being considered in a holistic and integrated manner.

2.3.3 Design for Experience

This section deals with the topic of "experience" as it relates to interaction design. This thesis addresses design-focused questions around the creation of appropriate experiential conditions in the context of optional, optimal encounters with interactive systems. Breaking this down, we can see that it is necessary to address several elements, firstly considering what experience means in the context of interactive systems, and then looking more closely at the optimal aspects.

2.3.4 Optional and Optimal: Supporting Positive Engagement

Before considering how to design for positive experiences it is necessary to describe them. This is naturally a challenging endeavour as experience is both personal and subjective, making it difficult to articulate accurately and in detail. The language and analysis of such qualia, or qualitative perceptions, have been tackled by psychologists, philosophers and other researchers in the past and this section presents a brief review of this existing work in order to inform the research phases of the work.

The influential work of psychologist Mihaly Csikszentmihalyi describes what he terms optimal experiences, which is the term that is favoured in this thesis. These experiences can be more than simply pleasurable, they are enjoyable in a manner described by Csikszentmihalyi (1990, p46). He makes a clear distinction between these two modes of engagement, with pleasure as an important component in the quality of life of each individual, helping to maintain equilibrium. Enjoyment on the other hand is described as a transformative condition that requires effort from the individual, but augments his or her sense of self, changing the consciousness. This supports the definitions of complex pleasure presented by Martin Amis and Anthony Dunne as discussed in an earlier section of this thesis.

An enjoyable experience, maintains Csikszentimihaly, may not feel wholly pleasurable at the time, as it can be demanding, complex and difficult, but afterwards, it is viewed as a positive event. As Overbeeke et al (2003) point out, "*a user may choose to work with a product despite it being difficult to use, because it is challenging, seductive, playful, surprising, memorable or even moody, resulting in enjoyment of that experience.*" Csikszentmihalyi (1990, p71) describes this condition of optimal

experience in engagement with some kind of activity as "flow" and identifies its characteristics. He lists; a sense of adequate mastery of skill for the task, intense concentration, lack of self-consciousness, and distortion of sense of time as features of the flow experience. This flow condition is closely associated in research literature with work on presence and immersion, and is most commonly discussed in relation to activities that endure for a sustained amount of time, such as gaming or productive tasks. In a more recent overview of the research literature, Mekler et al (2014) discuss the relationship of flow to enjoyment, and highlight the various differing perspectives of these concepts and their experiential components as they apply to digital games. Enjoyment was the main focus of the study, as this is accepted as a central concept within HCI research and a frequently assessed dimension of user experience. Flow, they conclude, is related to enjoyment, but enjoyment can be used as a valence metric to describe user experience, that is to say, how enjoyable an experience is.

Chen (2007) discusses Csikszentmihalyi's Flow concept as it applies to video game design. She describes how the skilled designer can create an adaptive experience that embeds choice for players within the core activities of the game and so offers the right level of challenge to each player in order to keep him or her in the optimum state of flow. The addictiveness of so-called "casual games" in particular can be engineered through a combination of creative design, applied psychology and software analytics. Online and mobile games such as "Candy Crush Saga" and "Angry Birds", avoid the high intensity excitement of console gaming, instead presenting an emotional experience that is less tiring but encourages feelings of security, happiness and pleasure (Simon Moore in Boxer 2014). The compulsion tactics evident in these games help the developers to generate high profits through in-app purchases, leading to concern over regulation of industry practices for the protection of the consumer.

Creating the conditions that enable the viewer to experience a state of flow has been a motivation for digital artists such as Golan Levin (2009), who discusses the flow state and describes this as "*sustained creative feedback with reactive systems*." However, in this thesis, where the optimal interactions under consideration are likely to be relatively short in duration, flow is less relevant a concept than enjoyment, while recognising that enjoyment may not include immediate pleasure in the moment.

In the study of games and play, Johan Huizinga and Roger Caillois provide some foundational concepts and definitions. According to Montola (2009 p7), Huizinga's philosophical and anthropological work conducted in the 1930s supports a view of play as something that happens outside of ordinary life, according to a different set of rules. The activity is "not serious" but yet absorbs the players "intensely and utterly". This definition concerns play as an activity that is structured and orderly, and Montola expands on his description, considering the ideas of Roger Caillios (Montola et al 2009 p9) who classifies playful activities on an axis ranging from "paidia" which is which is spontaneous and unpredictable, without a defined outcome, to "ludus" which is structured, rule and goal orientated play. The action-oriented interactions that occur in open and public space that are discussed in this thesis, would seem to fit more closely to the "paidia" concept.

2.3.5 Fun and Experience

Blythe and Hassenzahl (2003) differentiate between "fun" as equating to distraction, and "pleasure" as equating to absorption, two very different facets of positive experience, and a slightly different definition of the term "pleasure" to that of Csikszentmihalyi. Blythe and Hassenzahl go on to suggest that good design can make repetitive and routine work fun, but that non-routine and creative work should absorb rather than distract in order to be enjoyable. Already it can be seen that positive experiences have a variety of features, and that the terminology relating to these experiential features is used differently by researchers according to their own particular interpretations.

2.3.6 Temporal and Spatial Models of engagement

Interactions taking place within the space of a public area, within a defined timeframe, and reaching a conclusion of some kind can be described as discrete experiences Dewey (1934, p36). Mignonneau and Sommerer (2000, p80), along with other creators of interactive experiences, consider this kind of experience as a journey:

> "*We believe that interaction should not be linear but instead feel like a journey. The more one engages in interaction, the more one learns about it and the more one can explore it. We call this principle non-linear interaction or multi-layered*

> *interaction: interaction should be easy to understand but also rich so that the visitor is able to continuously discover different levels of interaction experiences."*

Benford and Giannachi (2008) discuss this issue of engagement over time, and the designing of the pace of collaborative interactions. Although their work involves the structuring of interactions that take place over longer periods of time, sometimes many days, their work is interesting in its accounts of narrative and temporal trajectories, and how time can be considered in layers with mappings between them. As an example, they suggest the development of an account of the relationship between interaction time and perceived time.

An interactive, layered journey of this kind can be considered to consist of various stages, broadly corresponding to an initial attraction stage, an engagement and activity stage, and a completion or ending stage. As Shedroff (2001, p4) states, an experience needs an attraction, an engagement and a conclusion. Edmonds et al (2006) also classify engagement phases as belonging to three main categories; firstly there are the attractors, aspects of the system that encourage the audience to approach the artwork, secondly there are sustainers, aspects that keep an audience engaged for a period of time, and finally there are the relaters, aspects that encourage an ongoing relationship with the work. Edmonds et al place an importance on this continuing relationship with the work rather than talking about a more final conclusion phase. This may mean that participants return repeatedly to the gallery, or it may be that they internalise and retain the experience personally. In a particular example, where the authors are discussing the creation and installation process of an artwork entitled Absoute_4.5, the three stages of engagement are supported by different factors. The attractor stage is related to difference from the situational context or background, while the sustainer phase is supported by the behavioural properties of the work itself. Here the authors use words such as "obscure" and "puzzlement", echoing the discussion in section 2.12 of this thesis on the Jim Carrey website.

Brignull and Rogers (2003) discuss a similar issue to Edmonds et al's idea of attractors in their description of the Opinionizer project, based around a participative public display in a social area. Of particular relevance is the issue of how people move from the activity space of "peripheral awareness" to one of "focal awareness", and from there

to take part in "direct interaction activities". A key factor that generates enough motivation to cross the threshold from peripheral to focal awareness was observed to be that of curiosity. To move to the third phase of directly interacting with the system (entering text on a keyboard) the participants need be provided with both a clear affordances of how to begin interaction, and reassurance of safety, or lack of social embarrassment, although here there seemed to be a trade off between lack of risk and potential for fun and excitement.

2.3.7 Pleasure and perception of products

The idea that designed products and services can integrate good usability characteristics with provision of pleasurable experiences is becoming fully accepted in many areas of interaction design practice. In the introduction to "Pleasure with Products, Beyond Usability" (2002) one of the editors, Bill Green, describes this change of focus from usability to pleasure, evoking Maslow's hierarchy of needs. The implication here is that once the basics of ergonomics and usability are sorted out, designers can move up the hierarchy to address the higher level needs of pleasure and "joy in use". This shift of focus has encouraged the emergence of academic conferences such as the ACM "Designing Pleasurable Products and Interfaces" series. Experiences that are explicitly designed to be pleasurable can now be found not only in the more "pleasure oriented" gaming and entertainment industries, but also across a range of sectors associated primarily with practical functionality, such as domestic thermostats and alarms, for example the acclaimed Nest range of products (www.nest.com), and automotive and medical devices. These products have embraced design values such as intuitiveness, engagement, and aesthetic appeal, and these have now become accepted as resources for the design of essentially functional interactive experiences, making them pleasurable as well as efficient and effective.

2.3.8 Pleasure and Usability

At least in part, the relationship between perceived usability and pleasure in use can be attributed to the halo effect. Also described as the "what is beautiful is good" principle, this is a phenomenon identified by psychologists where people tend to attribute more positive personality traits, such as competence and social desirability, to attractive

individuals than to others (Dion et al 1972). The halo effect has also been observed in products and interactive systems, for example Tractinsky et al. (2000), found a strong correlation between aesthetics and perceived usability. In fact they discovered that, "*post-experimental perceptions of system usability were affected by the interface's aesthetics and not by the actual usability of the system*" (p140). Usability and aesthetics, claim Tractinsky et al, are highly intertwined, and they argue that the importance of aesthetics and affect was under-estimated at the time of writing. For the authors, this finding raised a rather awkward question for the HCI professional, suggesting that the application of usability techniques should be supplemented by the involvement of creative or aesthetic design. Of particular importance to this thesis, Tractinsky et al, draw the conclusion that. "*Intuitively, it would seem that the importance of aesthetics design is relevant mainly to systems that are used voluntarily*". (p141) The reason for this is that users are more likely to be attracted to use or purchase a system if it is perceived to be usable, and this quality is likely to be signalled to the user by the level of aesthetic design.

2.3.9 Addressing Aesthetics

Work that reveals the relationship between aesthetics and user satisfaction or perception of usability is tantalising, but it it clear that this is a multi-layered issue. Questions are immediately raised as to the nature of aesthetic attributes, and how stable they are. Simply by reflecting a little on our own personal responses to the designed objects that inhabit our physical environment, it becomes clear that individual preferences and cultural issues are likely to play an important role, as well as changing over time. Objects that appealed to us in our early teenage years may not be so attractive to us several decades later. The influences of such factors as novelty and nostalgia are also likely to play an important role here. The interactive objects that delighted us a decade ago seem sluggish and unsophisticated now while, on the other hand, rediscovering technologies from a few decades ago can be a delight, as evidenced by the current fashion for retro gaming from the 1970s and 1980s. We can conclude therefore that qualities of attractiveness are rather unstable, and there is a strong element of individual preference involved.

The definition of aesthetics tends to favour visual aspects, but Hekkert (2006) reminds us that the origin of the word lies in the Greek word aesthesis, referring to sensory perception and sensuous knowledge. From this meaning the word anaesthetic is derived, referring simply to the lack of any sensory perception. It was in the eighteenth century that the term aesthetic began to include the connotations of gratification or delight of the senses, and started to become associated with the experience of art, and judgements of its value. Hekkert (p159), therefore proposes that the term aesthetic should be restricted to the particular aspect of sensory perception that is pleasurable, rather than talking about an experience as a whole being an aesthetic one. Lavie and Tractinsky (2004) assert that this issue of beauty, or aesthetics, and the relationship to usability is a complex one, and that in fact there are two subdimensions of perceived beauty. They claim that perceived, or subjective, usability is linked to the idea of "classical" aesthetics that emphasise orderly and clear design, and are closely related to the design rules favoured by usability experts. What they term "expressive" aesthetics on the other hand, are related to creativity, originality and convention breaking aspects. They conclude by suggesting that their aesthetic measures could be useful in informing research about the entire user experience. Hassenzahl (2001) calls for an expanded concept of usability as a result of his research into the notion of product "appealingness" and increased enjoyment as being related to perceived hedonic qualities, or "fun factors". These are non-task-related factors such as music or graphic elements.

More recently, Bardzell (2009) has argued for the inclusion of the study of aesthetics and critical theory into interaction design, both practically and theoretically:

> "*The concepts and vocabulary of aesthetics and critical theory have much to offer HCI, because they emphasize qualities and issues that HCI is obviously concerned with in interaction: experience, symbolic density and cohesion, beauty, enlightenment, social justice, dialogism, identity and the self, form and meaning, taste and judgment, ideological encodings, interpretation/hermeneutics, and signifying structures, among many others.*"

This interplay between the physical world and the internal semiotic world is relevant to the inquiry undertaken in this thesis and points towards the use of sociologically informed methods as a means of examining subjective aspects of experience. Jacucci

and Wagner (2007) suggest that the very materiality of artefacts can make cognitive processes and communication activities 'visible' to the participant and the observer. They assert that concrete, physical objects are associated with abstract, non-physical meanings, affecting the ways in which we relate to them, experience them and interact with them. To extend this idea, they put forward the notion that tangibility increases social behaviour and collocated interaction. Hornecker & Buur (2006) also discuss how Tangible User Interfaces (TUIs) lend themselves to the support of face-to-face social interaction due, in part, to the observable nature of their use. They go on to assert that, while much work has been undertaken recently on the technical development of these interfaces, there is still a need for conceptual frameworks that describe why tangible interaction works well for users, especially in relation to the design of new hybrid environments that are inherently socially organised.

Gaver (1996) goes to the extent of proposing what he terms an "ecological" view of design, a view that suggests that the physical world is the basis for the construction of social meaning. He explains that he is concerned with: "*the possibilities offered by the physical environment for social interaction. These are not social affordances... but affordances for sociality. I believe they offer new opportunities for basic research and a powerful tool for design*." Gaver asserts that designers of interactive systems increasingly need to understand social phenomena as they are designed for collaborative or group situations. Therefore, he argues, sociological and anthropological approaches have much to offer to the domain of design for social contexts. He then suggests that this kind of inquiry can, in turn, provide fresh insights for the study of social behaviour. By introducing new interactive systems into a social environment, new behaviours emerge and the study of these can potentially be relevant for understanding social phenomena in a wider context. To update this view, design research must also take on board the current challenges of designing in the context of constant connectedness. Not only are interactive systems now able to draw on a myriad of real-time data streams, but analytical capabilities also enable the processing of these so as to mediate and influence the user experience.

2.4 Social and Spatial

2.4.1 The role of the user: Spectator, Participant and Performer

The term "user" is widely employed in the world of HCI design and evaluation, but in the context of optional interactions this term becomes problematic. "User" implies a static, one-to-one relationship between a system and a person who "uses" the system for a particular task or purpose. The implication here is that the human is controlling the system. Contemporary experience-focused technologies are conceptually and socially more complex than this model suggests, often distributed across devices and locations, and used in diverse situations, often without a clearly articulated objective. Considering familiar, common examples such as tablet-based online magazines or social media apps, these might be accessed during a train journey just to pass the time. The user is hoping that the app will suggest something of interest or amusement, and so to some extent at least, the system can actually be in the controlling role. If the app is driving attention towards advertising content, perhaps the "user" could even be described as "used". Apparent in this simple example are issues of the open-endedness of the task, as there is no pre-defined completion point, and there is also ambiguity around how the interaction experience is driven or constructed. Therefore terms other than "user" may be more appropriate, perhaps borrowing from the spheres of theatre and performance. In the study presented in Chapter 4 of this thesis it is interesting to note that none of the artists whose words are analysed, used this term. Instead instances of the terms "participant", "audience" and "viewer" were identified.

Dalsgaard and Hansen (2008) describe the user as taking on various roles throughout the process; as being simultaneously operator, performer and spectator while engaged in experience-oriented uses of technology, including spatial artworks. They go on to discuss the notion of the performative spectator and the spectating performer, suggesting that users of interactive systems in public areas are constantly aware of the actions and perceptions of others, and of others' possible observation and perception of themselves. This idea of users as constantly aware of their own actions as being perceivable and understandable to others is also the foundation of ethnomethodological approaches to research, and this topic will be expanded on further in the sections on research methodology in Chapter 4.

By developing this idea of user as actor, enabling participants to actively perform for others can become a central resource in the design of a wide range of interfaces. Reeves et al (2005) suggest a framework of four approaches to the design of public interfaces, resulting from an exploration of the range of "manipulations" (physical actions) and "effects" (outcomes within the system) that interactive interfaces can provide. This framework is informed by a taxonomy of interactions, arranged according to how publicly revealed or hidden their "effects" and "manipulations" are to other spectators. Supporting the work of Dalsgaard and Hansen (2008), the authors take a view of performance that includes users implicitly performing interactions for others in public settings, as well as actors and artists performing explicitly. Their suggested design principles; secretive, expressive, magical and suspenseful, utilise different blends of revealing and concealment of interaction actions and results in order to achieve desired experiential effects.

2.4.2 Social and emotional models of engagement

Key topics of interest in this research are emotional and social aspects of human experience, and this thesis attempts to examine these quite distinct and separate elements and also how they relate to each other. Public settings, such as galleries and museums are increasingly tasked with offering their visitors richer experiences, and many are opting for interactive installations to achieve this. They are recognising that this "added value" for the visitor can be offered by enabling visitors not only to interact with the collections held by the institution itself, but also with other people, often with the aim of encouraging active and collaborative "meaning creation". As discussed in vom Lehn et al, (2007) the nature of these kinds of exhibitions means that engagement with the installations takes various social forms, including individuals, pairs and small groups. A feature of interactive installations is that they are often designed specifically to encourage social interaction. An example is the interactive artwork "Do Not Touch" by Christian Moeller (2004), situated in the Science Museum in London, and designed to demonstrate the energy of electricity. As the image shows, the installation is a metal pole surrounded by a clear instruction not to touch. The context of the exhibition however, means that many visitors believe this to be some kind of trick and are tempted to disobey. The artist has created a situation where you can make a decision: whether or not to follow the instructions. The act of touching necessitates both disobeying the clear

instruction on the floor, and doing so very obviously in public view. This creates conflicting emotions in both the brave visitor, and their companions, including risk, curiosity and self-consciousness, nervousness and amusement. Eventually, with much encouragement, someone breaks the rule and touches the pole. The pole carries an electrical current and gives a very mild electrical shock, this effect being greatly amplified by a dramatic sound effect so that everyone in the vicinity notices. The excitement and humour in the piece are created by the social situation, the more people that are passing by to see someone getting a dramatic, if harmless, electric shock, the more everyone's emotions are engaged in the shared surprise and laughter.
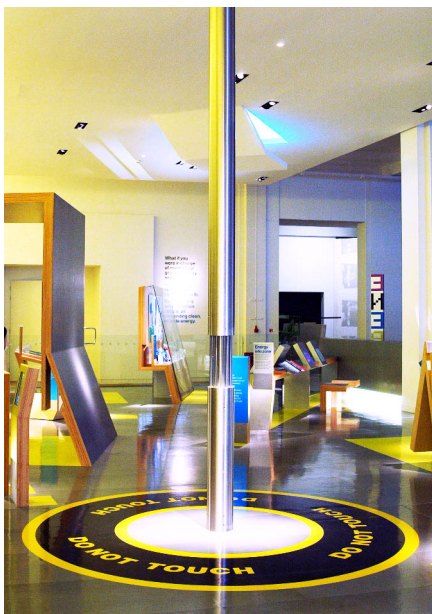
Figure 2.4. Do Not Touch by Christian Moeller (2004) Science Museum London.

From their work in developing affective interactive systems, Boehner et al (2005) draw the conclusion that "an emotion cannot be seen purely as an internal, individual, and private phenomenon; not only is the experience of emotion mediated by cultural and social situations, but it is also used to enact and sustain those settings." This is certainly the case in Moeller's example, where the physical and social context of the work heavily influence how people feel about whether to interact with it, and then in turn, the emotional reaction to the work supports a shared, social experience. A single visitor interacting with the work in an empty room would have a very diminished experience indeed. In alignment with this argument, Boehner et al suggest an interactional model

44

of emotion as being social in origin, produced and interpreted through social and cultural practices, where collective meaning shapes individual experience, rather than only being a product of rational thought. In an interactive context this would suggest that emotional experiences can be created or generated through both the physical design of the installation as well as through the structuring of the social situation.

2.4.3 Affective Computing

The role of emotion in the design of interactive systems of all kinds is now well recognised and established within the HCI literature. Neuroscientists, including perhaps most famously Antonio Damasio (1994), have argued that the link between emotion and decision making is much more important than previously thought. Damasio proposes that our emotions provide guidance for us when we need to make the many small decisions required in daily life, and that logical reasoning alone is not enough to shape our behaviour in social and interactive situations. As well as the ability to manipulate emotions in a simple sense, as in the Moeller example, researchers have called for the need for systems to read emotions in users, and also to convey emotion. This interest lead to the development a sub section of HCI labelled "affective computing", after Rosalind Picard's 1997 book of that name (ref). In a later paper, Picard (2003) presents a number of criticisms and challenges that affective computing needs to address as researchers build systems that have affective abilities, such as recognizing, expressing, modelling, communicating, and responding to emotion. Although Picard agrees with the premise that emotional mechanisms are valuable and important as aspects relevant both to understanding users, and to the design of systems, she advises caution. Issues such as accurate and meaningful measurement of affect, and the effective modelling and expression of emotion in machine form are still substantial challenges, although we can presume that progress has been made in the decade since Picard's paper was written.

Realism is an interesting issue to explore in the context of designing for emotion. It can be noted that artists working with interactive systems often present work that expresses emotion or affective behaviour in a way that is highly minimalistic. For example works by the artists studio Random International, such as Fly (http://random-international.com/work/fly/ 2011), use inanimate objects, in this case a ball bearing

suspended on wires, and include only a minimal amount of responsive behaviour to suggest sentience and life. Nevertheless this is enough to attract the attention of visitors, allowing them to infer an emotion, perhaps fear, in the artwork. By taking this approach to the presentation of life-like attributes, these artists avoid the pitfalls of the uncanny valley. This phenomenon, or hypothesis, states that the more that systems, devices or robots become human-like, the more positive the reactions to them become. However when a certain point of life-likeness is reached, this emotional response swiftly turns to repulsion. This sharp dip in the upward trajectory of positive emotional reaction is referred to in robotics as the "uncanny valley", and was proposed originally by Masahiro Mori in 1970 (Bartneck 2009). It should be noted that once the object in question becomes indistinguishable from a real human, the plotted line moves upwards towards a more positive reaction, and so it would seem that it is the "nearly human, but not quite" that evokes the revulsion in observers, particularly if movement is included.

2.4.4 Social behaviour in public places

Before considering how to design for engagement and experience in public space, it is necessary to consider social behaviours that occur in those spaces and the conventions that govern them. Any system or installation that is introduced to a public space should aim to support, or at least should not conflict with, the desirable behaviours that already exist in the space. Going further, the designer of an interactive system may wish to encourage particular behaviours or reactions amongst the audience of the system. Therefore an understanding of culturally accepted rules of social behaviour is required. Going back to the foundational social science literature we can start with the work of Erving Goffman. His work, carried out in the 1950s and 1960s, on behaviour in public places is helpful in gaining understanding of social interactions between people, and we can consider whether this work can also apply to the design of experiential encounters between people and systems.

2.4.5 Encounters and Engagement: interpreting the signs

Goffman (1963 p91) defines an "encounter" as the prelude to an "engagement", and claims that it is initiated by one party making an opening move, acknowledging the presence of the other party. This initiation can take either subtle or direct forms, such as

facial expression (subtle) or verbal statement (direct). The encounter becomes an engagement when the other party acknowledges this overture with a reciprocal signal. For this communication to be effective, both parties must understand how to interpret the signs, and they must share enough of the same cultural language for the exchange to be meaningful. Eye contact in particular is discussed by Goffman (p92) as a commonly used tactic to initiate interaction. A glance, he explains, can be sufficiently tentative and ambiguous so as to allow the initiator to check whether the proposed interaction is likely to be welcomed or resisted by the other party, before committing to an overt communication gesture. The rituals and cultural significances of eye contact are especially powerful, according to Goffman (p93), quoting the sociologist Georg Simmel, who wrote in the 1920s:

> "*Of the special sense-organs, the eye has a uniquely sociological function. The union and interaction of individuals is based upon mutual glances. This is perhaps the most direct and purest reciprocity which exists anywhere… No objective trace of this relationship is left behind, as is universally found, directly or indirectly, in all other types of associations between men, as for example, in interchange of words. The interaction of eye and eye dies in the moment in which directness of the function is lost.*"

The unique power, yet lack of substance, that characterises eye contact has been used by artists to attract the attention of audiences. Golan Levin's Opto-Isolator (2007: with Greg Baltus) figure 2.6, for example, presents a single, blinking mechatronic human-like eye that responds to the gaze of visitors. The installation is very minimal in its visual design and relies on programmed feedback that is modelled on human-like behaviours. The eye appears to look directly at viewers, and then looks away if stared at for too long, evoking a common understanding of behavioural norms and boundaries. Levin states that the aim of the artwork is to explore the condition of spectatorship by posing the questions: "What if artworks could know how we were looking at them? And, given this knowledge, how might they respond to us?"

Figure 2.5: Golan Levin's Opto-Isolator

2.4.6 The structuring of social encounters

This example illustrates how social encounters are structured through common understandings about communication, or meta-communications, and that they go through temporal phases. The two sides of the encounter go through a set of actions designed to initiate, sustain, and discontinue communication, and also to check on the condition of the other party. The communication can then be adjusted or altered to take account of the evolving social and physical context of the situation. As Edward T. Hall (p5) states in the introduction to his book on proxemics, "*All of us are sensitive to subtle changes in the demeanour of the other person as he responds to what we are saying or doing*". Goffman emphasises (1963 p243) that situations that involve the presence of more than one person are governed by a set of rules, accepted by convention, that he names "situational properties". These rules describe the way that people behave towards each other, and the roles that they adopt in particular public and social situations. These rules are relevant to inquiry into interactive systems sited in

public spaces, such as the Opto-Isolator example discussed above, as it seems that people do react to some systems by anthropomorphising them, thereby evoking rules of social engagement, at least to some extent.

2.4.7 The sociology of space: proxemics

Rules of social engagement are influenced by spatial contexts, most obviously in the consideration of distance between the actors in the social situation. Edward T. Hall, writing in the 1960s, presents a description of four degrees of personal distance that influence our social communications that he terms; intimate, personal, social, and public. Hall asserts that this spatial framing is affected by many factors that relate to anthropological and cultural factors, as well as human perceptual faculties (1966 p78). They include such aspects as; the distance that enables touching, bodily warmth, visual detail and stereoscopic roundness. Hall uses the term 'proxemics' to refer to the "*interrelated observations and theories of man's use of space.*" (p101). It is interesting to note that Hall presents a discussion of the practice of visual artists, drawing comparisons between his own findings from the field of anthropology and those of sculptors and painters. He suggests that the training that artists undertake in awareness of the visual field enables them to make explicit these unconscious, culturally influenced spatial frames.

As a cultural anthropologist, Hall was very interested in the development of communication technology and its potential impacts on human interactions. During the 1960s and 1970s he corresponded with Marshall McLuhan, the writer on communications and media theory, and he influenced McLuhan's thinking about the emerging technological landscape (Rogers 2000). McLuhan is credited with stating that the way that information is presented is at least as important as the content of that information, in terms of how it is perceived by the individual, and he is most well known for coining the phrase "the medium is the message". However these ideas were developed in collaboration, and through correspondence, with other academics and writers of the time. Everett Rogers discusses the relationship between these two academics:

> *"Early in their correspondence, McLuhan (letter to Hall, January 27, 1962, in the Hall Papers) stated, 'Your page 79 [in The Silent Language, Hall's statement about the extensions of man] has become ever more crucial in my work.' Evidence of McLuhan's (1964) subsequent focus on extensions of man is evident in his book Understanding Media: The Extensions of Man." Rogers, 2000. p122*

> *"To say that any technology or extension of man creates a new environment is a much better way of saying the medium is the message." Marshall McLuhan to Edward T. Hall (letter dated September 16, 1964, in the Edward T. Hall Papers, University of Arizona Library) (in Rogers, 2000. P117)*

From examining this correspondence, Rogers claims that Hall was an important influence on McLuhan's influential and popular writings on mass communication, especially concerning aspects to do with media technologies and how they impact on the human senses. McLuhan argued that media and technology are extensions to man (humans), both physically in that they augment the capabilities of the body, and also affecting the mind, in that they extend the capacity of human senses. Just as the development of tangible machinery extends the ability of people to perform complex physical tasks, the development of mass media in all its forms also extends and alters human cognitive, conceptual and sensual abilities.

The way that both Hall and McLuhan frame technology as essentially intertwined and integrated with human social behaviour lends some credibility to one of the central themes of this thesis, which is that technological entities can be considered as social entities. This means that taking an anthropological or sociological view of technological enhanced settings can be a valid way to proceed with the research.

2.4.8 Proxemics and interaction design

Hall's work on the spatial influences of human interactions has inspired a new subsection of interaction design termed Proxemic Interactions. Nicolai Marquardt and Saul Greenberg (2015), provide a description of this field, stating that people's expectations of human proxemics can be used to influence the design of "small

ubiquitous computing ecologies". They suggest that collections of devices including large displays, personal devices and other computational objects, can offer increasing interaction possibilities as people move closer to them. This is an explicit modelling of the way that people can interact in a more engaged and intimate manner when they move closer together in a particular space, echoing Hall's four degrees of public distance introduced earlier in this section; intimate, personal, social, and public.

Marquardt and Greenberg particularly foreground the idea of ecologies as an important aspect of proxemics. This implies a network of connected devices located within a particular space, usually at a "human" scale, such as a room or office. This ecology is aware of the spatial layout of the environment and the presence of people within that space. It reacts in an intelligent and responsive way to people and to other devices and non-digital objects, in accordance with the programmed purpose of the system. Marquardt and Greenberg (p6) limit their discussion to small room spaces, but they acknowledge that systems designed for public spaces and urban areas could also make use of proxemics. This thesis extends the discussion on proxemics into public, exhibition type spaces.

It is worth noting that Marquardt and Greenberg are interested in understanding proxemics in order to operationalise "*proxemics as dimensions that can be sensed and managed by a computer, which will help you as a practitioner, developer, or interaction designer apply proxemics to your own system creation*". It would seem that their motivation is to inform the design of systems that are automated in a way that recalls the discussions on seamless design earlier in this chapter. The aim is to provide computation that resides invisibly in the background, and then makes itself available just at the moment that it is required by people for the purpose of carrying out tasks. The technology in this situation exists to serve the user, and the user is intended to be the dominant force in the system. Our devices, assert Marquardt and Greenberg (p11), have now reached a level of sophistication and ubiquity that could support this vision, but it is the connectivity and contextual awareness that is lacking. The "fluent transitions between foreground engaging activity and background peripheral perception", still present a substantial challenge for technologists and interaction designers. This issue of context awareness is a difficult one, and the authors are fully aware of the difficulty or even impossibility of creating rules of behaviour for such

systems that take account of all aspects of dynamic and social context. (p16). While these challenges are undoubtedly relevant to address, this thesis is more concerned with exploring the potential design resources that are provided by "less than perfect" technology, particularly as deployed by artists.

It should be noted that this vision of proxemic interactions within a small ecosystem tends to include various personal devices that are carried or used by people either as individuals or as collaborating groups. This is sometimes also the case in interactive artworks, where visitors' own mobile phones can be incorporated into the interaction activity. For example in Greyworld's "Paint" installation (2010), which invites the audience to add their own mobile phone "selfies" to the art display. (The artwork was commissioned by the Nokia phone company to launch a new model, the N8).
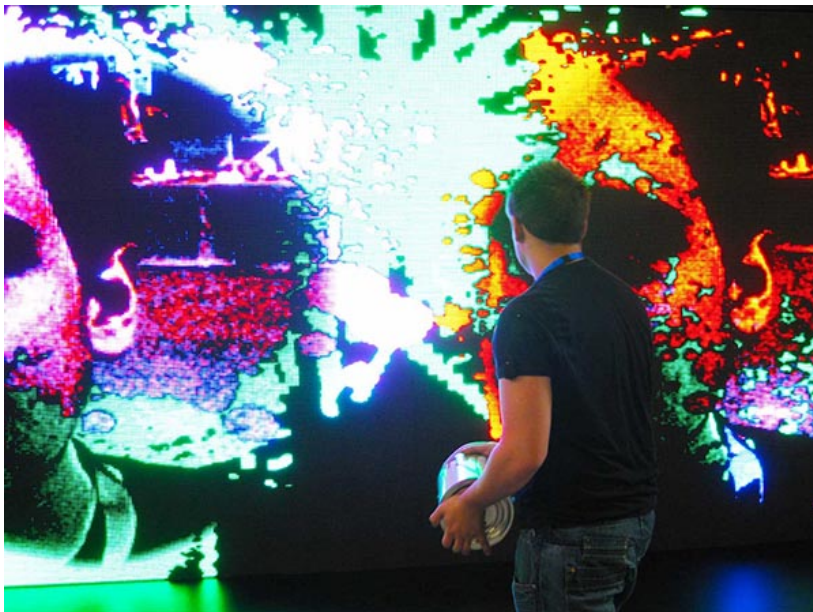
Figure 2.6: Paint by Greyworld.

However, in the case of "walk-by" interactive artworks, it is more usual that only the physical presence of the audience is required for interaction with the artworks, and creates a rather different context for the use of the proxemics framework.

2.4.9 Proxemic framings

As mentioned earlier, Edward T. Hall (1966) describes the four main proxemic zones of interaction between people as intimate, personal, social, and public. These relate directly to the levels of distance that support varying types of personal interaction, from close and highly engaged, to distant and less engaged. In the field of proxemic interaction with technology, some researchers have followed this structure in their system designs, such as (Ju et al., 2008). Others have developed variations on the theme, for example (Vogel and Balakrishnan, 2004), whose framework describes transitions from distant implicit to up-close explicit personal interaction. Their four continuous phases include fluid inter-phase transitions and are named; Ambient Display, Implicit Interaction, Subtle Interaction, and Personal Interaction. This framing includes a kind of initial "pre-interaction" stage, where the system is making its presence known to the passer-by. The user can then choose whether to step forward to interact with the system. This is rather different to a work-based context where it might be assumed that all the human participants have already entered into some kind of interaction situation. Brignull and Rogers (2003) recognised these interaction zones in an optional system, suggesting that a system has to provide a strategy to encourage participants to "cross the threshold" from peripheral awareness (not engaged or interacting with the system) to focal awareness (attending to the system and ready to interact with it. Streitz et al., 2003, use a three phase framework; Ambient Zone, Notification Zone and Interactive Zone, that emphasises the physical proximity to the system.

2.4.10 Design on the dark side

Design as an applied activity is value neutral, but most of us are well aware that technology can be utilised for purposes that are not always for the benefit of either humankind in general or for particular users in particular situations. Whether a specific design project can be considered beneficial depends on personal perspectives and political standpoints. As ubicomp technology becomes more accessible, proxemics as a design approach is now becoming visible in domains such as marketing and advertising, arguably to the detriment of the user.

Greenberg et al (2014) offer a critical perspective on this development in the form of speculative "dark patterns" describing how, in their opinion, proxemic interactions can be misused. In some cases the outcomes are intentional but in others, which they term "anti-patterns", the negative results are in the form of unintended side effects. The way that patterns are discussed in Greenberg et al's paper, will be returned to later in this thesis in more detail. The authors provide examples to illustrate their pattern framing, and many of these involve exploiting the presence and selective attention of passers-by in order to present them with commercial advertising or informational material. This may be personalised and specifically tailored to the individual, evoking concern over privacy and security issues. In their discussion Greenberg et al raise, and reflect on, some concerns that are relevant to the context of this thesis. These can be summarised as concerning the issues of control and meaning, and these resonate with the findings discussed later in this thesis. Specifically, some of the issues the authors discuss are; the problem of opting-in and opting-out, the interpretation of meaning, ambiguity of ownership, and user intent. Turning to the design of interactive installations as addressed by this thesis, these factors differ in their importance depending on the contextual situation. For example, an individual entering an art gallery or a museum space can be considered as entering into an implicit contract for the duration of that visit. Therefore curators might feel that they have permission to present provocative or even mildly disturbing experiences for the visitor on the basis that there is a mutual understanding that the visitor is there to be engaged in an experience, and will therefore be receptive. However, the pedestrian in a busy urban environment is in a very different and much more ambiguous situation. Issues of intrusion, attention, irritation and frustration are likely to play a much more important role in this context, and the designer must proceed with greater caution, respecting social conventions and ethical concerns.

2.5 Summary

This chapter has introduced the position that this thesis takes in relation to the domains of Human Computer Interaction, interaction design and new-media art practice. It has discussed the motivation that underpins the research work that follows, presenting background context on the interrelated themes of designing for experience, and the influence of social behaviour on interaction design. The thesis addresses a research

topic that is both important and timely for the interaction design research community, as interactive technologies increasingly spread out into the public spaces that we collectively inhabit. It is proposed that the approaches used by digital and new-media artists have an important contribution to make in this domain. Public space is a rich potential area for exploitation by commercial and private interests, but this thesis makes a call for a wider representation of interests and for the foregrounding of the social in this sphere. Interaction designers potentially have much to contribute in making our shared spaces interesting, varied and enriching environments, and this thesis will show how ideas from interactive art can be influential in this endeavour.

The chapter began with an overview of the stages of development of the domains of HCI and Interaction Design over the past few decades, outlining the widening scope of the challenges that this discipline is currently facing. It is suggested that approaches such as ambiguity and complexity, that seem to contradict the accepted rules of these fields, may in fact be rich sources of design potential when attempting to design for engaging experiences. Fallman's (2003) description of an interpretative and situational approach to design has emerged as a relevant concept when designing for action-orientated interactions, along with the idea of framing interactions between human and technology as open-ended, social dialogues, where both parties have autonomous agency. A discussion on how interactivity has been considered and addressed was presented, with particular consideration of how to engage participants, audiences and viewers where the designed system is optional, focusing on providing positive or optimal experiences. This optional aspect is key to this thesis, and these kind of "walk-by" systems are considered in comparison to social interactions between people.

The following chapter presents a further review of current work, with a focus on examples of digital and interactive systems sited in public spaces, and interactive artworks. Chapter 3 concludes by summarising key themes identified from the review carried out in chapters 2 and 3, that provide a starting point for the original work that is presented in Chapters 4 to 6, culminating in a conclusion in Chapter 7.

Chapter 3: Review of related work

3.1 Review of public, interactive systems and artworks

This thesis examines interactive work produced by artists and identifies aspects from the process of their creation that could provide potential as resources for designers. These findings are framed as "intermediate" forms of knowledge, bridging the conceptual space between theory and practice. As the thesis is concerned with public spaces, where the context means that people are passing through, this chapter presents a discussion on current work on digitally augmented spaces. As our physical environments are becoming augmented with an increasing quantity of digital and interactive systems, it is relevant at this point in the thesis to describe developments in this field. This chapter begins with a discussion of the types of interactive system that are appearing in our environments, along with illustrative examples, and follows this by focussing specifically on examples of interactive artworks.

3.1.1 Designing engaging experiences

A representative range of relevant interactive artworks situated in public spaces are described and analysed in this chapter. An assessment of key factors that contribute to engagement are discussed. The work produced by artists often draws on approaches that apparently break the rules of HCI, in that they present difficulty, complexity, opacity and ambiguity, and yet they seem to provide engaging interaction experiences for users, at least in the more successful examples of the genre. These aspects are examined in this research, with the aim of framing guidance for designers.

3.1.2 Public settings for optional interactions

The first section of this chapter presents a review of relevant works that demonstrate the contextual settings for the research in this thesis. These are presented in two categories, first addressing exterior and urban systems, and secondly looking at interior examples, including museum, gallery and exhibition situations. It is acknowledged that there are many overlaps between the two categories, but nevertheless this is a useful way to structure the discussion as there are some differences between the two contexts.

3.2 The rise of Urban interaction design and Media Architecture

Anyone travelling through an urban area in the last decade in the western world will have noticed the increase of digital media in our city streets. This section presents an overview of these, firstly looking at large scale systems incorporated at an architectural level, and then focusing on the smaller scale, personal and human level. These definitions are not clear cut, and they can be described as existing on a continuum. For the purposes of this discussion, large scale systems are categorised as those primarily designed to be viewed from a distance, and aimed at numerous people simultaneously, while small scale systems are those designed to be viewed at a closer distance, by fewer people at once, and they may also include interaction through personal mobile devices. Large scale systems are often incorporated into architectural facades and city squares, while smaller systems may exist as features of street furniture or window displays.

3.2.1 From facades to dashboards

As digital augmentation has proliferated in the urban landscape, the academic and research communities have responded. Evidence of this topic informing a new research domain includes workshops held at conferences, for example; "Large Displays in Urban Life – from Exhibition Halls to Media Facades" (Hinrichs et al, CHI 2011) and the creation of organisations such as the Media Architecture Institute founded in Vienna in 2009 (http://www.mediaarchitecture.org/about/). The institute has instigated events including the first Media Facades Summit in 2010, and the first Media Architecture Biennale. More directly addressing the artistic, cultural and social aspects of media architecture, a European Union funded network project, Connecting Cities (http://www.connectingcities.net/) has a stated aim of building up a connected infrastructure of media facades, urban screens and projection sites to circulate artistic and social content. The project places itself in opposition to the commercial use of these urban media, and prioritises the active role of communication and exchange between citizens. Other projects across Europe share this motivation of active citizen engagement, including Medialab Prado in Madrid (http://medialab-prado.es), who position themselves as a citizen laboratory for the production, research and dissemination of cultural projects. Many of their activities have involved interactive,

collaborative projects based around large building facades, and data visualisation has also been a theme of their work, for example projects by Sergio Galán and Víctor Díaz such as City Fireflies, (2011-2012) an interactive game, and BigGames: Urban Games for Big Screens, (2012).

Particularly addressing the category of media facades, Dalsgaard and Halskov (2010), state that these types of design situations create several specific new challenges. As well as the practical issues concerning the physical siting of systems in outdoor contexts, particular types of social conventions and behaviours operate within the urban environment, and these must be taken into account when introducing digital media to these settings. Several of their eight challenges are pragmatic, such as dealing with weather conditions, and working with stakeholders, but they do identify two sets of challenges that are more directly relevant to the topic of this thesis. These are; firstly the evolving and unpredictable nature of shared, public spaces, and secondly, a consideration of the social behaviours found within these spaces that may be transformed by the introduction of new technologies.

3.2.2 Large scale: Responsive environments and buildings

Urban media displays and facades have been increasingly occupying the HCI community over the last decade. As the costs of installation and maintenance of these technologies reduce, more and more surfaces in the urban landscape are augmented with digital media of various kinds, limited only by the restrictions enforced by city planning authorities.

The largest scale of urban displays are often designed into the architecture of the building and can be more accurately described as responsive rather than interactive. These can be classified as falling into two main types, firstly the "skin" where the external surface of the building is enhanced with computational digital media, designed into the building from conception by the architectural design team, and secondly the "facade", where a section of the building is used as the location for a media display. The latter may be added to existing buildings, and they may be temporary, or serve some particular purpose that is unrelated to the original architectural design concept. In this way the building serves only as a "holder" for the media rather than being an

integrated element. Examples of this type of skinning of architecture include The Institut du Monde Arabe in Paris, designed in the 1980s by the Architecture-Studio practice, and architect Jean Nouvel. The facade of this building incorporates a series of decorative panels, in the style of traditional Islamic decorations, including apertures that open and close in response to sunlight, providing shade to the interior of the building. This type of seamless, automated behaviour could be described as intelligent or "smart" in that the building is reacting to external conditions for the benefit of the inhabitants, recalling the aims of Wieser's vision of invisible computing, discussed in Chapter 2. Another example of this type of responsive architecture, built around the same time as the Institut du Monde Arabe, is Toyo Ito's Tower of Winds in Yokohama in Japan. This building also reacts to ambient conditions to transform itself. By day it is a simple perforated aluminium structure, housing air conditioning equipment for an underground mall, but at night the tower is transformed with the use of computation into a creative light installation, responding to sound and wind.

There are many other examples to be found of buildings built since the 1980s that are designed to react to localised environmental conditions, in some cases in to be "readable", as in Christian Moeller's 1992 "Kinetic Light Sculpture" in Frankfurt. This building façade changes colour according to current weather conditions. One can imagine that if the passer-by knows that this is the way the installation works, it is a beautiful and creative way to absorb some relevant information. The obvious challenge for the interaction designer is how to signal this to an ever-changing flow of people who only have a fleeting interaction with the installation. Further questions concern how to tackle possible changes in the dataset at some time in the future.

Another example of large-scale media are installed in the urban environment for the purpose of conveying information to a wide audience, includes City Bug Report (2012) displayed on the side of the Aarhus City Hall in Denmark. Comprising around 5500 lighted pixels wrapped around an architectural tower, the installation displayed moving circular graphical elements, to symbolise "bugs", playing on the mixed meaning of insects and software gliches. The colours of the bugs signify the level of problems that the citizens of Aarhus are reporting to the municipality through online communication platforms. Here the installation was connected to more personal modes of interaction, using desktop and mobile computing, along with social media, potentially enabling

more complex and meaningful interactions with the system. However, the issue of communication with passers-by was a real problem here, and this was acknowledged and discussed by the research team (Korsgaard and Brynskov, 2014):

> *"However, the animation and content on the facade was very hard to decipher for outsiders to the project. … it was very clear that the content on the media façade failed to make the civic communication and transactions on Postlisten more accessible, transparent or relevant. On the contrary, it was very hard to explain the project and content to outsiders and the media trying to convey the installation on the city hall tower to the public, confusing and mixing up the actual content."*
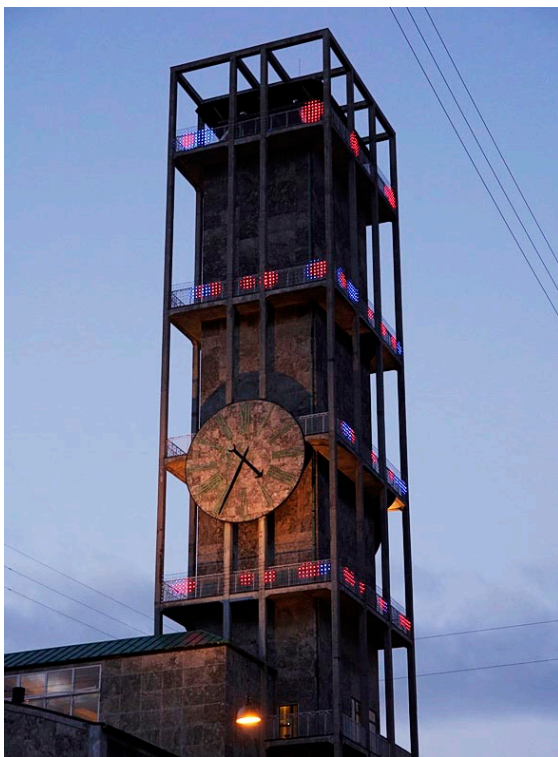
Figure 3.1 City Bug Report

On a smaller scale, and at the other end of the information granularity continuum, is the introduction of "Bike counters" in city locations in Edinburgh. Supplied and installed by Falco, (www.falco.co.uk, 2014), a manufacturer of cycle parking and street furniture products, these installations include a range of sensors and data gathering functionalities. The display is configured to show the time, temperature and a tally of

the number of cyclists that have passed by both daily, and over a longer period. This is undoubtedly a very useful tool for the gathering of data to inform traffic management and urban planning strategy, but the benefit to the passer-by is much less evident. A critique of the system from an interaction design perspective highlights some obvious issues. As can be seen in Figure 3.2, the text on the display is very small to be noticed by a passing cyclist traveling at normal speed. The numbers on the counter may be useful to a researcher, but they are actually of very limited interest to anyone else as they lack contextual information. It is not at all clear what the message here is: are these high or "good" numbers? The change over time is very difficult to assess: are numbers of cyclists rising or not? A final point in the criticism is that, as a public installation, it is very functional looking and not especially attractive or interesting. This was an opportunity to install a novel, creative and engaging digital object in an attractive public setting, and it was an opportunity that was missed.

Figure 3.2 Edinburgh cycle counter (Falco.co.uk).

To conclude this section of the discussion, some questions may be raised here in the context of the development of sensing technologies that are being increasingly introduced into our public, shared spaces. As these installations will be increasingly able to identify the presence of passers-by, including the identification of personal demographic aspects, we should consider how this might affect the individuality and character of urban spaces. As Adam Greenfield says:

"Technologists have tended to treat the environments in which the things they design are deployed as abstract, generic, unconditioned spaces, containing infinite potentials for connection. But as insightful observers of technology like Paul Dourish and Malcolm McCullough have pointed out, this isn't so, and can never be: space is always some particular space, systems are always given meaning by being situated in a specific locale and human community, with all the limitations and constraints which go along with those things." Adam Greenfield (2012)

3.3 Museum and exhibition studies: meaningful visitor experiences

As this research is being carried out with the aim of offering guidance and imparting new knowledge to practicing designers, it is important to have an understanding of the domains in which they operate, and the measures by which their work is assessed. One important area that is relevant to this work is the domain of museum and exhibition settings, and as interactive technologies are increasingly being installed in these spaces, there is an emerging body of literature in this field that is of relevance to this thesis. Some of the main approaches and work in this area are discussed in this section.

The interpretation of "museum" here is broad, using Falk and Dierking's (1992) definition as a starting point. In their influential work on museum experience from the visitor perspective, they include a wide range of informal settings including historical and cultural sites, science and technology centres, and outdoor nature gardens. The unifying feature of these situations is that they are open to the general public, and visitors are free to move around the physical space more or less as they choose. Falk and Dierking (1992 p5) provide a useful model that they use as a lens through which to make sense of these experiences, the Interactive Experience Model. In their efforts to understand visitors' motivations, activities and what they remember afterwards, they present a conceptualisation of a visit as involving interplay between three contexts; the personal, the social and the physical. These are used to understand the experience of the visitor from the visitor's perspective. The personal perspective, they say is unique and internal to the individual, whereas the social context describes the dynamics of contact between visitors. Much of Falk and Dierking's discussion addresses the interplay of

these relationships, along with a temporal consideration of a "visit" as a discrete experience, and one that should be seen in a holistic manner. The experience of a visit takes into account the planning, getting there, the visit itself, and the memory afterwards, and all of these need to be taken into account by the museum professional. This would now be called the UX or user experience.

3.3.1 Interactive technology in museums: relevance to public spaces

As Hornecker and Stifter (2006) claim, with the recent rise in their technological augmentation, public spaces and museums as application areas and settings of use have become a respected field of research for HCI. However they also go on to highlight design issues, for example explaining that traditionally installations are designed so as to only include enough interaction to get the point of the exhibit across, intentionally providing shallow functionality as museums aim for fast visitor throughput. If a set of visitors lingers too long at one installation, this can cause frustration for the next approaching group who want to have a chance to interact and who may have to wait. It can also cause bottlenecks in the physical space, impeding flow and movement around the building. This illustrates the constraints within which designers operate, and the kinds of goals that are important to the range of stakeholders and clients involved in the design process.

These kinds of contextual interaction design issues are similar to those that are encountered in a wider range of "walk-by" public settings. While the visitor to a museum or gallery has made a choice to enter the space and is expecting to be engaged with exhibits, there are still barriers to interaction to be addressed by the designer. One important issue, termed "chain of use" or non-use, is discussed by Hornecker (2008). She describes how visitors are enticed to engage with an interactive installation by observing others interacting with it, thereby setting up a "chain of use" as participants take turns to interact, with new participants joining in as others leave. This form of signalling action, or visual affordance seems to have several effects, firstly new participants receive a clear indication that the installation is in fact interactive and interaction is permitted and encouraged, and secondly they learn how to begin to interact with it. Another effect is the breaking down of social barriers over a shared activity. The other side of this situation is that lack of interaction can lead to a long

chain of non-use. This takes us back to the discussion in 2.3.6 of this thesis, where Edmonds et al (2006) discuss the importance of including "attractors" as design tactics in order to initiate interactions and draw in audiences.

In an early phase of this thesis research, in 2012, a fieldwork observation was conducted during a busy university campus open day, and this observation supported Hornecker's findings. The interactive digital wall, discussed in Chapter 5, was observed for several hours during the day, and the chain of use effect was clearly apparent. Almost all of the people interacting did so in couples or groups, reinforcing the theory that optional interactions around public installations are inherently social. Lone individuals seemed to be reluctant to initiate interaction. In the situations that occurred when visitors ceased interacting and moved away from the screen, without a nearby group ready to take over, there would be a long break with no interaction. This would continue even when there were many people in the nearby zone. Eventually a new group would be attracted to the screen again, and this would set up another chain of use lasting for several turns.

3.4 Personal meaning and dialogue

"And what is the use of a book," thought Alice *"without pictures or conversation?"*

As Lewis Carroll suggests in the opening paragraph of Alice's Adventures in Wonderland, as humans we are strongly both visually and socially driven. The trajectory of an experience is structured through external sensory cues that support an internal sense-making process, just as the characters, action and relationships within a novel grip the reader and sustain interest in the story until the final scene. In technologically mediated encounters, interactivity can be seen as a form of social discourse and dialogue with others, whether those "others" are identifiable human individuals, technological entities, or aspects of our own selves; internal dialogues leading to reflection on one's own identity and self.

3.4.1 Internal and external dialogue

Discourse and dialogue can be seen as part of the mechanism by which we carry out the search for meaning in which we are constantly engaged as we strive to make sense of

the world and our place in it. This continuous immersion both in meaning-making itself, and in an awareness of that meaning-making, has been described by sociologists as "reflexive awareness". As Giddens (1991, p35) asserts, "*we begin from the premise that to be a human being is to know, virtually all of the time, in terms of some description or another, both what one is doing and why one is doing it*." He goes on to say that human beings go through a continuous, but tacit or "non-conscious" monitoring process of their own activities that is essentially discursive.

In the specific context of engagement with an interactive system, Dalsgaard and Hansen (2008 p5) describe how the relationship between system and user is largely defined as the user's exploration of the meaning of the system. This view is related to that put forward by Suchman (2007) who, in her influential study of interactions with technology, states that the source of meaning is not located as much in aspects of purposeful forward planning, but is found more in the process of situated action itself. Even though Suchman's work mainly concerns practical and functional technologies such as office machinery, she maintains that the interaction process is dynamically created in a manner that is not defined at the outset of the activity. Rather it is an iterative process of action and reaction by both the user and the system. The user's plans are constantly altering and adjusting in response to the unfolding of events, in the manner of a social or conversational dialogue.

This theory supports the view that construction of personal meaning can reside to a greater extent within discursive and exploratory encounters with interactive systems than within planned and goal-orientated interactions. The implications of this are firstly, that importance must be placed on the unique relationship between the individual participant and the particular context in which the interaction takes place, and secondly that serendipitous and improvised interactive experiences may be more meaningful than those that are more directed and focussed. Open-endedness and potential unexpectedness are the characteristics of conversations between people that make them worth participating in.

3.5 Art and Interactivity

As designers are increasingly tasked with providing richer experiences, deeper engagement and more enjoyable and satisfying interactions, it may be rewarding to

explore the ways in which other disciplines approach the study of user experience. Bolter and Gromala (2003) put forward a strong argument for the serious study of digital art as a method for informing interaction design:

> *"Digital art is relevant for information architects, creative managers who are building Web sites, usability specialists testing productivity software, computer scientists imagining new applications in mixed reality and ubiquitous computing, and those seeking to create new forms of digital entertainment."*

Describing the gallery of digital art exhibited at SIGGRAPH 2000, Bolter and Gromala (2003) say:

> *"These works are not meant to deliver some benign information content and then disappear from our consciousness. Instead, they engage us in interactive experiences in which it is meaningless to try to separate form and context. Rather than castigate the Structuralists, we want to convince them that digital art can help all information technologists achieve their goal of effective design."*

Since the 1960s, and earlier, artists have increasingly been exploring the possibilities offered by new interactive technologies, particularly so since the widespread growth of the Internet during the 1990s. Freed from the disciplinary constraints of Human Computer Interaction (HCI), artists can explore unconventional and ambiguous ideas in their work. This study intends to describe the way that digital artists are currently dealing with computer-mediated data, investigating concepts and approaches that are perhaps less quantifiable, more difficult, but possibly more intriguing and inspirational than those that have been studied in-depth to date. These concepts include such ideas as randomness, ambiguity, suggestiveness, exploratory and heuristic interaction, and manipulation of user-generated content.

The research to be undertaken will explore the question of how it is possible to move further beyond the currently accepted methodologies of interaction design practice by drawing inspiration from the concepts and theories being explored by artists working in new-media digital arts, with the aim of discovering what interaction designers can learn from this work. With fewer pragmatic constraints such as efficiency and

commercialism, new-media artists often work with challenging concepts such as ambiguity, randomness and intrigue, in the creation of engaging and thought-provoking experiences. Practitioners are already experimenting with, and evaluating the results of, these approaches. For example in the experimental design of a sensor-based system for the home, Gaver et al (2007) describe their attempts to shift the responsibility for meaningful interpretation from the system to the user through the use of design methods that are deliberately ambiguous. The designers claim that ambiguity can work when the goal is not just to use a system, but to engage with the issues raised by that use in ways which are relevant to users' own lives. As Gaver et al (2003) state in an earlier paper:

> *"Ambiguity can be frustrating, to be sure. But it can also be intriguing, mysterious, and delightful. By impelling people to interpret situations for themselves, it encourages them to start grappling conceptually with systems and their contexts, and thus to establish deeper and more personal relations with the meanings offered by those systems."*

3.5.1 Art and Interaction: timelines

In a desire to trace the trajectory of interactive art, a good starting point would be the well documented exhibition, "Cybernetic Serendipity", that took place in London in 1968. While this was not the first ever computer art exhibition, (McGregor, 2008), it did have a particular focus on exploring the relationships between technology and creativity, especially concerning the topics of control and communication. That said, there were actually very few digital computers involved in the exhibition, and not much in the way of interactive technology as it would be recognised by the HCI community. In the words of the curator of the exhibition, Jasia Reichardt, "*Cybernetic Serendipity deals with possibilities rather than achievements, and in this sense it is prematurely optimistic. There are no heroic claims to be made because computers have so far neither revolutionized music, nor art, nor poetry, in the same way that they have revolutionized science*". (Cited in (McGregor, 2008 p91), The exhibition was undoubtably highly influential in that it demonstrated the potential for using computation as an artistic resource, and it clearly inspired many people to take this

work forward to new levels. However the high cost, limited availability and sheer complexity of computational technology were limiting factors at this time.

Myron Krueger used the term "responsive environments" in a 1977 (Krueger 1977) paper presented to the National Computer Conference, held in New York. Responsive environments, in the broadest sense, are one of the main areas of interest in this thesis, so this chapter considers the features that distinguish them from other types of interactive system. Krueger introduces the term as describing an environment which "*perceives human behaviour and responds with intelligent auditory and visual feedback*." It is interesting to note that human behaviour is highlighted in this definition, and also that the idea of the human as initiator in the interaction is also implicit. Krueger's definition places the human in the primary role, but the paper explains that the computer's behaviour can establish and alter the environmental context. Using an interestingly anthropomorphic choice of phrase, Krueger explains how the design of the computation can "flirt" with the participant's expectations, suggesting that the experience can be controlled and manipulated to some extent. He goes on to suggest that responsive environments are a new art medium based on real-time interaction enabled through sensing, display and control systems (p430). Foretelling the technological developments that would appear at the end of the 20th and into the 21st Centuries, Krueger calls for a new way to look at the relationships between people and technological products, emphasising that the design of technology is an aesthetic issue as much as it is an engineering one. In this discussion, the themes of system agency, and the importance of designing human-like relationships emerge strongly, as he states that there is "*a personal need to understand and express the essence of the computer in humanistic terms*." (p433).

3.5.2 Computational technology, Art and Academia

Around the same time as Cybernetic Serendipity was in its planning stages, the Association for Computing Machinery was organising a professional development seminar on Interactive Computer Graphics, and this gradually evolved into the annual SIGGRAPH conference, first held in 1974 in Colorado as the 1st Annual Conference on Computer Graphics and Interactive Techniques. (http://www.siggraph.org/about/history). It was not until the last 1970s that an

exhibition was held alongside this conference, and this has developed into an important event in the international academic calendar. Just over a decade after the Cybernetic Serendipity exhibition, the first Ars Electronica Festival was staged in Linz, Austria. With a stated philosophy of "art, technology and society", the international reputation of the festival has continued to grow, and many artistic and research activities now centre around the Ars Electronica building, which includes a large external media facade. In 1990, the International Society for the Electronic Arts was founded in the Netherlands as an international organisation for "*interdisciplinary academic discourse and exchange among culturally diverse organisations and individuals working with art, science and technology.*" (http://www.isea-web.org/) The main activity of this organisation is the annual ISEA symposium, which began in 1988.

Alongside these major, internationally recognised events that actively shaped the development of creative computing practice, there is now a proliferation of smaller organisations, events, festivals, conferences and exhibitions of creative, interactive artworks. The annual Kinetica Art Fair, running since 2009 in London is one such example. This exhibition and programme of events is more commercially oriented, rather than academic, and it provides a platform for the display of interdisciplinary new media art.

3.5.3 Identifying themes in interactive artworks

Following on from the preceding section that discussed the development of interactive art from the days of experimentation with early computers, to mainstream familiarity and acceptance in a wide range of exhibition spaces and public arenas, this section provides an over view of some of the types of interaction that can be found in interactive art. There are many anthologies and collections that provide much more comprehensive overviews than can be attempted here, and instead this section presents some illustrative examples, specifically highlighting the themes that can be identified across a range of appropriate types of interactive art. A particular focus is placed on audience engagement with "walk-by" installations, which will be addressed in more detail in the next chapter. This section also examines the topics of artistic motivation and inspiration, through themes identified in qualitative analysis of interviews with artists.

3.5.4 Interpretation and ambiguity

An example of an interactive artwork that encourages personal interpretation, The Giver of Names by Canadian artist David Rokeby (1991 -), is a computer system that describes objects, selected from a collection and placed on a pedestal by visitors to the installation. A video camera captures an image of these objects and then runs a series of programmes that analyse the images according to shape, colour, texture and so on. The system then generates text from its database of words and phrases according to matches from the visual analysis. The resulting text is both meaningless by definition as it is computer generated, and strangely poetic, triggering interpretation in the viewer. There are no instructions, visitors have to work out how to interact with the work for themselves, and interpret and respond to, the results in the manner of a dialogue. In evaluations, Muller (2008), visitors to this work have described it using words such as; confusing, intriguing, exploratory, enigmatic, frustrating, playful and curious, all words that express qualities more often associated with human dialogues.
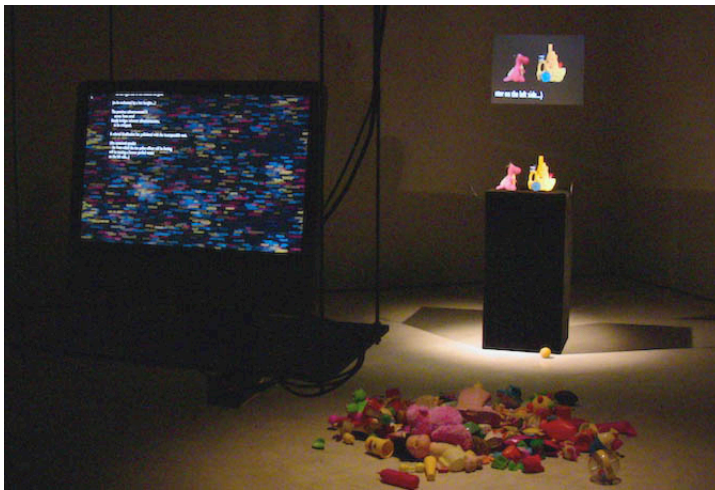
Figure 3.3 : The Giver of Names by David Rokeby.

Sharing a similar approach is Mark Hansen and Ben Rubin's Listening Post (2001 -), comprising of a wall of small screens displaying cut-up text fragments sampled in real time from internet chatrooms and public forums. While this piece is not interactive in the way that The Giver of Names is, it too offers an invitation to the viewer to interpret the content in a personal and individual manner. As with The Giver of Names, the textual content of the Listening Post is not devised directly by the artist but is generated through computation, is seemingly random, and so is intrinsically devoid of meaning.

In spite of this lack of human consciousness, both pieces have been described as poetic and meaningful, due to the way that imagined connections are created in the mind of the viewer from the juxtapositions of elements of the artworks.

3.5.5 Entering the mainstream

As the previous discussion has demonstrated, the domain of interactive and new media art emerged in from early developments in computing in the 1960s to become widely recognised in the 2000s. As evidence of this, the Victoria & Albert museum in London, in collaboration with ondotzero, curated an exhibition of digital and interactive design called Decode: Digital Design Sensations in 2009. The exhibition categorised the work according to three types; firstly the theme of code, including programming and open source, secondly interactivity and responsiveness, and lastly networked and connected art. By presenting the work under these three categories, the curators have provided a structure for visitors in order that they might understand and "read" this novel artistic medium. While code based and network art are interesting topics, it is primarily the interactive theme that is of relevance to this thesis. On the exhibition website these are defined as designs where the viewer directly influences the work. By exposing the interactive works to such a large audience, issues emerged that had to be addressed and overcome. As V&A conservator Clair Battisson (2011) explains:

> "*Heavy control may remove some of the subtle, personal, unexpected experiences produced by the works and their collaborators.... As previously with video art, perhaps this type of work needs to gain a certain distance and independence from its technology to fully establish itself as an art form with in a museum context.*"

For such a major, well-known and high profile museum to present an exhibition of this type is a strong indicator that interactive art is becoming as well understood and accepted as any other form of contemporary art, by both experts and the general public. This is in addition to the high visibility of media art sited in public spaces and on building facades that is making new media installations an increasingly familiar part of our urban experience. The effects of Moore's law, which predicts the increase in computing power of devices over time, has lead to much cheaper and more accessible components being made available to creative practitioners. The increased availability

and lower costs of a wide range of sensing, recording and transmitting devices has also had a huge impact on the spread of interactive systems. Items such as video cameras, webcams, data projectors, screens, motion sensors and microphones are now relatively easy to access, at least in comparison to the 1960s and 1970s. These factors have lead to the proliferation of electronic and interactive media, and the corresponding need for informative research into design aspects.

A key aspect of interactive art, which differentiates it from almost any other type of creative output, is this ability of the viewer to change, and even add to, the artwork itself. As the V&A's website states, "*Visitors will be invited to interact with and contribute to the development of the works, many of which show designers playing with the boundaries of design and performance.*" Interactive art in this aspect is unfinished, never complete.

3.5.6 Interaction in art

As the use of computational technology in art is still a relatively recent practice, writers and critics are still discussing how to define and categorise new-media and digital art. Popper (2007, p5) believes that technology can be humanised through art, by the application of the artistic imagination. This is not so far from the aims of the interaction designer, and suggests that there are factors in common in both of these domains.

It is important to reiterate here that this research thesis is situated in the domain of interaction design, and the contribution that is presented is primarily concerned with "usefulness to design". The implication is that this is not the place to make any judgements about the quality of artworks from an artistic or art criticism perspective. This is a highly contested topic even within the academic domains of art theory and practice, and in related domains such as aesthetics, and is well beyond the of scope of this thesis. From an interaction designer's perspective it would be difficult to meaningfully compare and discuss the artistic merits of such artworks as, for example, Man Ray's "The Kiss", and Raoul Hausmann's "Elasticum", (Figure 3.4). Computational art was of course heavily informed by the art practice that preceded it, particularly the artistic movements that emerged from the early 20th century onwards. Experimental movements such as Dada and Surrealism, with their interest in the

integration of new technologies such as photography, and the appropriation of mixed media, had strong influences on the computational art that followed in later decades.
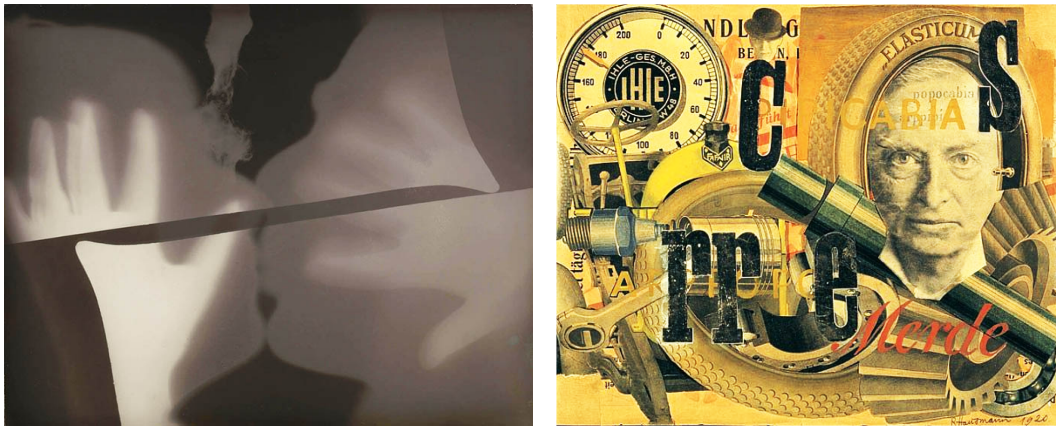
Figures 3.4 a: Man Ray, "The Kiss", 1922, rayography. 3.4 b: Raoul Hausmann: "Elasticum", 1920, collage and gouache.

3.5.7 Addressing artistic computational interactivity as a design challenge

Returning to Myron Krueger's 1977 paper on responsive environments, it can be seen that computers were being used for aesthetic and artist purposes as soon as the capabilities of the technology enabled this to happen. Krueger presents a kind of manifesto for interactive art, based on his own practical experiences of working with artists. His succinct findings are reproduced in full here, and in these it is notable how he considers that interactivity is an aesthetic medium in its own right, and that participant awareness of responsiveness is important. In his opinion this is what distinguishes a good interactive experience from one that is merely visually or aurally ambient:

> "*1.   Interactive art is potentially a richly composable medium quite distinct from the concerns of sculpture, graphic art or music.*
>
> *2.   In order to respond intelligently the computer should perceive as much as possible about the participant's behavior.*
>
> *3.   In order to focus on the relationships between the environment and the participants, rather than among participants, only a small number of people should be involved at a time.*

4.   The participants should be aware of how the environment is responding to them.

5.   The choice of sound and visual response systems should be dictated by their ability to convey a wide variety of conceptual relationships.

6.   The visual responses should not be judged as art nor the sounds as music. The only aesthetic concern is the quality of the interaction." (Krueger, 1977).

3.6 Literature review summary and identification of themes

This section summarises the main themes that have been discussed in chapters two and three. The review of previous work has identified a shift within HCI in recent years towards acceptance of more design-oriented perspectives, including an interest in the ideas of creative artists, and also a growing confidence in the adoption of a broader range of investigative techniques, particularly interpretative research methods. Researchers are increasingly looking at a wider range of contextual factors that influence the design of conditions and situations that support positive, engaging experiences, drawing on approaches from the social sciences and the humanities.

This section provides background for the work that follows in the next chapters. In particular, the following ideas emerging from the review are of particular relevance to this thesis:

1. Consideration of "optimal" experience, and the state of flow.
2. Stages of engagement, enticement and attraction, and encouraging sustained engagement.
3. Interactions framed as social encounters, affected by spatial aspects.
4. Action oriented engagement, in opposition to task orientation.
5. Complexity, difficulty and ambiguity as resources for engagement.

Chapter 4 presents a further analysis of themes expressed by artists themselves as they discuss their own work. The five themes listed above are evident within the HCI and Interaction Design literature review, and are also found within the artists' texts. This mapping between the original themes and the themes identified in the analysis is

examined in the next chapter. In addition, a sixth theme is identified as prevalent within the thematic analysis that is much less evident within the HCI and Interaction Design literature. This theme of "Apparent lifelikeness, sentience and agency", is promising as a resource for informing the design of publicly sited systems and the following chapters investigate this further.

The texts that are analysed fall outside of the formal published body of academic literature, and therefore they have not been subject to the same level of research scrutiny. The themes that emerge from this study are then compared to the themes identified in within the two literature review chapters as verification of their relevance. The thesis goes on to structure and present these themes as a framework, named here as the Optional Interactions Design Framework, and argues that this can be considered as a form of "bridging concept", linking theory and practice in the context of action-oriented interactive systems design.

Chapter 4: Art as a Design Resource

4.1 Introduction

This chapter is the first of three interconnecting sections that present original work, including an evaluation in Chapter 6, and concluding with a discussion in Chapter 7 of the implications of the thesis findings and recommendations for further work. This introduction begins with an overview of the structure of the research, followed by a brief outline of the three phases of the research work.

4.2 Overview of research methodology

The research work that is reported in Chapters 4, 5 and 6 was carried out using a mixed methods approach. Each chapter includes a discussion of the methodology that informed that particular phase of work. Briefly, Chapter 4 presents a qualitative analysis of themes used to inform the work of artists, Chapter 5 presents three design case studies as exemplars that exhibit aspects of the themes identified in Chapter 4, and Chapter 6 presents a more formalised "Optional Interactions" design framework informed by literature on design pattern languages. Chapter 7 completes the research phase of the work by presenting a reflective evaluation of elements of the framework in practice.

4.2.1 Identification of themes employed by artists

This chapter presents findings and insights generated from an analysis of the words of artists, in the form of interview data, as they discuss their motivations and strategies for the creation of their interactive artworks. The selected interview texts were closely read to reveal and identifying key themes, in order to categorise methods and approaches that artists use to support engagement with interactive systems. The thesis proposes that there are gaps in the HCI literature around the topic of identifying and describing strategies employed by artists that could inform interaction design practice in the domain of publicly-sited, optional, interactive systems.

The phase of research described in this chapter uses applied thematic analysis, informed by the grounded theory approach (Glaser and Strauss, 1967), where the themes are allowed to emerge from the data, rather than taking a particular hypothesis as a starting point for the analysis. The qualitative data, in the form of "found" interview texts has been scrutinised to identify relevant ideas, leading to the formation of theoretical framework to support the conclusions of the literature review. This type of qualitative research method has been selected as it is useful for examining subjective and situated data in an iterative way. Ideas and concepts that were not previously considered can be handled in this type of approach, and the developing theoretical framework can be adjusted to take account of findings as they emerge.

The rest of this chapter: describes the thematic analysis methodology; presents the identified themes in a schematic format: and discusses the insights gained from the study.

The chapter concludes with discussion of how these insights can be used as the basis of "bridging concepts", which are more directly relevant and to useful in informing design practice.

4.2.2 Bridging concepts and exemplar case studies

Following on from the discussion in the current chapter, chapter 5 provides a detailed, descriptive account of three interactive design projects intended for public spaces, titled "This Pervasive Day", "BetaCity" and "Beat Haiku". These projects illustrate the influence of the themes identified in Chapter 4, demonstrating that these themes that emerge from art practice are relevant to design practice.

4.2.3 Design Patterns and the Optional Interactions Framework

In this section of work, presented in Chapter 6, the Optional Interactions Design Framework is further developed, using Christopher Alexander's design patterns approach as a structuring aid. The Framework, and the underpinning design patterns approach, is evaluated in an educational, workshop setting with novice designers, and findings are presented and reflected upon.

4.3 The use of qualitative methods in interaction design research

This chapter discusses the ideas produced through the application of qualitative, thematic analysis, a methodology that is used widely in the social sciences to understand human phenomena, particularly to examine ways that people experience and make sense of the world. Glaser and Strauss, who developed grounded theory in the 1960s, used the approach in work with hospital patients, and it continues to be a popular approach in the field of healthcare. Methods borrowed from social science research disciplines have now become established within the interaction design research repertoire. Design ethnography, for example, is a common and well understood early phase of many design projects, based on approaches developed by anthropologists. It can be an important contribution to the as a user-centred research repertoire as it provides a "rich-picture" view of potential users and design settings and contexts that can, in turn, be used to develop valid personas and realistic scenarios in order to inform concrete design requirements.

Nicolas Nova (2015) has reflected on this evolution and integration of ethnography into design field research in a recent book chapter, reminding us that these highly detailed and rigorous methods are only used in a very limited way in design projects. Nova is interested in how designers have appropriated these methods from the academic social sciences, and how they have transformed them into practical tools that add to the design researcher's repertoire. Referencing Frayling's influential 1993 paper, Nova addresses the three key types of design research focus: "Research on design", "Research for design" and "Research through design". The use of ethnographic methods to inform design requirements would be classified as "Research for design", and that is the closest of the three types to the aims of the work in this thesis. In this case, thematic analysis of a selection of existing texts is deployed as a method of eliciting insights than can be fed into future design projects. However it is also worth looking more closely at the third of these approaches, "Research through design". Nova suggests that the knowledge that he has generated through his design research can be presented as original work that contributes to a wider domain, extending beyond the particular project that he is engaged in. He is very careful to draw a distinction between this kind of design research and that undertaken by specialists in the social sciences, but nevertheless this work can have influence beyond directly informing a particular

design project. Nova's concluding comments resonate with the aims of this thesis, in that there is an aspiration that the knowledge gained can go beyond informing a limited group of design projects. Therefore he extends his practice of ethnographic enquiry into current human activity, to include provocative considerations of where these behavioural trajectories might lead. As he considers this balancing of pragmatic and forward-looking aims in his work, Nova says:

> "*To some extent, the project is ethnographical in the sense that we conducted an open-ended field research. But the fact that it is project-based and driven by a design intention makes it different. Since design is concerned about the near future and projecting ideas about how things could be, we did not limit ourselves to documenting the past. Our speculation can be seen as a form of experimental ethnography with an interest in proposing situations and possibilities about the future.*" *(p127)*

Dourish (2014) also considers this appropriation of anthropological and sociological methods as a means of knowing in HCI; "*ethnography has often been seen instrumentally as a way of understanding important aspects of technological practice while its own epistemological commitments have remained somewhat murky.*" (p2) Of particular relevance to HCI (and by extension to interaction design) and to this thesis, are the concerns that he summarises. These include; the understanding that ethnographic data is produced rather than found, and that this happens through participation and engagement; that subjectivity and reflexivity are important elements of the process; and the interpretive stance of the researcher. Although the data that is analysed in this section of the thesis was not elicited by direct observation as in a classical ethnographic field study, nevertheless these aspects are all relevant to the overall approach of this work. The data set that is examined was selected with particular priorities in mind and, for a particular purpose, and therefore the subjective influence of the researcher must be acknowledged when considering the findings.

4.3.1 Limitations of Ethnographic Approaches

Alongside the enthusiastic advocates of these approaches, there are those who voice concerns about the way these methods have been adopted by the HCI community, and the claims made for their utility. Ethnographic fieldwork provides researchers with

materials with which they can gain understanding of activities within existing situations, and for this reason there has been criticism of the use of ethnography as a means of informing design of future products. Classical ethnography is used by anthropologists to investigate and describe a current situation, and not as a way of generating inspiration or requirements for new designs. As Dourish (2004, p20) says when discussing context, "*Turning social observation into technical design seems to be problematic*". In the same paper, he goes on to say that while translating ideas from domains such as social science can be valuable, it can also be unexpectedly difficult. Räsänen and Nyce (2006) claim that the question of how to make ethnography "work" properly for design has not yet been resolved. However, ethnographic interpretation can be used to inform research strategy at a higher level, as it can provide information about the social context and setting in which the technology is to be used. Observational ethnographic methods were popularised in the 1990s through the influence of researchers such as Suchman (2007) in research studies investigating work practices. The growing interest in this approach to the understanding of relationships between people and technology lead to the increasing involvement of anthropologically trained researchers such as Genevieve Bell in technology design and research projects, leading to a shift in emphasis within HCI towards wider human culture (Bell & Dourish, 2007). Many researchers have preferred this turn towards an anthropological view of broader context and culture, particularly as experiential aspects of design gain prominence. This more recent approach favours using ethnographic methods to engage designers in a critical dialogue, based on cultural interpretations, as an alternative to a more analytical orientation to methods of fieldwork which scrutinise people's actions and behaviours in closer detail.

From the discussion so far, two styles of approach can be identified. Firstly, the pragmatically oriented approach that prioritises the utility of the method in directly informing design, and secondly, the wider approach that is more concerned with gaining deeper understanding of the cultural and societal background in which novel designed systems are destined be situated. While the first, pragmatically oriented, approach may attract scepticism from an academic community concerned with the rigour of social science methods, the second, broader, approach also has its critics from within the HCI and interaction design community. In a provocative 2009 CHI paper,

titled "Ethnography Considered Harmful", Crabtree et al. point out issues about the validity of the "cultural interpretation" approach. The authors seem concerned that taking investigative methods back to their anthropological and cultural origins may not be the best way to approach research for design. The authors frame this as a "new" approach, as opposed to the "traditional" HCI situated action methods that focus on detailed empirical studies of how people act and behave in particular, relevant settings. To quote from the paper;

> "*In this case what new ethnographic practice offers design is an assessment and revision of the social or cultural adequacy of technical concepts.*" *(p881)*

> "*Through it ethnography is transformed into a literary practice and design is offered conceptual rhetoric that turns upon the literary skills of the ethnographer, rather than the organized conduct of those who will ultimately use the technology. The inherent danger is that we turn the ethnographer into a wordsmith rather than a fieldworker, and in doing so run the risk of removing the foundation of an empirical base to locate ethnography, and in turn design, in practices for producing social and cultural texts instead.*" *(p882)*

Although the authors here do not seem to favour the use of social science methods for producing cultural commentary, they are not dismissing the role of ethnography in design research, instead they are advocating a more specific employment of particular ethnographic methods. They propose an ethnomethodologically informed variety of ethnography that looks directly at people's actions and behaviours, and which supports the development of concrete insights that are directly relevant to the design of technological systems. This approach keeps researchers' attentions focussed on practical outcomes, rather than distracting them with broader considerations of how and why social and contextual situations emerge and are constructed.

Ethnomethodology, as presented by Garfinkel (1967) is less concerned with describing overarching theories of cultural and social structures, instead it is concerned with the practices of individuals, and the exploration of these forms of action. Ethnomethodology places more importance on how individuals themselves make sense of their own activities, than on the interpretative framing developed by the researcher. This more constructive use of ethnography in design foregrounds what people actually

do in a particular situation with the aim of introducing new systems that improve upon the situation. It is worth comparing this to Nova's approach, discussed earlier in this section, which speculates on scenarios that may happen in the future, and therefore cannot be observed and investigated in this ethnomethodological way. A potential disadvantage, therefore, is that ethnomethodology is more suited to incremental improvements on existing systems and is doubtful that it can support the design of disruptive innovations or radically new models of system design. It is unlikely to lead to deeper understandings of contextual issues or of the possible implications of introducing new systems to the world.

This discussion of ethnographic approaches to design projects is directly relevant to the analytical work that follows this section, as the stated aim of this thesis is primarily to present work that is pragmatically useful to designers. There is more than a small amount of sympathy with the broader aim of revealing social and cultural insights that may emerge from the study, and also on the importance of the interpretation of findings by the researcher. This raises a question as to whether it is possible to satisfy both aims - pragmatic and interpretive - within the same research study, or whether they are conflicting aims as Crabtree et al. (2009) imply. The work that follows in this thesis attempts to achieve both of these aims, drawing on the interpretation of the researcher to increase broader understanding of engagement with interactive systems, while also directly informing and developing a framework that is of practical use to designers.

4.4 The Thematic Analysis process

When embarking on the analysis process it is important to be clear about the question that is the starting point of the work. This part of the study accepts that some interactive artworks seem to engage people in experiences that they regard in a positive way. A thematic analysis, used to identify and label concepts embedded within texts, might help to uncover and reveal what is going on as artists create these works.

This section presents a thematic analysis of artists' methods of encouraging engagement with their artworks. This work is founded on the idea that examining and describing these methods can provide insights into designing for engagement. Using thematic analysis based on a grounded theory approach, textual data is examined with the aim of understanding how artists achieve appropriate engagement with their works.

Grounded Theory is a method originating in the social sciences, and used for drawing out and cataloguing insights hidden within qualitative raw data sources. The resulting theory is "grounded" in the data and should therefore be more robust than theories generated in other ways. It is a qualitative method of data analysis that can be particularly useful when there is no starting hypothesis to test, and as such should be a good fit to this particular research, which is exploratory in nature. One of the key ideas behind grounded theory is implicit in the name. The researcher should not start with a theory to test, but instead becomes immersed in "real world" data, enabling the emergence of theory, grounded in this data, that explains observed phenomena. In this research study, the phenomenon that has been observed, put very simply, is that some interactive artworks seem to promote positive engagement. Taking a grounded theory approach would seem to be a useful way to proceed.

As discussed by Furniss et al (2011), the grounded theory approach has been applied to HCI research topics with the aim of eliciting insight into how people relate to technology. Grounded Theory is often used as an iterative structuring technique in qualitative interviewing, and subsequently to handle and organise the resulting data. Originally described by Glaser and Strauss (1967), the approach has been popularised as a method to gain understanding of subjective experiences, and to support the development of theories. However the application of the method has often deviated from the original approach described in the 1960s, with even the original authors disagreeing on this from the late 1980s onwards. Matavire and Brown (2008), conveniently present an analysis and discussion of the four main ways that the Grounded Theory approach has been used in Information Systems research, and this is helpful to provide guidance on the best way to proceed.

4.4.1 Which Flavour of Grounded Theory to use?

Matavire and Brown (2008), identify four main approaches, briefly; the Glaserian, the Straussian, a mixed method approach, and a simple application for data analysis, the latter being the most commonly used technique. A distinction is made between the original key methodological principles (emergence of theory from data, iterative comparative analysis, and theoretical sampling) and the practical methods and techniques that are used in accordance to these principles. In this research study, after

some experimental attempts to conduct original interviews with artists, it was decided to use existing texts. The amount of textual data already available seemed rich and interesting enough to merit closer examination to see if any useful theory did indeed emerge. This decision seemed to point to the use of a grounded theory data analysis approach to inform the coding investigation of the data. The focus here is on the development of useful concepts that can be presented in a way that helps designers to create better interactive systems, that are more engaging and more positively regarded by their users. In order to develop these concepts, the motivations and working practices of artists - their "thinking and doing", is being examined for underpinning themes. Keeping this goal in mind helped to guide the methodology towards an approach that prioritised the uncovering of themes, rather than either creating highly descriptive documents, or on the other hand developing explanatory "grand theory". This could be described by true social science researchers as a lightweight approach to grounded theory, as it does not involve the application of the full range of analytical tools and approaches available to the grounded theory expert. However as a pragmatic analytical methodology, this approach suits the aims of this research.

4.4.2 Applied Thematic Analysis Methodology

As the main motivation behind this study is to inform and influence design practice in the context of action-oriented rather than goal-oriented systems, this thesis takes an interpretative approach rather than a positivist approach. The purpose of this research is not to "prove" scientific facts or to generate solid theory of any particular phenomenon. Instead the aim is to gain and deepen understanding of artistic and creative practice, to identify and describe themes within that practice, and to assess how this knowledge can be applied to design situations. The data that was collected for this section of the study is qualitative, non-numeric data, and so it requires an analytical method that can identify, reveal and extract the ideas contained within it. The approach chosen for this task is applied thematic analysis, as described by Guest, MacQueen and Namey. (2012), and also drawing from the method described by Braun and Clarke (2006).

Applied thematic analysis is closely related to grounded theory in that the methods are systematic yet flexible, and are aimed towards constructing theory grounded in the collected data, allowing the theory to emerge from the data. Applied thematic analysis

is characterised by the emphasis placed on the description and understanding of how people think and behave within a particular context, rather than aiming for the construction of theoretical models. In this study the people are artists, and the context is the activity of designing interactive systems. As Guest et al (2012) themselves say:

> "*Applied thematic analysis as we define it comprises a bit of everything--grounded theory, positivism, interpretivism, and phenomenology--synthesized into one methodological framework. The approach borrows what we feel are the more useful techniques from each theoretical and methodological camp and adapts them to an applied research context.*"

This practical approach, intended to be transparent and credible, is well-aligned to the motivations of this research study. The approach allows for analysis that identifies high-level themes that have practical applications, rather than placing emphasis on the thorough theoretical understanding of why artists do what they do. Braun and Clarke, (2006 p81) argue that researchers using thematic analysis "*need not subscribe to the implicit theoretical commitments of grounded theory if they do not wish to produce a fully worked-up grounded-theory analysis*". They do, however assert the importance of transparency and clarity with regard to the theoretical position of the analysis.

4.4.3 The coding approach

An important phase of this work in this chapter was the coding of both implicit and explicit ideas found within the texts, in a descriptive and exploratory manner, which is to say that this was content driven rather than hypothesis driven. The data in the study was read through to identify some initial codes before detailed analysis took place, this was influenced by the high level themes identified in the literature review. The themes and categories were identified from within the data, rather than existing beforehand, although there were some potentially interesting themes already identified from within the literature. These topics, concerning strategies to design for audience engagement, were found to exist within the interview data, but the coding process revealed richer layers and further themes within the texts. These themes were analysed and used to inform the first version of the Optional Interactions Framework. In the words of Braun and Clarke (2006 p82) a theme "*captures something important about the data in relation to the research question, and represents some level of patterned response or*

meaning within the data set." By investigating the words of several artists, the intention was to see whether patterns could be identified across the data set that were more than single instances. The judgement of the researcher is necessary here to determine the identification of a theme, and this is influenced by how the theme relates to the overall research question. Therefore the same researcher looking at the same data set again at a later date might identify different themes if the research question was significantly different. In this study there were many interesting ideas present in the texts, but attention was focused on discussions relating to strategies for structuring audience engagement and experience.

4.4.4 Coding of found texts

Ethnography has been discussed in this introduction to the methodology in order to provide a background to the discussion of the work that follows. Ethnographic methods follow a non-directive approach, allowing the concerns of the subjects to take priority, within the broad interests of the research question. The early stages of this research project included a plan to interview artists specifically for this study, and some interviews with current practitioners were carried out during a pilot study. However, during the literature review process it became clear that there was already a substantial existing corpus of interview data that could be used to yield insights into the approaches of artists. There were several advantages to using this data, one of which is the variety, scope and richness of the interviews. The interviews were conducted with highly regarded artists at various points in their careers. This scope would not have been possible to recreate specially for this thesis. The interviews with artists are "found texts" in that they were not generated for the purpose of this research, and they were conducted by different interviewers. This makes them a rather interesting primary, historical data source, as they are not tainted by the issues of researcher influence. It also frames the work as being closer in methodology to an ethnographic approach, by preserving a detachment between the researcher, who is here in the role of observer, and the subjects.

The interviews were mostly carried out as part of the promotional and media activities that accompanied exhibitions or new installations of work, and were not conducted under research conditions. Therefore we can infer that the artists were motivated to

explain and discuss their work for a general audience, rather than as the subjects of a particular investigation. Feeling that they were the subject of research scrutiny may have lead to the interviewees attempting to adjust or rationalise their approaches to suit the topic of the interview, perhaps at a subconscious level.

4.5 Selection and analysis of the data

The data that was analysed in this study was pre-existing or secondary data, rather than being generated specifically for the research study. The interview data set was gathered from a range of external sources according to a set of criteria described in the following section. This section presents a discussion of issues that were considered when deciding on this data selection.

4.5.1 Criteria for selection: relevance rather than random selection

As discussed in Ponelis, (2015 p540), interpretive research does not require randomised selection of material in order to ensure validity. Depending on the aims of the research study, it can be preferable to select texts based on relevance to the research question rather than aiming for a selection that is fully representative of a particular situation or set of people. Instead the selection should aim to be information-rich according to the needs of the research task. Purposive, judgemental or subjective sampling is therefore suitable as a method of selection. In interpretative research, a relatively small set of cases can be used, as relevance is of greater priority than rigour. As Ponalis (ibid) explains, the interpretive paradigm, with criteria such as dependability, credibility and transferability, differs from the positivist paradigm with its emphasis on measurement and proof. Dependability and credibility relate to selection, qualitative analysis and reporting, while transferability relates to the application of the understandings produced through this process to the practical work later in the thesis. The validity of the research, therefore, is supported by how well the knowledge gained through the analytical process is expressed in the design framework, and ultimately, used to inform design practice.

This phase of the research project aims to reveal ideas around engagement and experience that inform the work of interactive artists, and as such it was important to

firstly select appropriate artists, and secondly to identify texts that are close to the first-hand accounts of those artists.

The final collection of texts that were selected for investigation and analysis were drawn from a wide search of publicly available online material. The final choices were made using judgement based primarily on relevance to the research question, along with richness of content. Each text contained enough discussion of salient issues to enable meaningful analysis. The size of the collection is large enough to provide variety of concepts, without being so large that the analysis is unwieldy.

The interviewees were all artists who are accepted and validated as such by their peer communities - authoritative sources relevant to interactive, digital or new media art. In practice, the works discussed in the texts have been selected for curated exhibitions, commissioned for public display or otherwise recorded in the literature.

4.5.2 Informing the framework

Following an approach suggested by Guest et al (2012), the research plan involved developing a conceptual framework from the literature review, reported in the early chapters, that provides focus but does not limit the identification of emergent themes. The previous review work provides a scaffold to structure the analysis. This was carried out in chapters 2 and 3, culminating with the identification of several themes that provide structure to the following analysis. The work that follows supports and validates that framework of themes. As Ponalis (2015) asserts, in interpretive research "general ideas" or "expectations" rather than a particular hypothesis can guide the research. These guiding general expectations have been provided by the literature review (summarised in 3.6), and the process of interpretation of the artists' texts develops, expands and enriches this understanding through deeper examination of the articulated ideas and discussions.

4.6   Description of the selected texts

A set of published interview texts were selected for thematic analysis according to several criteria, described in this section. All are first hand accounts although they are each edited and reported by a journalistic interviewer who is not part of this research

project. In order to get as close to first hand accounts as possible, direct speech is considered primary, and sections that are paraphrased by the interviewer are secondary.

4.6.1 Selection of artists

Using relevance to the research question as a guide for selection, all the selected artists work with interactive media that are sited in locations where viewers and audiences can walk by and encounter the works. These are either in gallery and exhibition situations, or in public areas. As this type of optional interaction is the core feature of this inquiry, some categories of digital or media artist were excluded, such as those working in net art or generative art. The artist also had to be clearly identified as artists rather than designers, although this is becoming a more problematic aspect as interdisciplinary and transdisciplinary practice increase (Rodgers & Smyth 2010). Some of the artists, such as Daan Roosgaarde, run design or architectural practices in addition to their art practice, and some of the artists' practice has evolved over time to include domains other than art. This is addressed here by including artists who are clearly identified as "artists" within the context of each interview, for example interviews that accompany the opening of an exhibition, even though their practice may be broader than this, and may include other labels such as "designer" and "architect".

4.6.2 Status of the artists

Only artists with substantial experience of exhibiting their work were considered, and all of them had a level of recognition and critical acclaim. Several of the artists are considered to be pioneers in the domain of interactive art, and most have had their work selected by curators for exhibition in internationally recognised venues and exhibitions. This criteria meant that younger artists and students were mostly excluded from the study. Although many of these artists might have interesting contributions to make, for this study, it seemed likely that more experienced artists would have had a longer time to develop and reflect upon their own approaches to their work. This would increase the possibility of uncovering insights into which approaches were found to be more successful when applied in practice. The artists selected are:

Andre Goncalves

Camille Utterback

Daan Roosegaarde

Daniel Rozin

David Rokeby

Golan Levin

Jay Yan

Justin Goodyear

Justin Lui

Philip Beesley

Rafael Lozano-Hemmer

Stuart Wood, Florian Ortkrass and Hannes Koch (rAndom International)

Ruari Glynn

Tobie Kerridge

4.6.3 Publishing medium

The interviews were published in established online magazines and blogs covering relevant topics. This provided some indication that the interviewees were likely to have interests that aligned with the motivation of the study, broadly covering aspects of artist motivation and practice, and issues relating to audience engagement and experience. The majority of the blogs are based across Europe, although the artists themselves work across a wider range of locations. As the selected texts had to be in English, this did restrict the range. A list and description of each of the magazines follows.

1. Artificial (www.artificial.dk) A news resource for information about net art, software art, and other computer based art forms. net art, software art, and other computer based art forms. An archive of articles and activities from 2001-2007.

2. Digicult (www.digicult.it) Established in 2005, Digicult is a cultural platform that examines the impact of digital technologies and applied sciences on art, design, culture and contemporary society.

3. Digitalarti news (www.digitalarti.com) The magazine, online and print, deals with digital art, new media, news, artists, innovation and research, festivals programs and the tight relationship between arts and sciences. English and French language versions.

4. Domus (www.domusweb.it) Art, design and architecture magazine. The physical magazine was established in 1928.

5. Furtherfield (www.furtherfield.org) The Furtherfield Blog has been running since 2006 as a shared space for personal reflections on media art practice: making it, curating it, translating it.

6. Happy Famous Artists (www.happyfamousartists.com) A blog established in 2004 by a collective of practising artists, documenting events and new works.

7. Photography Playground (Photography.playground.olympus.de) online magazine about creative photography, by the Olympus camera company.

8. Software and Art (www.softwareandart.com) A blog run by Leaders in Software and Art (LISA), a society of creative thinkers centered around monthly salons and an annual conference, founded in 2009.

9. Solo Mosaico (www.solo-mosaico.org) is an Italian/Russion magazine articles exploring the history and contemporary practice of mosaic -

10. Studio International (www.studiointernational.com) Long established magazine based in New York, covering visual arts, design and architecture. The physical magazine was established in 1893, and the online e-journal appeared in 2000.

11. Vague Terrain Www.vagueterrain.net A web based digital arts publication that showcased the creative practice of a variety of artists, musicians and scholars. Established in 2005 and active until 2012.

12. We Make Money Not Art (www.we-make-money-not-art.com) An award winning site established in 2004 by Régine Debatty, a blogger, curator and critic. Topics covered include the intersection between art, science and social issues.

4.6.4 Format of the selected interviews

Interviews in public news media take many forms, shaped by the type of publication, and the individual style of the reviewer. The interviews were selected in order to provide enough textual material that was as close to the original words of the interviewed artist as possible. In making the final selections, an important criteria was that the voice of the interviewee was clear in the text. This lead to interviews where the interviewer included a large amount of paraphrasing and analysis being rejected in favour of simpler formats. These typically included an introduction from the journalist,

followed by a straightforward question and answer format. The motivation of the interviewer in each of these texts would be to present an interesting article for the intended reader of the particular blog or magazine, in accordance with the editorial policy of that media. It is accepted that the interviews were likely to be edited by the interviewer for journalistic and editorial reasons, but all the selected texts included substantial direct quotes from the interviewee. By selecting work from several journalists and sources, the effect of interviewer bias and style is kept to a minimum.

There are advantages and disadvantages in this use of third party material. On the one hand, the influence of the researcher is absent from the texts. The interviewers have varied backgrounds, and they each bring their own knowledge and expertise to the task. Therefore they have asked a much wider range of questions than the author of this thesis is likely to have achieved, adding greatly to the richness and interest of the discussion in the texts. The interviewees also, are not placed in the position of a research subject, which can influence their responses. Instead they are speaking in a situation where they are promoting and presenting their own work to an interested and knowledgable interviewer. On the other hand, this separation and distance from the interviewing process means that the researcher was not able to control the questions that were asked, or to follow up any topics of particular relevance to the research questions that emerged during the interview.

Taking these aspects into consideration, the texts that were selected were as close to research interviews in their format as possible. Generally the interviews follow a pattern where the interviewer firstly presents some introductory discussion of the artist, their previous work and the reason for conducting the interview. The interviews were usually conducted to coincide with a new exhibition of work. The main body of the interview is then made up of clearly delineated questions and answers. The interviewees answers are presented as transcriptions without any paraphrasing or summarising by the interviewer, although it is not possible to be completely sure that no editing has taken place.

4.6.5 Content of the interviews

In selecting the final texts to analyse, the topics covered in the interviews were considered. All the selected interviews address two main issues that are relevant to the inquiry; the artist's approach to creating interactivity, and the consideration of the audience engagement and experience. These topics were addressed in different ways by the interviewers, which provided a range of responses that supported the thematic analysis approach.

4.6.6 Timing of the interviews

One of the major advantages of selecting existing texts was being able to choose interviews from a range of time periods. This enabled an examination of the views of artists taken from particularly relevant points in their careers. Daniel Rozin, for example, is interviewed in both 2006 and 2011. The earliest interview, with Camille Utterback, took place in 2005, and almost all years are represented between 2005 and 2014.

4.7 Coding and Analysis Process

The texts were analysed and coded using Nvivo qualitative analysis and data management software. Data about the interviews was recorded in order to enable queries to be carried out and then the texts were examined in closer detail. The texts were read and codes applied in a two-stage process:

4.7.1 First Stage: getting familiar with the content and identifying themes

The first stage took an open-ended approach, beginning with no predetermined codes in the manner of grounded theory, where the ideas emerge from the texts, although the broad themes already identified provided some focus. Passages that discussed the audience engagement aspects and the conceptual visions of each artist were identified and prioritised. This meant that some passages were left uncoded, where the artist was discussing aspects that were out of scope for the research direction of this project. This was not always a clear-cut or easy process, and some subjective interpretation was needed, for example where an artist discussed the technical process of programming the interaction for an installation, or where a topic was too general and was not

concerned directly with the artist's own personal work. Another consideration was to avoid coding overly superficial or intrinsic ideas such as "interactivity" or "technology". Some of these concepts cut across all the texts, and can be taken as a given.

The texts were closely read, and codes were identified from the relevant passages within the texts. This generated a long list of around 350 separate words and phrases that captured the ideas and concepts within the texts. These phrases often included combinations of concepts, expressing how various ideas and topics work together and interrelate. For example the phrases: "bodily presence as a catalyst for interaction", "influence of other audience members", and "involvement of the particular viewer", all include ideas of physical presence of people within the interaction zone, but they each concern slightly different aspects of this topic. Each of theses phrases contains a distillation of a longer passage of discussion. The passages of text, representing natural speech, often contained several overlapping ideas, and these were identified and coded separately. This scrutiny of the texts enabled familiarisation with the range of concepts and topics contained within the data.

4.7.2 Second Stage: distillation of themes

The next step involved grouping the identified phrases into overarching themes. It was decided to restrict these to single word theme concepts in order to create a simplified structuring, and also to include sub themes with the aim of refining and clustering concepts. The original codes identified in the first stage were then removed from the texts, and the texts were then coded over again, this time using the predetermined single-word codes. During this process, further codes and sub-codes were added, and the grouping was refined. During this examination of the texts, some codes were duplicated and assigned to different groups according to semantic meaning. For example there are two instances of the sub-code "Scale", one in the group "Perception", and one in the group "Physicality", with different sections of text coded in each. The resulting code structure has been expressed in two ways showing connections and clusters. A mind map (figure 4.2) shows a more visual type of representation, while an affinity diagram (figure 4.1) shows the codes organised and structured in a manner that is common during workshop-style "interpretation sessions". This latter method is often

used with stakeholders in the early stage of the design process in order to reveal and identify aspects of the particular design context and problem. Either method simply allows the codes to be viewed along with the relationships between them, although the mind map style give a rather more holistic overview of the interconnections between the topics.

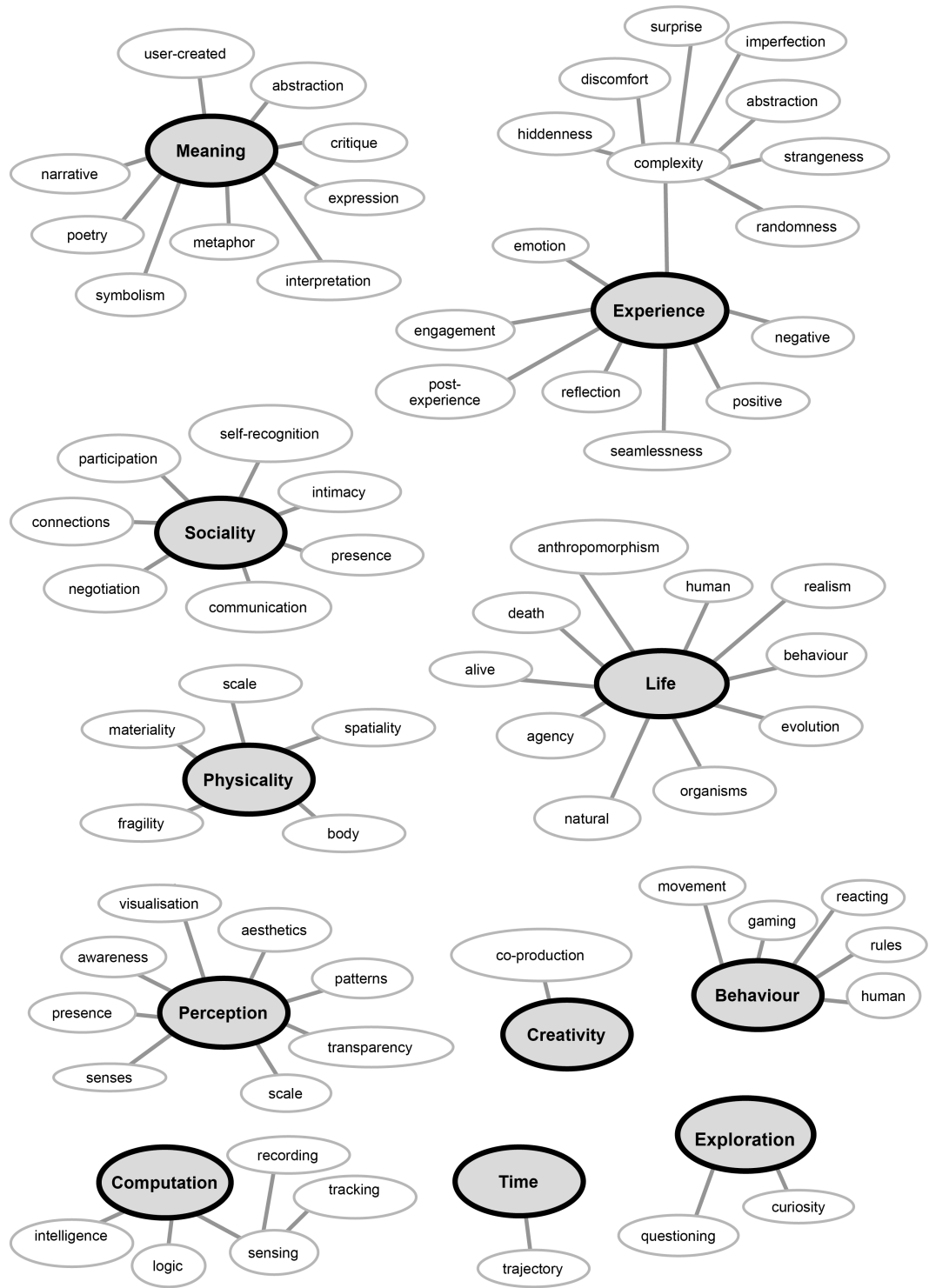|		
Experience: Emotion engagement post-experience reflection seamlessness positive negative ***Complexity:*** hiddenness discomfort surprise imperfection abstraction strangeness randomness **Meaning:** user-created abstraction narrative poetry symbolism metaphor interpretation expression critique	**Sociality:** self-recognition intimacy participation connections negotiation communication presence **Life:** natural agency alive death anthropomorphism human realism behaviour evolution organisms **Physicality:** fragility materiality scale spatiality body	**Perception:** senses presence awareness visualisation aesthetics patterns transparency scale **Computation:** intelligence logic ***sensing:*** recording tracking **Behaviour:** movement gaming reacting rules human **Exploration:** questioning curiosity **Creativity:** co-production **Time:** Trajectory

Figure 4.1 Affinity diagram of identified themes

Figure 4.2 Overview of identified themes showing relationships

4.8 Insights from the thematic analysis: from identification to deeper understandings

In the previous section, inroads were made into the task of revealing and understanding concepts that will inform and shape the final design framework that is the output of this thesis. A thematic analysis method was used to interrogate a set of texts in order to shape and structure a collection of ideas that reflect some of the inspirations and interests of artists working in the domain of interactive media.

4.8.1 Reflections on the thematic analysis methodology: limitations

Although thematic analysis is a flexible and practical method that can be helpful in highlighting ideas and concepts within texts, it does have several limitations as a methodology. In this first study, one issue is clear - that there is a lack of nuance in the identified themes. Although the collection as a whole and the links between them are interesting, and serve to demonstrate useful concepts that merit investigation, the findings require further interpretation in order to uncover more understanding. Grounded theory type methods, including thematic analysis, emphasise the "emergence" of ideas from data, however, as writers such as Alfred Schutz (discussing the theory of social action) assert, *"The facts do not tell their own story; they must be cross-examined, analysed, systematized, compared and interpreted"* (Schutz, 2011 p8). This view particularly concerns data that emerges as a result of human activity, as in the study undertaken here, where the information generated must be understood within the conceptual scheme of the motives and goals of the actor. Therefore the collection presented in this thesis so far can be viewed as a kind of skeleton of concepts; useful for providing a frame, but requiring further flesh and muscle that can be provided through interpretation.

4.8.2 The use of interpretation to examine the texts.

Paul Dourish (2014, p9), discusses the reflexive turn in ethnographic research, emerging in the 1980s, as an approach that places greater focus on the role of the author *"as someone who creates and crafts a narrative, selects and shapes the data to be presented, who presents an account in which others are the actors…"*. In this approach, the author or researcher cannot hide behind the objective neutrality of the

data and the rigour of the data analysis method. Instead, the work can be judged by taking on board the accountability and self-awareness of the researcher.

Mantzavinos (2016), in his discussion of the hermeneutic approach to interpretation, explains that there are ongoing questions over the position that can be taken in choosing an analytical method, depending on whether the object or the method of inquiry take priority. Briefly, this debate concerns the difference between the research goal of "explanation", common in the sciences, as opposed to "understanding", which aligns more closely with the social sciences and the humanities.

In this thesis, the motivation of formulating resources – practical and theoretical – that are of use to design is the aim of the research. This view is supported by design researcher Alain Findeli (2016, p28) who claims that valid and trustworthy knowledge is best produced in experiential situations of inquiry. This inquiry should be consistent and valid, but if situated in experience it becomes alive and significant, instead of remaining abstract.

In the section that follows, the relationship between the researcher and the data is acknowledged, and subjectivity and reflexivity is understood as part of the research method. The interpretive stance and the motive of the researcher is foregrounded. The interpretation of the textual data is carried out explicitly for the purpose of informing the design framework that is the output of this thesis, and should be read accordingly. There could be other ways to interrogate the data, depending on the motive and aims of that researcher and the context of another, different project.

4.8.3 Identified themes & comparisons with the literature review: sociality, agency and "life".

Many of the ideas and themes revealed - including experience, computation, exploration, physicality and perception - are intrinsic to interactive system design and have been identified and addressed in the literature review. To a large extent therefore, this analysis demonstrates that the concerns of artists do indeed map onto the landscape of concerns of HCI and interaction design, as described in the literature review.

An argument was made in the literature review for drawing to a greater degree on ideas of social relationships and interactions, and also on the role of agency within the design of interactive encounters. These concepts were also apparent in the thematic overview, particularly relating to concepts of presence, negotiation and intimacy.

There are however, a few ideas that are revealed in this thematic overview that were much less visible in the review of HCI literature, and these merit further investigation. The most important of these, it is argued, is the idea of "life", a concept that covers further complex ideas, broadly across two categories; *anthropomorphism*, meaning the mimicking of a living organism, and *active agency*, meaning the sense of a sentient, decision-making entity. This seems to be a topic that interests interactive artists.

4.8.4 Summary: Extending the themes from five to six

To summarise this section, the findings of this first process of analysis show that themes identified in the literature on contemporary approaches to interaction design and HCI are indeed echoed in the words of creative artists discussing their interactive work. However, more ideas are revealed that merit further investigation with a view to informing and enriching the findings described in the literature review, in particular the idea of "life" emerges strongly. Therefore the initial five themes identified in the literature review have been extended with the addition of a sixth theme. The table (4.1) that follows demonstrates the mapping of themes as presented in figures 4.1 and 4.2 onto the extended framework.

The extended list that comprises the complete Optional Interactions Design Framework is as follows:

1. Consideration of "optimal" experience, and the state of flow.
2. Stages of engagement, enticement and attraction, and encouraging sustained engagement.
3. Interactions framed as social encounters, affected by spatial aspects.
4. Action oriented engagement, in opposition to goal orientation.
5. Complexity, difficulty and ambiguity as resources for engagement.
6. Apparent lifelikeness, sentience and agency.

Optional Interactions Design Framework themes		Emergent themes and subthemes from the grounded research process
1	Consideration of "optimal" experience and the state of flow.	Experience: emotion, engagement, post-experience, reflection, seamlessness, positive, negative. Complexity: hiddenness, discomfort, surprise, imperfection, abstraction, strangeness, randomness Time: Trajectory Perception: presence
2	Stages of engagement, enticement and attraction, and encouraging sustained engagement.	Time: Trajectory Exploration: questioning, curiosity Meaning: user-created, interpretation Physicality: fragility, materiality, scale, spatiality, body Perception: senses, presence, awareness, visualisation, aesthetics, patterns, transparency, scale Behaviour: movement, gaming, reacting, rules, human
3	Interactions framed as social encounters, affected by spatial aspects.	Sociality: self-recognition, intimacy, participation, connections, negotiation, communication, presence Physicality: fragility, materiality, scale, spatiality, body Perception: senses, presence, awareness, visualisation, aesthetics, patterns, transparency, scale Computation: intelligence, logic. Sensing: recording, tracking
4	Action oriented engagement, in opposition to goal orientation.	Exploration: questioning, curiosity Creativity: co-production Meaning: user-created, abstraction, narrative, poetry, symbolism, metaphor, interpretation, expression, critique
5	Complexity, difficulty and ambiguity as resources for engagement.	Complexity: hiddenness, discomfort, surprise, imperfection, abstraction, strangeness, randomness Meaning: user-created, abstraction, narrative, poetry, symbolism, metaphor, interpretation, expression, critique

6	Apparent lifelikeness, sentience and agency.	Life: natural, agency, alive, death, anthropomorphism, human, realism, behaviour, evolution, organisms
		Behaviour: movement, gaming, reacting, rules, human
		Computation: intelligence, logic
		Sociality: self-recognition, intimacy, participation, connections, negotiation, communication, presence

Table 4.1. Mapping of research themes to Optional Interactions Design Framework.

The rest of this chapter presents a more detailed, interpretive examination of the texts, fleshing out the thematic skeleton. In the following discussion, each of these themes is discussed in turn, demonstrating how they are represented by the words of the artists. There was evidence of all of these ideas found within the artist interviews, with number 3 (social) and number 5 (ambiguity) represented particularly strongly. Flow as represented in theme 1 is a concept that tends to describe longer lasting experiences of engagement, and many installations offer only more fleeting interactions. There are examples of artistic works that can offer enough media content and physical space for visitors to remain in the setting and to reach a state of flow. However, the installations discussed here are often designed to allow a greater number of people to experience them by lingering only for a while before they move on, rather than remaining for long enough to fully achieve the flow state.

In addition, theme number 6 was weakly identified within the HCI/IxD literature review, but was more apparent in the review of literature from interactive art domains. This theme of "life", or "lifelikeness", emerged strongly in the interview texts suggesting a particular interest in this topic within the artistic community. This was considered to be an especially relevant and important theme, which informs much of the rest of the work in the thesis. This theme concerns the idea of apparent "life". This could be further identified as comprising two aspects, firstly concerning physical, "animal-like" behaviours and movement, these being externally and perceptually apparent, and secondly concerning the concepts of sentience, autonomy and agency, which are implicit, internal and inferred.

4.9 Interpretive discussion of the six themes

The following sections discuss, describe and interpret each of the six identified themes of the Framework in turn with reference to the interview data and the themes and sub-themes as presented in figures 4.1 and 4.2, and table 4.1.

4.9.1 Optimal experience and the state of flow

This theme was present in the interview texts, although aspects of experience and flow were often inferred and implicit rather than explicit within the texts. The theme of "experience" was identified clearly with the sub-themes of: emotion, engagement, post-experience, reflection, seamlessness, positive and negative. Another cluster of experience sub-themes are described as belonging to the idea of "complexity"; hiddenness, discomfort, surprise, imperfection, abstraction, strangeness, randomness.

The "state of flow" concept can also be connected with the theme of "time", and "trajectory" suggesting the unfolding of events. The idea of presence, related to time, and categorised as a sub-theme of "perception", is also an important element of experience, as rAndom International describe in this extract discussing one of their installations. The viewer can actively influence the image that is created, but this lasts only for a few seconds before fading away. As the artists say here, this impermanence, and the repeated opportunities to participate and create a new image, support extended engagement with the installation:

> *"With Self Portrait, you don't have that reassurance; you have to be completely present to 'consume' your act of portraiture, as it fades within the minute. By removing the baggage, the viewers are encouraged to experience themselves with more 'presence'. Or at least, to have a lot of fun by trying again and again without the fear of 'failure'." (rAndom International)*

Presence is also discussed by Camille Utterback, and she also connects the ideas of activity and exploration with presence expressed by inner questioning:

> *"...I do feel that if people have an experience in this piece where they are open to questioning things, then... I think the process goes like: 'Oh this thing is reacting to me!' And then you ask: 'Well, how is it reacting to me?' There is*

nothing written in here, so the only way to discover that is to try things out, and you start thinking: 'What happens if I try this? What happens if I try that?' I think this questioning mode puts you in a state where you are present, aware and very open." (Camille Utterback)

Surprise emerged as a distinct theme when artists discussed creation of positive experiences. Here Justin Lui states that contexts outside of the gallery environment present opportunities for creating personal interpretations:

"But I also find that public spaces present an opportunity to engage a larger audience; one that isn't pre-disposed to look for art, which means there's a greater potential to surprise people (provided the piece has the conceptual clarity required to connect them in a meaningful way)." (Justin Lui)

Philip Beesley also discusses surprise and unpredictability as resources for engagement, encouraging audiences to guess and speculate about what might happen next, and what the motivations are that are driving the behaviours in the installation:

"Things that inspire me most are things which are at the very edge of stability rather than things that are very stable and predictable. If something starts to break apart and starts to flutter and starts to oscillate, perhaps it starts to convulse, perhaps it starts hiccuping. Those kinds of qualities in which things become slightly unstable have tremendous fascination in them. Is this going to die? Is it diseased? Or is it playing? Is it actually laughing?" (Philip Beesley)

Beesley also considers how his large-scale environments create a sense of connectedness as visitors examine the small details and lose themselves within the worlds he creates. This technique of setting up a situation or setting for unstructured exploration allows visitors to engage with an installation at their own personal pace, enabling an engaged and unpressured encounter that provides positive experiences.

"Each of these things in isolation has a great deal of detail, but when they speak together, when they start rolling together, it produces a tremendous kind of involvement. An immersion, which allows us to feel that we are in the world, that we are in all of our bodies." (Philip Beesley)

103

4.9.2. Stages of engagement, enticement and attraction, and encouraging sustained engagement.

This theme relates closely to the idea of "time" and its sub-theme "trajectory", and also to the theme of "exploration", as an activity driven by the user's "questioning" and "curiosity", the two identified sub-themes of "exploration". The third main theme apparent here is that of "meaning", and particularly the sub-themes of "user-creation" and "interpretation". The "physicality" theme is also relevant here in that the proximity of the visitor to the system is an element that enables enticement and attraction, sometimes through the use of visual or sound elements, as identified in the theme of "perception" or movement as identified in "behaviour".

Within the artists' texts the idea of open-ended and undefined exploration was discussed, for example by Philip Beesley, who describes his work as providing a setting for meaning-making and individual engagement with the installation. Here he discusses how he designs subtle sound cues that firstly attract attention, and then draw people in to explore what is going on. As they begin to examine his very detailed installation they are drawn in further:

> "*My hope is that if somebody comes into this rather darkened room, a place which is quite quiet and which has small mechanical sounds that are running throughout the work, rustling and chirping and exchanging. My hope is that people would not need any rules at all. That there is no sign here that says what you must do. Rather I hope that people would become very involved in exploring, looking and searching. And the little bits of contact of coming very close to something which is delicate or strong or aggressive starts to set up a dialogue where I think that we go on a personal adventure when we look through a rather complex work like this. I think that what it does is it sets up some very interesting reactions in people. People start to take care of things, they respond with empathy and with curiosity.*" (Philip Beesley)

In Beesley's work, initial attraction is carefully constructed, and once the visitor's engagement has been gained, further aspects of the work are gradually revealed, holding sustained attention as the detail of the installation unfolds for the explorative visitor. This sustained engagement aspect has elements that overlap with the concepts

of flow and optimal engagement, but is possibly more relevant in installation design as interactions are often of a limited time duration.
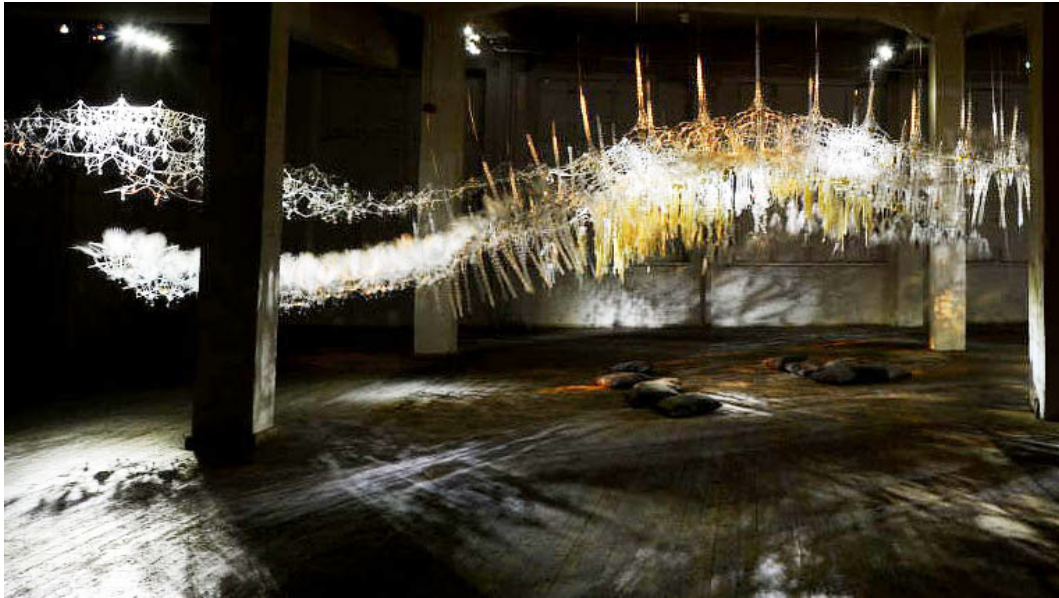
Figure 4.3 Epiphyte Membrane, www.philipbeesleyarchitect.com

In a similar manner to Beesley's work, Lozano-Hemmer discusses how he hands over ownership of the experience to the visitor, and through their own involvement with the work, sustained engagement can be encouraged. The visitors themselves construct engagement with the work:

> *"I'm looking for artworks that are out of my control. It is people who will in the end complete them, through their interpretation, their views, their memories, their uses. As Marcel Duchamp said: "Ce sont les regardeurs qui font les tableaux" – It is the onlookers who make the paintings." (Rafael Lozano-Hemmer)*

Daniel Rozin describes how he is interested in the use of scale and phased interactions to draw visitors into his works, echoing ideas on use of proxemics for design discussed earlier in the thesis. The passer by is initially attracted by a single bold image, and on moving closer this changes into something else, more detailed or revealing something different.

> *I remember seeing these photomosaics that were popular maybe fifteen years ago – you saw an ad for Star Wars or something and then as you moved closer, you would see that it was actually made of many smaller images, maybe stills from the film. I really liked the far away aspect of it, but when I got closer and saw all of these tiny pieces, each one this discrete other thing . . . for me it was too much. It didn't let me tell a story because it broke down to a million stories. And I thought, wouldn't it be interesting if you could see one image from far away, and then when you get closer the piece tells a second story, rather than a million stories? (Daniel Rozin)*

The difficulties of designing for sustained engagement in a walk-by context are addressed by David Rokeby. Here he considers the tensions faced by the artist who wishes to balance the instant feedback that draws a visitor into the interaction, and the communication of deeper or multi layered ideas:

> "*It became clear after the first four or five years that the intense interactivity of Very Nervous System made me a lot of fans, but didn't take as many viewers as I would have liked deeper into the question that the piece was asking. It was as though the piece was so exciting for people that it failed on a certain level and the work had to become a little less exciting if it was to communicate the things that I was wanting it to communicate." (David Rokeby)*

4.9.3. Interactions framed as social encounters, affected by spatial aspects.

This theme of "sociality" was identified along with the sub-themes of self-recognition, intimacy, participation, connections, negotiation, communication and presence. "Physicality" was identified as a related theme, and its sub-themes include the concepts of the materiality of both the person and their surroundings; fragility, materiality, scale, spatiality, body. "Perception" is another theme that connects the visitor with the surroundings and with other entities, often in relation to the theme of "computation" and the sub-themes of intelligence, logic, sensing; recording, tracking.

Spatial aspects are naturally important to artists working in the medium of installation art. Daniel Rozin highlights this powerful relationship people have with their surroundings:

> "*We all spend our entire lives in the physical world and have an amazing intuition regarding its behavior, this is a type of intuition that I believe we will never have with the digital or virtual.*" *(Daniel Rozin)*

He suggests that drawing on the experience and understanding that we already hold internally concerning our surroundings is an appropriate starting point for designing interactive installations:

> "*Combining the physical with the digital or computational allows us to take the best of both worlds, on one hand to tap into this collective intuition and on the other, to take advantage of the flexibility of computation.*" *(Daniel Rozin)*

In discussing movement and interactivity, Daan Roosegaarde states the importance of working with digital media, but in a more organic and physical way, blending our bodies, and the spaces we inhabit with technology:

> "*The concept is the same--to update our senses by reconnecting them with nature. We need this "new grammar", because the general rhythm of our lives is affected daily by our overexposure to multiple forms of media. I'm interested in what happens when technology comes out of the screen to become an integral part of our walls, our cityscapes, even our bodies.*" *(Daan Roosegaarde)*

Justin Lui also mentions this desire to work with spatial scale. In this extract he discusses his interest in exploring audience's perceptual experiences of space:

> "*A project like Animate Field could really benefit from being enlarged to a more expansive field, to get closer to the infinite Ganzfeld-like spatial condition that James Turrell - for example - has in some of his work.*" *(Justin Lui)*

Lui goes on to describe how the affordances and the spatial aspects of the work would encourage social interactions amongst audiences:

> "*What happened often was that one brave soul would enter the fiber cloud, play with the fibers, then others would follow inside - like a chain reaction.*

> *Sometimes it became a shared experience between strangers. I didn't really anticipate this sort of sociability in Animate Field, but it was gratifying to see."* (Justin Lui)

It is interesting to note that Lui himself did not anticipate this social interaction between audience members, but that it was recognised as a positive aspect of the work in the context of an artistic installation. Camille Utterback also discusses how social relationships are negotiated within the physical space of her installation, and the influence of pre-existing relationships between visitors:

> *"I think it is socially engaged, because obviously people have some dynamics with each other in front of Untitled 5. You can have more than one person negotiating how to move in the video tracked area. If they are friends or not friends they might interact differently. Strangers might start moving in different ways when they see each other's movements here, so it's definitely a social piece. And - I don't know if this is very social - but it's definitely a process of discovering and exploring yourself in the piece."* (Camille Utterback)

As well as encouraging social interactions between visitors, some of the works discussed by the artists were designed to behave as social actors themselves, enabling them to develop relationships with visitors. Here, Ruari Glynn describes his work that uses behavioural mimicry to illicit feelings of empathy:

> *"Our brain has neurons that mimic behaviour of other people in order to gain better understanding of our environment. This sort of mimesis also increases an empathy we feel for each other. The giant robot scans the environment, then picks up and imitates movements of an individual within the audience. As its body is very different to a human one, the movements are transformed but still mirror features of audience movement."* (Ruari Glynn)

Glynn extends the design of this social behaviour to create awareness of other visitors, and to draw them into interactions with each other:

> *"It would randomly change its attention to different audience members, which was interesting because audience members – flattered at first by the robot's*

attention and then confused when confronted with its rejection – started questioning themselves and competed for the robot's attention." (Ruari Glynn)

4.9.4. Action oriented engagement, in opposition to goal orientation.

This theme relates to the themes and sub-themes of "exploration", including questioning and curiosity, and "creativity", including co-production. "Meaning" is another relevant theme here as the visitor draws on exploration as a way of constructing, questioning or reflecting on the ideas expressed by the work.

Interactive artworks are inherently optional. There is no compulsion to interact with an art installation, and there is no task to be completed by the visitor, as there would be with publicly-sited technology that provides a service, such as a ticket dispenser. This means that the purpose of the interaction rests in the action itself rather than achievement of a concrete goal. It can be said that having an experience is the goal in this situation, but that is more high-level framing of the goal concept. This theme was present within the interviews through such concepts as "co-production", often framed by presenting the visitor as part of the content, tightly connected with active participation. Daniel Rozin discusses this reflexivity, where visitor completes the work through their actions, and is encouraged to consider this unfolding process.

> *"With my artwork, there's a very simple 1:1 reflection that happens: you stand in front of a piece and hopefully within a couple of seconds you say, "Oh that's me", and that whole part of the discussion is over. The content is you. If you're not there, there is no content. So at that point you're starting to think, how is this image created? How am I seeing it? What is this material? What is the logic that is driving it?" (Daniel Rozin)*

Lozano-Hemmer also addresses this aspect, raising the point that this is a risk from the artists or designer's perspective, as the actions of the visitors are not able to be fully known in advance of the installation completion:

> *"A good artwork is like a good nightclub – you create the music, the ambience and whatever, but it's only when the public comes in that you know if it's going to be a good party or not. The public brings the energy and the content, and the*

artist just creates the conditions for an experiment to take place over time."
(Rafael Lozano-Hemmer)

Justin Lui considers this aspect of visitor curiosity as a catalyst for active participation with his installation. He also identifies the "chain of use" effect (Hornecker 2008) that is discussed earlier in the thesis. This is similar to the "honeypot" effect (Brignull and Rogers 2003) where people tend to be attracted to something that other people are doing or looking at.

> *"The choice between observing from outside the thicket of fibers and participating inside it probably wasn't about the fear vs. embrace of technology, as the fibers themselves looked more like a natural plant-like substance than something mechanical and intimidating. Instead, I just chalk it up to the participant's sense curiosity vs. personal inhibition. What happened often was that one brave soul would enter the fiber cloud, play with the fibers, then others would follow inside - like a chain reaction." (Justin Lui)*

4.9.5. Complexity, difficulty and ambiguity as resources for engagement.

"Complexity" was identified as a strong theme through the texts, categorised here as a sub-theme of "experience", and incorporating ideas of; hiddenness, discomfort, surprise, imperfection, abstraction, strangeness and randomness. The theme of "meaning" is also relevant and related, as experiences of ambiguity and hiddenness can support the drive to find meaning in the work. Sub-themes here are; user-created, abstraction, narrative, poetry, symbolism, metaphor, interpretation, expression and critique.

Rafael Lozano-Hemmer states quite directly that complexity and ambiguity are important aspects of artistic practice. In the interview text he discusses how he is interested in creating reactions, and he implies that people seek difficulty and related concepts to create engaging experiences:

> *"…art tries to complexify things, to create ambiguity. Poetry is by definition something that has multiple readings. Different people will read it differently; that is what we look for in art. We look for interruptions and frustrations. We look for questions rather than answers." (Rafael Lozano-Hemmer)*

110

Most of the artists expressed the desire to enable varied interpretations of their artworks by providing enough information to stimulate thought and meaning-making processes. Curiosity was a strong theme within the interviews, but this was coupled with ambiguity and "hiddenness" as André Goncalves states:

> *"I always enjoy it when I choose the right title, because the title is to awaken people's curiosity. When you read them, you need to stay within the frame of ideas that they give you. But if you really want to know what they say, well, I do not ever tell you!" (André Goncalves)*

Here he is providing a starting point to structure engagement, but he gives the audience freedom to decide on their own relationships with the work. Ruari Glynn echoes this need to keep audiences engaged by providing experiences that are resistant to easy interpretation:

> *"From a technical point of view scanning of the environment was one of the most challenging things, but in order to create an immersive experience we needed to add this little bit of randomness to keep the audience intrigued." (Ruari Glynn)*

David Rokeby mentions his own interest in the ambiguous, the unknown and the partially hidden as starting points for creating his work:

> *"That is part of what I do, but in connection with that, what I'm doing when I'm working with technology is looking for those things that I catch out of the corner of my eye (not literally) that are strangely interesting, that I don't completely grasp and where there seems to be more to it." (David Rokeby)*

4.9.6 Apparent lifelikeness, sentience and agency.

A concept that emerged very strongly from the interview data was that of the system mimicking life and displaying the impression of understanding and sentience. Related to this concept is the idea of agency, and internal motivations of the installation that may not be clear to the audience, although they can be inferred and speculated upon.

The theme clearly associated with these ideas is that of "life" with sub-themes including an array of concepts summarised as; natural, agency, alive, death,

anthropomorphism, human, realism, behaviour**,** evolution and organisms. The theme of "behaviour" is also closely connected to these ideas, as behaviour is often an indicator of life. The relevant sub-themes here include concepts of movement, reacting and human. "Computation" is another linked theme, incorporating the ideas of intelligence and sensing, which can also be aspects that support the impression that there is sentience and life within the system. Finally, the theme of "sociality" is relevant, with the implicit ideas of negotiation of relationships as a strong feature of lifelikeness.

This was one of the most interesting themes that emerged from the data analysis that was less clearly apparent in the literature review. This suggests that the process of "reading" and attempting to make sense of the thought processes of the interactive system is a deeply engaging activity. This is also related to the idea of interactions being framed as social encounters, as in any social interaction between people there is a process of circular reflexivity going on. This involves placing oneself into the viewpoint of the other, and considering how ones own actions are being perceived, while simultaneously attempting to understand the motivation of the other party in order to adjust our own actions appropriately. As Golan Levin says:

> "*So, I think that it's very important that to the extent that we perceive robots as sensate, we are also able to sense the things that they're sensing. In terms of our ability to understand what robots are sensing, it's very important that we have an agreed upon reality. That might just be from human conversation that we inherit that, right? You know, if I'm conversing with you, and you start looking around --*" *(Golan Levin)*

Golan Levin in particular, discusses the visitor's strong social instincts that artists can tap into in order to create engagement with interactive artworks. In order to fully interact, there has to be a social "other" to interact with, and this is perhaps one of the reasons why we as humans seem to have an innate predisposition to detect "things that are alive", as Levin describes here:

> "*You can't help but to put emotional weight on it pulling slightly back of coming slightly forward, we are really built to put that weight on everything because the things that matter the very most to us, parents, the tribe, reading intention in movement and faces, are so important that it's easier to just attach them*

everywhere rather than miss them in a vital instance. I think that's interesting because it brings us into the territory of the robotic body, the robot that we know is a robot, but that we ascribe humanity to simply because we can't help but do that." (Golan Levin)

Justin Lui also mentions using techniques to create the illusion of human or animal life in his work "Water Clouds of Light" through the use of very minimal objects and technology: "*I wanted it to have a clear and direct reading. It's an unfussy installation; simple, serene, but not static as the lights 'breathe' in and out in a way that is life-like.*" He goes on to expand on this approach, explaining how in this instance the work has a "*stated allusion to the natural world.*" This behaviour brings to mind the design of the Apple sleep status indicator for computers, patented in 2002 as a "breathing status LED indicator", with a blink rate timed to mimic the slow end of the average respiratory rate of a human adult of 12 to 20 breaths per minute. (MacNN news, 2010)

Movement plays an important role in this indication of life within a system, and many of the artists discuss ways in which they use mechanical behaviours to create the impression of living creatures. Ruari Glynn in particular uses this technique widely in his robotic work, and here he discusses how he approaches this:

> "*According to perceptual psychology, movement has a bigger importance and impact on our visual perceptual field than color or form, yet it is still rather unexplored territory within the traditional visual arts. So with my focus on movement, I feel like I am pulling on the strings of fine art, performative art and architecture.*" (Ruari Glynn)

There is an important distinction to be made between the physicality of animal and human life, and the internal sentience that defines living beings. These are separate attributes that artists draw on in different ways, sometimes using both, and sometimes only limited aspects. Here Levin is discussing physicality in particular, and how certain movements can allude to living beings, thereby attracting audiences:

> "*I think we really have to talk as much about the human perceptual apparatus as we do about the aesthetics and machine form when we talk about the robotic body. The reason I say that is because if we're going to see a thing in the world move, big chunks of our reptilian brain are going to say, "That's alive." Or, the*

first thing they're going to say is: "That's alive," and then it's only when the
higher order processes kick in and say, "Ew! That's in the uncanny valley, I
don't like that," that then we say, "Ok, well, then what is it? Oh, it's a robot."
So, getting out of the uncanny valley is a really important place to be." (Golan
Levin)

Ruari Glynn uses this approach in his work, for example in his installation "Fearful
Symmetry". The title is taken from William Blake's poem, "The Tyger", in which
Blake considers the higher power that created an animal as deadly and terrifying as the
tiger as well as one as symbolic of gentleness and innocence as the lamb. In "Fearful
Symmetry", Glynn is examining how we project life into inanimate object, and here he
strips down the features of his mechanical robots to be abstract in form, using only their
movements to encourage people to attribute life and personality to them. Describing his
work, Glynn says:

> *"Since the entire room was dark, the only part of the installation, which the*
> *audience actually saw, was the glowing tetrahedron attached to the robotic arm*
> *– a dazzling element that glided through space and appeared to have its own*
> *personality. It could be perceived either as frightening and alien or as a*
> *companion offering guidance through the darkness. Most of the time the*
> *reactions of the audience changed dramatically from fear to fascination, once*
> *they saw it interacting with another person." (Ruari Glynn)*

Glynn picks up on how audiences adjusted their views of the robot through observation
of how it engaged with others. In his interview, Glynn discusses how he creates the
impression of life, through considering the way that behaviours of entities in simple,
early computer games are designed. These creatures are constructed from low
resolution grids of pixels, with a very limited colour palette so the options for designers
are limited. Glynn says:

> *"I do not know a huge amount about gaming, but one thing that really inspired*
> *me were the behavioural patterns of the Pac-Man enemies. There are just*
> *couple of rules that these ghosts run by and they are all strictly deterministic: a*
> *combination of simple logic with a little bit of randomness." (Ruari Glynn)*

Glynn goes on to discuss how to handle the programming from a designer's perspective, in order to present the right amount of behaviour so that the audience picks up on the key elements. He says:

> *"The right amount of randomness is crucial, in my opinion. When carefully balanced, it will trigger the player's interest; add too much and it will create noise and no sense of control. The key to success is a principle of simple agents in a complex environment together with a bit of random behaviour. And that is what made Pac-Man so popular." (Ruari Glynn)*

From this we can see that the interaction designer's task here is to use programming to create impressions and to evoke responses, rather than to create faithful reproductions of, or alternatives to, the real world, as is the goal in the domain of artificial intelligence. Golan Levin, discussing his work titled "Snout", also addresses this issue of using the least amount of programming possible - just enough to enable the audience to do most of the cognitive work, inferring agency and sentience within the work:

> *"People often make guesses about how sophisticated the model is that I'm using to create the illusion of life. Multi-level emotional state system, machine learning, and things like that. I tell them that with the very explicit admonition that it's not just that the piece is simple, it's that the observer is very complex and that the observer is going to impute all this intelligence to the thing that really isn't there... But when you watch it, what happens is that you'll do do something abrupt, it reacts with a little more speed, it accelerates or decelerates the Perlin noise in response and people say, "Wow! It understands what I'm doing and it's reacting!" No, you just really feel like it's alive because you have big chunks of your brain that can't help but see it as alive." (Golan Levin)*

As well as the theme of "life" that was found in the interview texts, "time" was also identified in a way that connected with the evolving nature of living beings. Here, in Ruari Glynn's work, development and change over time are strongly associated with a lifelike evolution of his robots:

> *"They used facial recognition to assess how successful their movements were by analysing the attention level of the audience after each performance. And just*

as in natural selection, their behaviour adapted and the most successful movements won. It was interesting to see how – after only three months in the gallery – they all became different and the gallery staff had even given them names." (Ruari Glynn)

4.9.7 Conclusion: designing the system to become an active agent.

Completing this discussion of the six themes, the final point is one made by Glynn who reminds us as artists and designers that letting go of control can be an important and beneficial technique, permitting the system itself to become an active and sentient agent in the interactive relationship between people and systems:

"I do not want to control what I build, control kills part of the mystery. I want it to adapt to its environment and be reactive to change. Only then does the interaction become interesting for the viewer – and also for the machine (laughs)." (Ruari Glynn)

4.10 From Theory to Practice: Intermediate-level Knowledge

This chapter has presented a qualitative analysis of words spoken by artists working in the medium of interactive technology. By using a thematic analysis approach, a set of themes have emerged that show promise as resources to influence design practice. To conclude this chapter, a discussion follows that begins to consider how these emergent themes can be presented in a format that is useful to practicing designers.

The interaction design and HCI academic literature addresses both theory and practice, and often discusses knowledge in terms of whether it is inductive - developed from looking at practice, or deductive - derived from theory. This chapter has looked at practice, but from a "meta" perspective, in that themes were identified from considering how art practitioners go about their work, not from looking at the work itself. These themes can be considered as being influenced by both theory and practice, as they have emerged from looking at considered approaches to practice, rather than from looking directly at practice itself.

These identified themes can be considered as a form of "intermediate-level knowledge" (Höök and Löwgren 2012), or as "bridging concepts", as discussed by Dalsgaard and Dindler (2014). Both of these are presented as ways of articulating knowledge that lies between theory and practice. In particular, Höök and Löwgren (2012) introduce the idea of "strong concepts" to describe a form of bridging knowledge between high-level generalised theories and particular, implemented instances. These strong concepts are similar in function to other forms of articulated knowledge such as patterns, heuristics and guidelines, that might be found in the designer's repertoire. They are described (p23.5) as connecting "the notion of abstraction to scope of applicability", by which the authors mean that elements of a particular, designed artefact can be isolated and described in a way that makes them useful to a range of similar design situations. In particular, they propose that a strong concept in interaction design exhibits several characteristics. These can be summarised as: concerning interactive behaviour; residing at the technology/human interface; including temporal aspects; applicability to different use situations; and that it can be realised at differing levels of design detail. Dalsgaard and Dindler (2014)'s bridging concepts have a closer alignment to the structure of design patterns in that they are composed of three constituents: "a theoretical grounding, a series of design articulations and a set of exemplars that embody the properties of the concept, reflecting the span from theory and practice."

	Conceptual constructs	Strong concepts	Bridging concepts
Primary origins	Theory	Design cases	Inspired by exemplars as well as theory
Primary intent	Theoretical advancements	Informing design practice	Facilitating exchange between theory and practice

Figure 4.4. Conceptual constructs, strong concepts, and bridging concepts. From Dalsgaard and Dindler (2014)

4.10.1 Strong concepts and design patterns

Höök and Löwgren (2012) differentiate strong concepts from design patterns in terms of how they should be used. They criticise design patterns and pattern libraries as being rather too standardised and rationalised to support academic discourse. Instead they

propose strong concepts as a way of expressing practical concepts that may be useful to other designers, while also providing scope for interpretation, adaptation and critique. Dalsgaard and Dindler (2014) describe strong concepts as being "*primarily developed bottom- up or inductively with the main purpose of generating knowledge that can be employed in design practice, whereas* **conceptual construct***s are primarily developed top-down with the main purpose of enriching the theoretical foundations of HCI.*"

Strong concepts are not intended to be followed as rigidly as rules and guidelines might be. As an example, and returning to a theme which was discussed in Chapter 2 of this thesis, Höök and Löwgren (2012) propose "seamfulness" as an example of a strong concept, and they discuss how it might be used, providing particular examples as illustrations.

4.10.2 Summary: From themes and strong concepts to exemplars

This chapter has presented a qualitative analysis of texts of interviews undertaken with interactive art practitioners. From these texts a set of themes have been identified and these themes map onto, support, and extend the Optional Interactions Design Framework that is the core contribution of this thesis, as presented below:

Optional Interactions Design Framework

1. Consideration of "optimal" experience, and the state of flow.
2. Stages of engagement, enticement and attraction, and encouraging sustained engagement.
3. Interactions framed as social encounters, affected by spatial aspects.
4. Action oriented engagement, in opposition to goal orientation.
5. Complexity, difficulty and ambiguity as resources for engagement.
6. Apparent lifelikeness, sentience and agency.

It is proposed that the ideas of both bridging concepts and strong concepts are relevant are relevant in expressing the themes that have emerged from the thematic analysis. These are closely allied to the approach of design frameworks as ways of bridging theoretical knowledge and design practice. In descriptive terms, "themes" is quite a

loose construct, and expressing them as forms of Höök and Löwgren's strong concepts takes these ideas closer to a more formalised structure for application in design projects. "Themes" uses the language of qualitative analysis, and these map onto the more "designerly" framing of strong concepts.

In the next chapter, a set of practical design exemplars are presented which show how the themes or strong concepts can be instantiated in practical design situations. Chapter 6 then consolidates the work by presenting a structured framework based on the design patterns approach.

Chapter 5: Design case studies

5.1 Introduction

This chapter presents three case studies of original work that demonstrate how the themes identified in the previous chapter, expressed as "strong concepts", and drawn from an interpretative analysis of interviews with artists, can be used to inform the design of interactive installations sited in public spaces. The design concepts presented in this chapter are discussed in relation to the themes that emerged from the qualitative research discussed in Chapter 4, rather than in response to a user-focused, identified need or problem. In Chapter 6, the Optional Interactions Framework is presented, which aims to fulfil this objective of providing a useful connection between theoretical ideas and practical implementation.

5.1.1 Design Case studies: exemplars of "strong concepts" in use

The three case studies were carried out as separate projects, but from the perspective of this thesis there is a conceptual progression from the first to the third. The first two, "This Pervasive Day", and "BetaCity", were produced as collaborative projects, while the third, "Beat Haiku", was designed solely by the thesis author, with some outside assistance for the programming of the working prototypes. All three projects are design exemplars that show how conceptual themes can be used to inform design practice. This presentation of design case studies is used in the manner discussed by Dalsgaard and Dindler (2014), who describe their design projects as exemplars that embody the properties of the concept, reflecting the span from theory to practice. Stolterman and Wiberg (2010) also discuss the idea of using designed concepts to express ideas, or knowledge manifested as artefacts (p97). They suggest that fully formed design concepts can be more impactful for the design research community than early version prototypes that are used for evaluation. They claim that this is because sometimes "*the contributions do not address, challenge, or complement the existing body of theoretical knowledge within interaction research in an intentional way.*" To make their point, they provide the example of the DynaBook, a conceptual portable educational device developed by Alan Kay in 1972, but not fully implemented at that time due to the

limitations of the available technology. Despite the fact that the DynaBook did not result in a prototype that could be adequately evaluated in the manner of a conventional HCI project, as a visionary design concept it has nevertheless become highly influential. Elements of the DynaBook concept can be seen in products that were developed later as technology advanced, and Alan Kay's paper describing the work is highly citied. The point to be made here, according to Stolterman and Wiberg, is that a good concept design functions both as an exciting design instantiation, and also as "*an inspiration and challenge for theoretical development*"(p108).

This way of looking at design research is in contrast to the widely accepted practices of user-centred design techniques, where a design situation is examined with the aim of enabling a solution to emerge through thorough examination of the contextual and human aspects of the particular situation. This is not to deny the substantial value of user-centred approaches, but for the research study undertaken in this thesis, the concept-driven view seem to have relevance in the context of designing novel, experience-oriented systems. Where the aim of a system is to support exploratory and experimental types of engagement, the idea of user needs is inappropriate, and it is likely that potential users would find it very difficult to express or articulate what they might want from such a system.

5.1.2 Case study methodology, frameworks and reflective practice

As discussed at the end of the previous chapter, these case studies are presented as illustrations of design concepts in practice. The design concepts that they embody have been developed in an inductive manner from the examination of the self-reported approaches of artists working in interactive media. The qualitative analysis reported in Chapter 4 detected patterns and recurring themes with the aim of abstracting knowledge from the approaches used in art practice that could prove to be useful to design practice. Applying an interpretative approach as discussed in Chapter 4, five themes identified in the literature review were extended to six themes through the incorporation of the ideas emerging from the thematic analysis of the interview texts.

In order to articulate this knowledge, a conceptual framing, or knowledge construct, is required. Part of this framing work involves the presentation of specific examples to act

as instantiations of ideas, but these articulations also contribute to the development of the framework. The act of designing, creating and presenting these case study projects can be seen as active research following the principles outlined by Donald Schön (1992). Schön asserts that design knowledge is difficult to articulate by designers themselves, as their knowledge is mostly tacit. He argues that designers work through "transacting" with the design situation, in a reflective, active way. They construct meaning through the repeated cycle of observing, acting and then observing the effects of that action. Schön describes the act of designing as a "reflective conversation" between the designer and the materials of the design situation. This suggests that practical examples of design work have an important role to play in the development, articulation and verification of design theory. The case studies presented in this chapter do not only illustrate the concepts encapsulated in the "Optional Interactions Design Framework", their creation has also informed the framework's development.

5.1.3 The Case Studies

Each of these projects was designed to engage and entertain audiences who are passing by. The first two illustrate how concepts to engage audiences can be used for design in real-world exhibition settings, while the third is further developed in terms of the application of themes that were identified and discussed in Chapter 4.

Each of the three case studies is described in detail, followed by a discussion of how they exhibit aspects of the thesis research themes and elements of the framework. The analysis here draws on the mappings presented in table 4.1 in section 4.8.4.

"This Pervasive Day" and "BetaCity" were both created collaboratively and were exhibited within public exhibitions in Edinburgh and Venice respectively. These exhibitions were both developed as part of EU funded Coordination Action projects (PerAda and UrbanIxD), and each had the wider aim of generating interest in new technological developments among a general audience. Both exhibitions had a broad theme of the future of pervasive, networked technologies, and how they might impact upon our daily lives. "This Pervasive Day" looked at a wide range of issues that could concern us all in the future, while "BetaCity" was part of an exhibition that was particularly concerned with technology in an urban context. In contrast to the other two

works, "Beat Haiku" was specifically developed as a stand-alone work to be installed on a large touchscreen sited in the foyer of a public building. "Beat Haiku" is more directly intended to provide an engaging interactive experience for passers-by, without any particular educational or informative agenda, although some information about the background to the "Beat Haiku" concept is provided as a small reward to the motivated participant.

The three projects are briefly outlined below:

1. "This Pervasive Day" This case study describes the concept development and implementation of an interactive installation that was part of an exhibition that aimed to convey ideas about ubiquitous computing and pervasive adaptation to a general, public audience. The exhibition was collaboratively developed by the thesis author and other team members as a public engagement work.

2. "BetaCity" This interactive exhibition installation was developed as part of a larger exhibition addressing the topic of urban interaction design and the future, networked city. The piece was collaboratively developed by the thesis author and other team members.

3. "Beat Haiku" This case study describes the concept and interaction design of touchscreen application to be sited in a public, foyer setting. This piece was developed by the thesis author. Programming of working prototypes was carried out by student interns, supported by Edinburgh Napier University's School of Computing.

5.2 Case study 1: This Pervasive Day

"We went to the New York World's Fair, saw what the past had been like, according to the Ford Motor Car Company and Walt Disney, saw what the future would be like, according to General Motors. And I asked myself about the present: how wide it was, how deep it was, how much was mine to keep." (From the prologue to "Slaughterhouse-Five" by Kurt Vonnegut, 1969)

Visions of the future are central within the work of every designer, but when this work includes the integration of new technologies this concern is amplified. The full impacts of introducing products and services to the world that include computational power are always unknown to some extent. Expressing the hopes and intentions behind these developments to wider audiences therefore becomes an important part of the whole design process. The work presented in this design case study was developed collaboratively by a team that included the author of this thesis for a public exhibition titled, "This Pervasive Day". This exhibition was developed as a public engagement activity as part of the project, PerAda: Towards Pervasive Adaptation. 2011 www.perada.eu. The aims of the work are described in several published papers: Helgason, Smyth & Speed (2012), Helgason et al (2011), Helgason, Bradley & Egan (2011) and Smyth and Helgason (2013)

5.2.1 Topic of the exhibition

The exhibition was part of the public engagement work of the PerAda EU FP7 coordination action project. The purpose of this project was to support European Commission funded research into pervasive, adaptive computing systems, and the exhibition was aimed at raising public awareness of this research and its implications for society. Pervasive, adaptive computing combines the capabilities of new generations of smaller, cheaper and more powerful sensor-rich devices with advances in intelligent software. Taken together, these developments support the design of new kinds of products and systems that can be embedded into our physical surroundings and the built environment. These systems may be invisible to people who encounter them, but they are capable of detecting, and responding to, many kinds of human behaviour. Movement, physical activity, facial features and internal emotional states can be detected, recognised, stored and processed. One of the implications of this research is that people are becoming machine-readable. The positive side of this research is that a wide range of new and beneficial applications and services will be developed in domains such as medical devices, transport systems and public services. The other view of this technology is that it will lead to less desirable and uncertain developments for society including invisible surveillance, invasions of privacy, and difficult questions

concerning issues of control, ownership and transparency. An edited academic book accompanied the exhibition, with an explanatory introduction:

> *"Imagine a world where your clothes sense your blood pressure, heart rate and body temperature. Suppose the sensors transmit this information to 'the cloud', continuously and unobtrusively. Suppose artificial intelligence in 'the cloud' detects an anomaly. Suppose it tells your doctor: sighs of relief all round. But then suppose it tells an actuary, who tells your insurer, who tells your employer ..."*

> *"This book takes as its unifying theme Ira Levin's 1970 science fiction novel This Perfect Day to expose both potential innovations and controversial social issues. It explores the science and technology of pervasive adaptation through a human-centred and socio-technical perspective within the cultural, ethical and legal context of contemporary life."*

> *From the introduction to "This Pervasive Day," The Potential and Perils of Pervasive Computing Edited by: Jeremy Pitt (Imperial College London, UK)*

5.2.2 Background to the Exhibition

Public exhibitions are often used to inform the public about novel developments that may impact on society in the near future, and Rust and Robertson (2003) go as far as to describe exhibitions as a form of research dissemination. However, in recent years there has been a shift from pushing information outwards towards encouraging greater two-way dialogue with the public in science communication work. (Holliman et al, 2009. Delgado, A. 2010). Rather than presenting information about scientific and technological developments in a deliberately educational and informative style, staff working in public engagement roles are increasingly aiming to involve audiences through activities such as festivals, and exhibitions with interactive elements. These developments sometimes encourage the visiting public to contribute their own opinions and reactions to the ideas presented within the exhibits, either for sharing with other visitors, or to provide relevant feedback to the exhibition stakeholders and researchers. In order to support this activity, exhibition designers face a challenge that involves producing exhibits that encourage a more critical or though-provoking engagement

with the exhibition content, creating new opportunities for the domain of interaction design. The idea behind this approach is that visitors are more likely to contribute their thoughts and record their reactions, if they are presented with information that is nuanced, provocative and that allows for audience interpretation.

5.2.3 Presenting "critical prototypes" to encourage engagement

In order to support this "feedback loop" aspect of public engagement with research into pervasive and adaptive computing systems, the PerAda project team designed and developed an activity-based interactive exhibition titled, *This Pervasive Day*" as part of the Edinburgh International Science Festival in 2011. The exhibition was open to the public for one week. Explicitly integrated into these exhibits were creative and entertaining methods of eliciting audience reactions to pervasive technologies and their potential impacts. To illustrate the topics of the exhibition, a series of installations that could be described as fictional prototypes were presented. The thinking behind this was to show how the rather complex concepts of pervasive adaptation would influence the products and services that form part of daily, lived experience. The design fiction, speculative or critical design approach has been well discussed and documented in recent years, for example by DiSalvo (2012), Auger (2013) and Bleeker & Nova (2009), and one of the ways it can be used is to encourage critique of the possible ways that technology might lead society in the future. By presenting concrete, fictionalised prototypes of products and services, these tangible examples invite reflection and debate about possible impacts to individuals and society.

Several exhibits were developed for the exhibition, and this case study describes one of these in detail, with particular focus on the interaction aspects.

5.2.4 Description: This Pervasive Day, Face Recognition app

This installation was intended to mimic an intelligent surveillance system that recognises the identity of everyone that passes by, presenting personal data about each person in response to their physical presence and proximity. The idea behind this concept was to show that pervasive systems would, in the near future, be able to identify and track specific individuals even if they were unaware of this process happening. As this installation was developed in 2011, it is worth noting that many of

the visitors, in discussions with the exhibition volunteer, demonstrated that they were not aware of the potential functionality and the implications of such systems. Reactions from the visitors were often surprising, ranging from horror at the potential power of such systems, to delight at the possibilities for "seamless" interactions, for example, never having to remember passwords due to recognition capabilities.

The "Face Recognition" application was developed using the open source Processing language (www.processing.org) and the OpenCV library (opencv.willowgarage.com/wiki). The programming work was carried out by a skilled programmer as part of the funded project work. The interaction design and graphic elements were designed as a collaborative effort, comprising a team of two researchers (including the thesis author) and one programmer. The same version was installed on two iMac desktop computers, with the keyboard and mouse removed, so that more than one visitor could interact at the same time (Figure 5.1).

Figure 5.1 This Pervasive Day exhibit in situ in the exhibition.

5.2.5 Interaction description

As the visitor approached the screens, the application displayed a short phrase that echoed the themes of the exhibition as a whole, such as "Have we thought through the implications of the technologies that we are deploying?" (Figure 5.1). This graphic included bright colours and animation to attract the visitor to direct their gaze at the screen.

The iMac's internal webcam was configured to capture still images at intervals, and a face detection algorithm identified human faces within these images. These images were not displayed or stored. When a visitor's face was identified, the programme extracted this section of the image, and displayed it on the screen. These images were rendered in quite a low resolution and at high contrast, so that the faces were only just recognisable to the visitor, attracting attention and generating surprise as the visitors recognised themselves. Alongside the image the words "*You have been recognised and your identity has been assigned...*" appeared, (Figure 5.1) in a visual style of reminiscent of a science fiction movie.
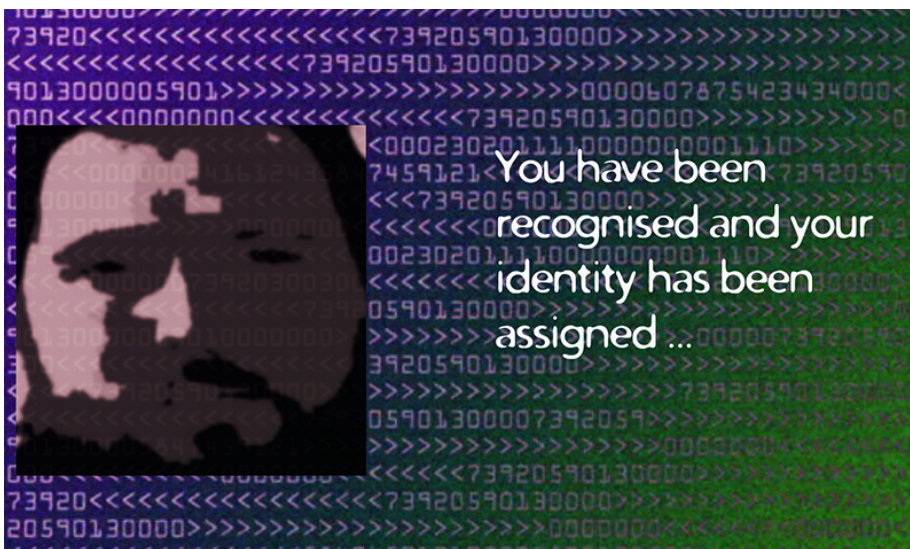

Figure 5.2 This Pervasive Day exhibit screenshot, showing the visitor's own face.

In the second phase of interaction, the visitors, who would now be looking at the screen with their own image, were presented with fictional personal identity data randomly generated by the system, concerning their birth date and employment. The "fiction" in this application lay in suggesting that simple face-detection was in fact face-

recognition, and that the system could identify any individual who passed by and then retrieve quantities of stored data concerning that person.

5.2.6 Discussion

This Pervasive Day is a good example of the type of interactive experience that is the subject of this thesis. As an application situated in a public space, it demonstrates some of the key themes of the Optional Interactions Design Framework. It is an "optional" interaction, that is to say that users are not required to engage with the system to achieve any particular outcome, and it is "action oriented" rather than "goal oriented", in that the experience of engagement itself is the reward for interaction. The designers of the system are also motivated by the desire to inform the visitors about the topic of the exhibition, and a positive, or optimal, experience is considered to be helpful in encouraging this engagement. Rather than presenting information directly to the visitor, the experience is intended to encourage reflection through delivering an appropriately engaging experience.

Returning to the findings of the review in chapters 2 and 3, the themes that emerged from the literature and have informed the Optional Interactions Design Framework as developed in Chapter 4, and presented in table 4.1, are addressed in turn as they relate to this case study.

1. Consideration of "optimal" experience, and the state of flow.

In observations and informal discussions with visitors, the exhibit did seem to provide an entertaining experience, particularly with couples and groups, who often seemed to find the experience amusing. However, the interaction was always of a short duration and so it could not be said that the exhibit encouraged a state of flow or immersion in the interaction. Further development of the interaction, as expressed in the "complexity" and "perception" subthemes could encourage a deeper experience.

2. Stages of engagement, enticement and attraction, and encouraging sustained engagement.

The interaction was explicitly designed to present a two-stage engagement, following the steps of firstly attracting attention of the visitor to notice the screen, and secondly

sustaining engagement through the presentation of thought-provoking fictional information.

The relatively short engagement time, and fairly limited scope for interaction, meant that these aspects were fulfilled to some extent. The screens did attract attention, although they were rather small within the exhibition space, and were perhaps positioned too low to fully take account of the line of vision of the average visitor. A three stage engagement could be observed to take place, firstly as the visitor noticed the screen, assisted by animated graphics, secondly as they identified their own image and thirdly as they read and made sense of the text. In observations, the first two stages were difficult to distinguish, and the final stage perhaps did not seen to hold as much attention as was hoped. There did seem to be a limit to how much the visitors could absorb in text format, and again the small size of the screen may have been a factor here. Referring to the emergent themes, there was some evidence of "exploration" and of "meaning".

3. Interactions framed as social encounters, affected by spatial aspects.

There was some indication that the theme of "sociality" was apparent in the interaction. Visitors did seem to be drawn to the human face on the screen, and the graphic style of the image meant that there was a delay before the face was identified as the viewer's own. As the interaction was passive on the part of the viewer, and only involved a single recognition-feedback step, the social nature of the encounter was limited.

4. Action oriented engagement, in opposition to goal orientation.

Although the visitor had no particular goal in interacting with the exhibit, there was not enough activity offered to the visitor to describe this as a fully action-oriented exhibit.

5. Complexity, difficulty and ambiguity as resources for engagement.

The interaction was rather simple for these features to be fully exploited as resources for engagement, however there was some complexity present, in that the fictional aspect of the application presented some ambiguity. Brief conversations with visitors revealed uncertainty and often a desire to find out more, or investigate the concept

behind the exhibit further, demonstrating some connections with the theme of "meaning".

6. Apparent lifelikeness, sentience and agency.

Due to the visually simple, screen-based nature of the installation, movement did not play a large role, except for the animated initial screen that attracts attention. However, the installation does draw on the concepts of agency, as the interaction is involuntary, initiated only by the proximity of the visitor. The installation itself takes control and directs engagement, presenting a captured image of the passer-by, along with fictional demographic data about the individual. The exhibit displays a limited level of sentience in that it gives the impression of knowledge and understanding personal and hidden aspects of the passer-by.

5.3 BetaCity exhibition installation

In the next case study, BetaCity, some of the interaction design concepts explored in this first case study are developed further.

> *"BetaCity tracks your movements through the urban space. You are a node in the network, a unit travelling in the crowd. The city harvests your data trail, making your presence known, shared and visible to all. But BetaCity knows who you really are. Watching, recording and storing your information, the city chooses what to reveal. Is your true identity safe within the city walls?"*
> (City | Data | Future exhibition catalogue 2014, p54)

This installation was designed and exhibited as part of the UrbanIxD EU funded project, under the FP7 programme. The installation was one of several that formed a larger public exhibition, and the concept and the interaction was designed by the thesis author, in collaboration with two colleagues who also worked on the UrbanIxD project, Michael Smyth and Michael McKellar.

5.3.1 Background to the City | Data | Future exhibition and the Design Fiction Approach

The UrbanIxD project curated and developed a touring exhibition, first exhibited in 2014 and then in several European venues in 2015. The major venue, for which the

exhibition was specifically designed, was the Telecom Italia Future Centre in Venice, and the exhibit was also shown in Aarhus, Denmark. This event was the culmination of the UrbanIxD project, and it served as a showcase of the work that the project developed over the previous two years. The aim of the exhibition, titled City | Data | Future, was to present a series of visions depicting what it might be like to live in a near future city saturated with data. Each piece was designed to question what this might mean for our changing relationship with the city and its citizens.

> *"What might it mean to live in a city where everything is measured, and crowdsourced opinion holds sway? How might this affect our own judgment in the face of such quantification and what does this mean for the creation and consumption of personal data?*
>
> *Will the city of the future protect us or will it monitor us? Will it provide shelter so that we can decide with whom we share our most intimate thoughts? As we reflect on the value we place on data, what new rituals might emerge around our need to share?"* From the City | Data | Future exhibition website (www.citydatafuture.eu)

The nine pieces that were presented in the exhibition were developed by designers and researchers who had an involvement with the UrbanIxD project over its two year lifespan (2013-14). They all took the form of "visions of the future", more specifically as design fictions or speculative designs. Design fiction and related approaches such as speculative design and critical design, have a common approach which presents realistic products and services, and descriptive scenarios of how life might be in the future. Practitioners of these approaches explicitly deploy methods from conventional design practice, such as physical prototyping, but they bring a critical or speculative approach to the presentation of the works. This means that the results are grounded in possibility, but they also encourage the viewer to consider whether society, culture and technology are are moving along a trajectory that might support the existence of these design concepts, and to think about the potential impacts of introducing such products into the world. In his analysis of this emerging methodology for analysing, critiquing and re-thinking contemporary technology, James Auger (2013) describes how:

> "*speculative futures imagine, through the extrapolation of contemporary systems and product lineages, near future products and services. These are intended to act as a form of cultural litmus paper, testing potential products and services on both a mainstream audience and within industry, before they exist.*"

Design fictions are not intended to be wildly and fantastically futuristic, although they may be informed by science fiction genres, instead they are more concerned with the everyday and the mundane, thereby connecting more directly to the lives of the viewers. They are often ambiguously neither dystopian or utopian, and this is perhaps one of the main strengths of this approach as it supports consideration and interpretation by each viewer. By presenting the visions as feasible, it is easier for the viewer to speculate, and to ask themselves, "what if", rather than to present an entirely fictionalised vision that can be easily dismissed as entertaining but nonsensical. Features of this approach can also be seen in the Face Recognition App case study discussed in 5.2. The City | Data | Future exhibition was designed with this underpinning approach in mind, and the visual style was intended to be attractive, intriguing and through-provoking to a broad audience, without being overtly futuristic, technological or educational in tone. This ambiguity seemed to work as an approach, and a range of reactions were evident in the audience feedback gathered and observed over the duration of the exhibition. Individuals responded very differently to the ideas presented by the exhibits, varying from worry and concern about the technological future, to excitement about the possibilities.

5.3.2 The BetaCity installation description

The BetaCity creative concept was directly informed by similar ideas to those explored in the previous case study, the "This Pervasive Day" face recognition app, and a research aim was to expand and develop those ideas further through more ambitious interaction design. The previous case study exhibit was collaboratively developed for a previous funded EU project, PerAda, with a different team, and only the thesis author was involved in the development of both exhibits. Both works explore the themes of surreptitious surveillance in public space, and the use of pervasive systems for identification and tracking of individuals.

BetaCity - Seeing, Sensing, Sharing

"The density of cities has always provided people with physical and emotional sustenance, as well as the anonymity of the crowd that we sometimes crave. In the near future this could change against a backdrop of increased technological systems both in the fabric of the city and among its citizens. Imagine a city that can continuously monitor and track our movements and habits, silently gathering data, extracting meaning and making decisions on our behalf, protecting us from harm through unseen eyes.

Is this our future? Is this a choice or is it already reality?"

Introduction to BetaCity from the City | Data | Future exhibition catalogue (2014).

The BetaCity installation is comprised of three separate stages, each revealing more about the BetaCity concept. The ideas involved in the installation topic are fairly complex for a visitor to grasp in the context of an exhibition, and so it was important not to overload the visitor with information in a short time space. Instead the ideas are revealed over the stages, with each stage presenting only a limited experience, using interaction to structure the unfolding of the installation narrative.
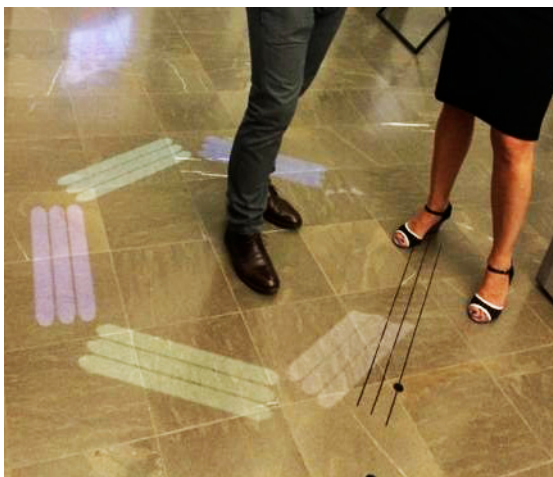
Figure 5.3 BetaCity stage 1

The first stage is designed to attract attention by identifying and responding to the presence of a visitor. The exhibition space is a visually busy area and when first entering the space there is a possibility that visitors can be overloaded with visual cues

as to where to turn their attention. Therefore this part of the exhibit is kept as conceptually simple as possible. It is sited near the entrance point of the exhibition, and is comprised of a projection on to the floor of slowly moving hexagonal shapes. As a visitor walks across the projection, the system detects this presence and the hexagon follows the movement of the visitor. At this stage the symbols and meaning of the hexagon shape are not explained, and the intention is simply to attract the visitor's attention, and to convey a responsiveness and feedback from the system to the presence of the visitor.

This first stage of BetaCity includes a multi-user tracking system using video analysing techniques in Max MSP. The hexagonal graphics are projected down onto users from above, tracking them and updating as they move within the space. The software is made up of two independent sections, working in unison with the attached projection and image capturing equipment. Through analysing a live video feed, variable coordinates were produced from the people moving within the space. This programming was carried out by a colleague of the thesis author (Michael McKellar), who worked on the exhibition technical production.
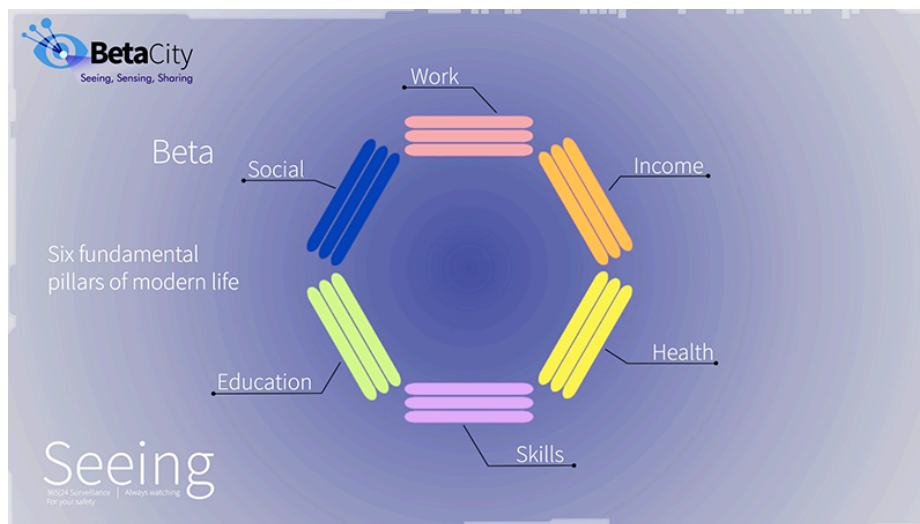

Figure 5.4 - BetaCity stage 2, still from video.

The second stage is a video projected onto a wall, placed a few steps on from the first stage. Here the hexagon design is incorporated into an animation that begins to explain

some of the concepts of the BetaCity installation. The idea of personal data tracking is introduced.
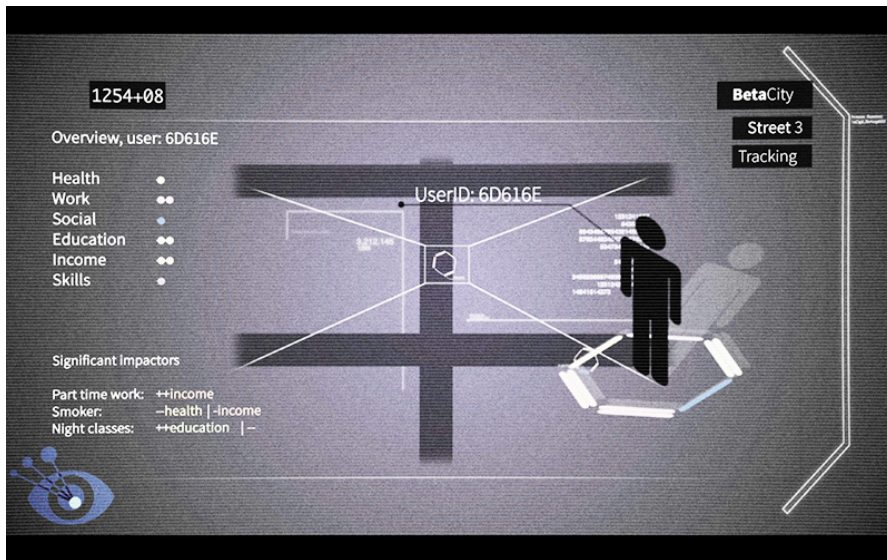

Figure 5.5a and 5.5b, BetaCity stage 3, projection in situ and still from video.

In the third and final stage, a more detailed video is projected onto a large poster, with branding of the fictional BetaCity system. The hexagon image is present showing continuity of the concept, and a more detailed narrative explanation is provided.

The interaction was informed in the early concept development stage by the "Attract and sustain" design concept, part of the second theme in the Framework: Stages of engagement, enticement and attraction, and encouraging sustained engagement.

5.3.3 Discussion

The next section addresses BetaCity in relation to the Optional Interactions Design Framework (see table 4.1, section 4.8.4):

1. Consideration of "optimal" experience, and the state of flow.

This concept was relevant to a partial extent only as the interaction experience was intended to be engaging for a period of a few minutes, and was sited in close proximity to other exhibits. This type of exhibition setting restricted the level of immersion that was desirable due to the pressures of visitor movement through the limited space. During the concept design process, awareness of these issues informed the structuring of the user journey. The design aim was to provide enough interaction and content for the installation to be engaging at each stage, but not so much that the visitor spent a long time at each section, causing annoyance to other visitors.

2. Stages of engagement, enticement and attraction, and encouraging sustained engagement.

This theme was at the forefront of the approach to the design of user experience of the installation, drawing on the framework themes of "trajectory" and "perception. The initial, moving floor-projected hexagon that tracked and followed the visitor was intended to act as an immediate attractor, presenting a simple responsive interaction. The placement of this element near the entrance to the exhibition was key to the experience. The second and third, video based, stages provided explanation of the first stage, and were placed so as to encourage more sustained engagement through revealing of the exhibit narrative.

The placement of the stages was sequential, but was influenced by the spatial layout of the exhibition spaces, and engagement with these was also influenced by proximity to the other exhibits within the exhibition. As a whole, the exhibition received positive feedback from visitors, evidenced through written comments. The feedback

demonstrated both excitement and trepidation at the visions presented in the exhibition, showing engagement with the exhibition topic and narratives. It was however, difficult to extract responses to each exhibit from the reactions to the exhibit as a whole, demonstrating some of the difficulties of carrying out evaluations "in-the-wild".

3. Interactions framed as social encounters, affected by spatial aspects.

The visibility of the responsive projected hexagon did provide a "talking point" for visitors, and there was some indication that a social element was apparent in the interaction from observing the visitors discussing the exhibit. Interaction with the floor projection was visible to other visitors and added a broader spatial element to the exhibition as the other exhibits were wall and table based.

4. Action oriented engagement, in opposition to goal orientation.

This theme is implicit in this type of exhibition installation as the design aim is to present some ideas to the visiting audience in an interactive and activity based way, while allowing the visitor to retain control of their own movement through the space. In a similar manner to the "This Pervasive Day" exhibit, visitors entering the exhibition space were curious about the topic of the exhibition and receptive to finding out more, but they had no particular goal to achieve. The exhibition as a whole allowed visitors to "dip in and out" of exhibits at their own pace, with only a lightweight structure to the route around the exhibition. This supported the theme of "exploration" and the subtheme of "curiosity."

Although there is a three-stage journey through the BetaCity installation, this was designed to be fairly fluid, enabling the visitor to experience the narrative out of sequence, and still find the installation engaging.

5. Complexity, difficulty and ambiguity as resources for engagement.

Of these three interconnected ideas, ambiguity is the strongest theme that informed the design of BetaCity. The installation sits within the classification of "design fiction", in that it presents speculative ideas of the future as if they are current reality. It is ambiguous to the visitor how much of the vision presented to them is based on real, implemented technological developments, and how much is fantasy. This ambiguity

supports a deeper engagement with the installation as the visitor works to construct their own interpretation of, and reaction to, the concepts they are confronted with. It is this ambiguity of the "similar but different" aspect that has lead to the growth of interest in the design fiction approach to engage audiences with emerging research topics.

The themes of "complexity" and its sub themes including, "discomfort" and strangeness", could have been incorporated into the installation to a greater degree, but the topics are already heavy in content and information for a walk-by exhibit, and too much complexity would have been likely to cause confusion and audience disengagement. Finding the right level of difficulty for such an exhibit is an important design challenge.

6. Apparent lifelikeness, sentience and agency.

This installation used this theme to a limited extend. Sentience and agency were implicit themes, as the installation presented a vision of a pervasive system that tracks, records and visualises the detailed movements of every citizen in real time, drawing on the themes of "computation" and "intelligence". The design aim was to suggest the city management system was all knowing and therefore exhibited a degree of sentience.

5.4 Beat Haiku: Interactive Poetry Application

The Beat Haiku application was designed to demonstrate how entertaining interactive technologies can be implemented on an interactive touchscreen in a foyer type of setting. The application was designed to provide a playful and engaging activity for people passing by or waiting for friends in the central meeting space in a university campus.

5.4.1 Beat Haiku Overview

The Beat Haiku installation was intended as an application to be implemented on a specific "Digital Wall", installed in 2011 as part of a research project to trial and demonstrate applications for this type of technology, which was fairly novel at that

time. The rear projection screen measured 2.5m x 1m, had multi touch capability, and 8K resolution (4320x1920). More than one application can be used at a time (Figure 5.6), and the screen was used for both information services including resources such as maps and timetables, and also entertainment and gaming applications.

Figure 5.6 The digital wall sited in the foyer area

5.4.2 Interaction Description

This Beat Haiku application invites the user to engage in the creative task of making up short Haiku poems. The interaction is kept as simple as possible for the user as the application presents a deliberately limited, but constantly changing, selection of words for the user to choose from. These are intended to invite interaction, and the restricted selection available prevents the task from becoming daunting or too lengthy. The selection of words are continuously, but slowly, replaced with new words taken from a stored database, This makes the interaction more interesting for the user, and introduces an element of challenge as the user cannot spend too long making their selection or the chosen word might disappear. The words are gradually replaced on a rolling basis (Figure 5.7a), with the intention that the user does not feel too pressured by information overload. The home screen is intended to look analogue and tactile through the use of natural imagery, and 3D word items that move gently against the background. The

notebook image is designed to provide visual affordance that suggests placement of words, without providing any explicit instruction. The visitor can explore by moving the words around the screen with a single finger touchpoint, and if dragged to the notebook area they will "snap" to the text area.

Figure 5.7a Home screen of Beat Haiku, showing animated words that move, change and fade in and out to signify interaction.

As the user adds their chosen words to the notebook area of the screen, the background image slowly changes in response to the emotional tone of the new poem, either turning lighter and brighter in response to positive words, or darker and more sombre in response to words that are more negative in tone.

Figure 5.7b The Beat Haiku shows response to the "light" emotionally themed words added by the user.
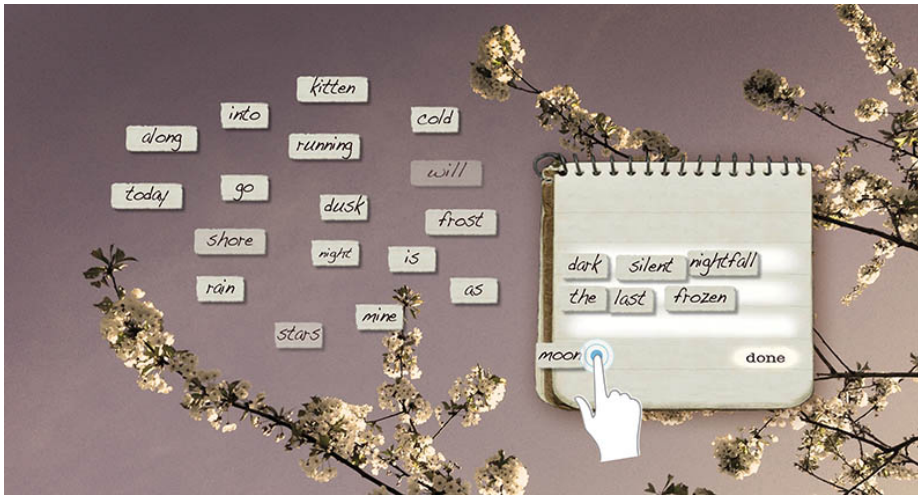

Figure 5.7c The Beat Haiku shows response to the "dark" emotionally themed words added by the user.

Each of the words in the system's database has been manually allocated to one of three collections; light, dark or neutral, and each of these is assigned a value of +1, 0 or -1. The system counts the total of the values assigned to the user-created poem and responds in real-time by gradually transitioning to the light background if the total is positive or the dark background if the score falls into a negative value.

Allocating values to the words was not a straightforward exercise, and judgement was needed to decide whether a word would take on positive or negative connotations. This was guided by the writing style and authorial tone of Jack Kerouac's original haiku poems in order to stay close to his artistic and emotional motivation. At this point in the interaction, the user is not aware of the link to the work of Kerouac, in order to prioritise engagement with the interactive element of the installation. This is explained in more detail later in this section.

An edited example of the code is shown below:

```
//words for building poems
var lightWords =
["found", "star", "birdbath", "July", "dawn", "supermarket", "purple",
"flowers", "protected", "turtle", "up", "head", "white", "bird",
```

```
"together", "shore", "winning", "splashing", "life", "poppies",
"delicacy", "now", "summer", "birds", "crickets", "kitten", "playing",
"dawn", "hurrying","pussywillow", "wash", "white", "whole", "spruces",
"advanced", "yellow", "swimming", "listen", "first", "wave",
"cricket", "dog", "sparrow", "looking", "like", "approach", "heaven",
"girl", "birds", "sing", "birds", "will", "bird", "contemporary",
"read", "page", "clean", "wine", "dawn", "coming", "home", "work",
"holy", "roses", "bird", "yellow", "dolls", "bowing", "birds",
"singing", "dawn", "leaves", "noon", "flowers", "cricket", "yellow",
"moon", "above", "to", "the", "beautiful", "young", "girls", "flower",
"perfect", "spring", "orange", "blossoms", "bee", "tree", "power",
"frog",  "morning"];

//words for building poems
var neutralWords =
["the", "why", "are", "you", "this", "line", "I'll", "go", "in",
"little", "at", "me", "I'm", "not", "mine", "a", "a", "little", "at",
"the", "icebox", "door", "it", "anyway", "by", "family", "the", "how",
"many", "miles", "those", "when", "the", "on", "elevators", "long",
"the", "the", "house", "running", "up", "the", "library", "steps",
"with", "shorts", "on", "at", "the", "the", "barn", "in", "a", "sea",
"of", "to", "read", "the", "page", "crossing", "the", "football",
"field",  "from", "the", "on", "the", "book", "my", "knees", "are",
"after", "the", "shower", "amongst", "the",  "in", "the", "bath",
"road", "my", "the", "to", "eave", "the", "is", "the", "for", "a",
"from", "the", "west", "covering", "the",  "a", "sound", "her", "on",
"the", "shelf", "my", "step", "grandmother", "in", "the", "in", "the",
"at", "the", "the", "garage", "doors", "at", "nodding", "against",
"the", "wall", "the", "the", "seventh", "the",  "in", "my",
"cabinet", "the", "has", "of", "the", "of", "naval", "Tuesday", "one",
"the"];

//words for building poems
var darkWords =
["drainpipe", "slowly", "prayerbeads","evening",  "falling", "star",
"dewdrop",  "weeds", "clouds", "moon", "sleeps", "nasal", "November",
"drunken", "black", "bull", "catfish", "fighting", "die", "night",
"late", "moon", "wind", "Autumn", "rain", "lamps", "closed", "moon",
"moon","behind", "silver", "clouds", "unencouraging", "crying",
"rain", "grey", "losing", "history", "cat", "die", "moon","moon",
"sinks", "down",  "waiting", "staring", "missing", "kick",  "closed",
"night", "marred", "squabbles", "moonlit",  "moon",   "away",
"silent", "only", "leaves", "fell", "smoke", "old", "battles", "dusk",
"windblown", "nightfall", "dark", "too", "too", "cold", "low",
"quiet", "lamplit", "useless", "useless", "heavy", "rain", "clouds",
"not", "dead", "rain", "dark", "rainy", "straining", "padlock",
"sneeze", "November", "last", "faint", "medicine", "winter", "fly",
"died", "old", "age", "gone", "frozen", "rainy", "sleep", "night",
"fall", "too", "dark", "too", "dark", "cold", "drenched", "thrashing",
"lonely", "businessman", "leaf", "December", "cold", "not", "even",
"cats", "barking", "no", "stepped", "telegram", "drop", "rain",
"roof", "frost"];
```

Once the user's new Haiku poem is complete, the "done" button is selected, and the poem is added to the database of stored user poems and the application enters a second stage. In this state, the application displays a rolling selection of the previously

completed poems so that users have the feedback of seeing their own poems in juxtaposition with others previously completed (Figure 5.7d). The newest poems are displayed more frequently to ensure that the user sees that their own poem is now included in the system. At this point the user may select a further information option, which provides further details about Haiku poetry, and reveals the origins of the selection of the words, which is that they are all taken from the collection of Haiku poems written by the author, Jack Kerouac in the 1950 and 1960s. Alternatively, the user can chose the home option to return to the original screen and create a new poem.
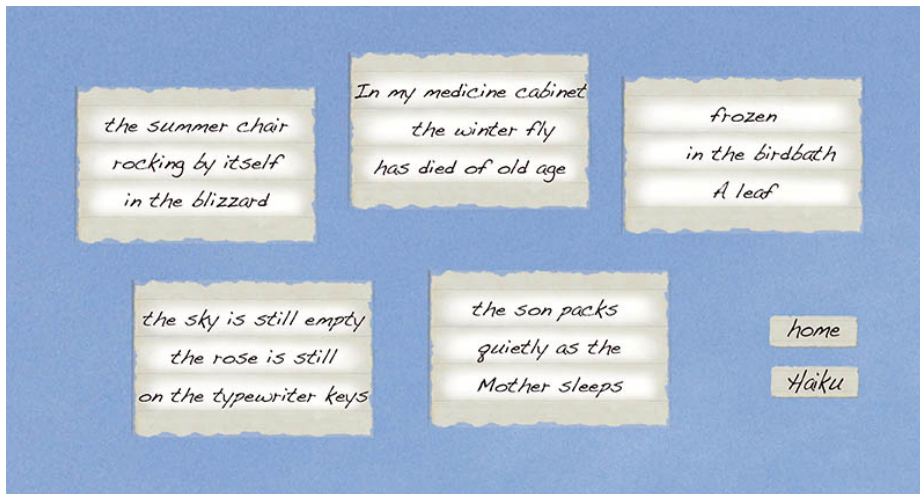

Figure 5.7d User created poems displayed, with options to find out more or return to Home.

After a short time without detecting any user activity, the application returns to the starting screen ready for the next user who passes by.

5.4.3 Creative origins: Kerouac and the Haiku

> "*Above all, a haiku must be very simple and free of all poetic trickery and make a little picture and yet be as airy and graceful as a Vivaldi Pastorella.*" (Jack Kerouac 1965)

The discussion in this section describes some of the original concepts that informed the creative development of the Beat Haiku application, setting out why the evocative and

serendipitous haiku format is relevant as a starting point for this type of "optional" interaction.

The haiku is fairly well known as a traditional form of Japanese poetry consisting of 17 syllables, arranged in three lines of 5, 7 and 5 syllables respectively. Although the haiku has a long, rich and fascinating history in Japan, a discussion of its origins and traditions is outside the scope of this thesis. However, there some key features of the haiku form that are important to this work. As Lucien Stryk (1994) says, "...*the haiku poets of Japan, are strongly emotional, moving constantly from light to dark and seeking change*". This expresses an important aspect of the haiku, that it evokes a mood implicitly through reference to an observation, often from the natural world, and often mentioning a season, standing as a marker of change or transition. There is very limited action in a haiku, it is more like a quick sketch that invites recognition of a feeling, or the recall of a fleeting moment. Haiku tend to draw on a familiar language of cultural symbolism, so that the poet can make references to objects from the natural world knowing that the reader will understand the intended meaning. From the mid nineteenth century Japanese decorative arts, culture and aesthetics began to have a strong influence on Western artists who were drawn to its bold, minimalistic imagery and natural forms. Although they were unable to read the full traditional and symbolic meanings of Japanese poetry, a few writers became particularly interested in the haiku form during the early part of the twentieth century.

The haiku lends itself to the development of creative, interactive applications in public spaces precisely because of this simplicity, along with the emphasis on visual imagery. Earlier in the thesis, in the discussion of the demands of public spaces, it was argued that, particularly during the attraction phase of engagement, the user can be overloaded with contextual stimuli, and an attractor is required that the user can easily focus attention on. Further layers of meaning or interest can then be revealed over time, in a pace that suits the physical and social situation.

In the second half of the twentieth century, the haiku format was adopted by American writer Jack Kerouac, after a period of studying Buddhism and Zen writings. Kerouac is well known as one of the major figures of the beat generation culture of the 1950s and 1960s, along with his contemporaries such as William S. Burroughs and Allen

Ginsberg. Ginsberg even stated that Kerouac was the only poet in the United States who know how to write haiku: "*Kerouac thinks in haiku, every time he writes anything--talks that way and thinks that way.*" (Ginsberg, interviewed by Clark, 1966). This spontaneity, and this rendering of the subject's essence is what Regina Weinreich (2004) cites as the strength of Kerouac's haiku. A haiku is a fleeting, ephemeral moment captured and distilled. In Kerouac's words, "*It has to be completely economical, no foliage and flowers and language rhythm, it has to be a simple little picture in three little lines.*" (Kerouac, interviewed by Berrigan, 1968)

Visually, Beat Haiku blends the natural, eastern imagery with the more modern imagery of Kerouac. The notebook and the typeface used in the interface are based on Kerouac's own personal notebook and his handwriting. As Kerouac was writing in English, he felt free to adapt the traditional Japanese syllabic structure to suit the way that he used language.

Returning to the Beat Haiku application, this freedom from the syllabic rules proved to be helpful in designing the interaction. One of the original ideas when developing the interaction concept was to place restrictions on the word selection, so that the user was forced to select words with a syllable count that added up to the right syllables structure in each line. The problem here was that this would have drawn attention away from the meaning of the words themselves, focusing instead on the syllable count, reducing creative freedom, and making the game seem closer to a numerical puzzle. When research into modern haiku forms revealed Kerouac's freer approach, it was decided to follow this method instead, simplifying the interaction, while maintaining an alignment with poetic practice. Therefore Beat Haiku follows Kerouac's rules:

> "*You see you got to compress into three short lines a great big story. First you start with a haiku situation... How you going to compress that into three lines? Now in Japanese you got to compress it into seventeen syllables. We don't have to do that in American--or English--because we don't have the same syllabic bullshit that your Japanese language has.*" *(Kerouac 1968)*

5.4.4 From Kerouac to algorithms

So far in this section, the influence of Japanese haiku and the modern, western haiku form of the Beat Haiku application has been discussed. The use of this pared down literary form to evoke visual imagery and emotional responses were considered to be relevant to the creative concept. This lead to the decision to populate the application's database with words taken from haiku written by Kerouac. The user, therefore, is unknowingly reorganising the poems of one of literature's iconic writers when interacting with the application. This is revealed at the end of the activity, providing a small informational reward to the user who is sufficiently interested to know more about the application.

5.4.5 Poems and Haiku in computing

The minimal linguistic structure, and the evocative imagery of haiku forms have influenced creative computing practitioners in various ways. One of the aims of haiku is to express ideas in an economical, yet beautiful and insightful way. This kind of "Zen" approach to communication has been used to parody the way that computing is often seen by users as clumsy and opaque. For example, there are countless "haiku error messages" circulating on the internet. The origin of this meme is unclear, but it seems to have started in the late 1990s as a rumour that certain Microsoft error messages were being replaced with haiku. A few examples follow:

> "*The Web site you seek*
> *Cannot be located, but*
> *Countless more exist.*"

> "*First snow, then silence.*
> *This thousand-dollar screen dies*
> *So beautifully.*"

> "*A crash reduces*
> *Your expensive computer*
> *To a simple stone.*"

These are appealing because they bring lightness, humour, and a sense of calm and order to a domain that is often perceived as unnatural, frustrating and inhuman. The haiku puts our modern technological concerns into perspective, reminding us of the essential poignancy of existence.

As well as haiku written about computers, there is a body of work that investigates whether computers can be creative and generate haiku themselves. This evokes some of the challenges of testing the artificial intelligence capabilities of computing such as the Turing Test. One of the earliest examples of this type of computerised creativity is from the Cybernetic Serendipity exhibition in 1968, in "Computerised Japanese Haiku":

> *eons deep in the lake*
> *I paint all time in a whorl*
> *bang the sludge has cracked*
>
> *eons deep in the ice*
> *I see gelled time in a whorl*
> *Pffftt the sludge has cracked*
>
> *All white in the buds*
> *I flash snow peaks in the spring*
> *Bang the sun has fogged*

M. Masterman and R. McKinnon-Wood, Cambridge Language Research Unit, in Cybernetic Serendipity, Studio International, p54, 1968 (http://cyberneticserendipity.com/cybernetic_serendipity.pdf)

The Beat Haiku installation aims to combine this automatically generated, serendipitous form of creativity, with enough user input for the experience to be attractive and engaging to the passer-by.

5.4.6 The Beat Haiku Case study: Design framework and optional interactions

The next section addresses BetaCity in relation to the Optional Interactions Design Framework (see table 4.1, section 4.8.4):

1. Consideration of "optimal" experience, and the state of flow.

Of the three installations discussed, this is the one that draws most on this theme. The spatial aspects of the installation setting within a wide foyer, enabled a longer interaction time than was ideal in the other installations. The game-like elements and the underlying responsiveness were explicitly designed to support a more immersive experience. The themes of "time" and "trajectory" play a larger role in this installation as there are distinct interaction stages presented, and the theme of "complexity" also supports longer interactions.

2. Stages of engagement, enticement and attraction, and encouraging sustained engagement.

This theme was also an explicit influence on the design of the installation, with an ambient, animated home screen with visual affordance to entice the user to commence the interaction journey. Sustained engagement is supported by the level of challenge balanced by rewarding co-creation and feedback including the responsiveness of the system reacting to the emotional tone of the user created poems. This responsiveness is not noticed at first as the user's attention is focused on the poem creation, and it becomes apparent at different levels depending on the poems that the user creates. "Behaviour" of the system is an important theme, and this is designed to support "exploration" and "curiosity".

3. Interactions framed as social encounters, affected by spatial aspects.

This theme is intrinsic to the installations presented on the foyer digital screen. The simple, single point interaction, the clear visual affordance, and the large space in front of the screen enables two or more people to collaborate on creating a poem. Passers-by can see what is happening and also engage in the activity, as expressed in the themes of "perception" and also "participation", a sub theme of "sociality".

4. Action oriented engagement, in opposition to goal orientation.

This theme is also relevant in that the activity of creation is the focus of the interaction. Although there is a goal in the creation of the poem, there is no scoring or specific target to achieve. The feedback of seeing a completed poem added to the database is the reward, and this can be repeated as long as the user wishes. It is the activity of interaction with the content and the creative aspect that is the main orientation of the application. "Creativity" and "co-production" are important themes here, as the users works together with the system to generate new poems.

5. Complexity, difficulty and ambiguity as resources for engagement.

In Beat Haiku there is complexity and ambiguity present as the interaction is not fully explained at the start, and the user must explore a little to understand the interaction. The responsiveness of the system changing the background imagery happens subtly and is this not explained to the user who must infer what is happening. By comparing the difference in system reaction to different word combinations, the user may guess the link between the emotional tone and style of the background image presented to the user. Themes of "surprise", "abstraction" and "randomness" are relevant here as subthemes of "complexity". "Meaning" is also an important theme, in particular the sub themes of "user-creation", "interpretation" and "expression". For a walk-by interactive system this is quite a complex interaction although the barrier to interaction is low.

6. Apparent lifelikeness, sentience and agency.

As all of the systems discussed in this chapter are largely screen based, the opportunity for interactive behaviours that mimic life in a kinetic way is limited. In order to fully exploit this aspect of the framework, the use of tangible, physical and robotic systems could be explored. More relevant to Beat Haiku is the theme of sentience and agency, as elements of the themes of "computation", and its sub theme "intelligence. The system presents words to the user apparently according to its own selection process, and then responds to the created poems in a way that is not immediately clear to the user. When the user correctly guesses that the system is processing the emotional tone of the words it becomes apparent that the system has its own form of understanding or sentience.

5.5 Chapter Summary

This chapter presented three case studies of original work that demonstrate how the themes identified in the previous chapter can be framed as expressions of "bridging concepts" that show how theoretical framings can be instantiated within interaction design practice. The design concepts presented in this chapter are discussed with reference to the Optional Interactions Design Framework that was constructed through work discussed in previous chapters, including the mapping to emergent themes in table 4.1, section 4.8.4.

In Chapter 6, the Optional Interactions Design Framework is extended by presenting it as a resource for supporting designers engaging in early concept generation. This is discussed in relation to ideas from the literature on Design Patterns.

Chapter 6: The Optional Interactions Design Framework

6.1 Introduction

This chapter presents further discussion of the contribution of this thesis, the Optional Interactions Design Framework. This chapter develops the concepts that emerged from the analysis of artist interviews and the presentation of the case studies in the previous chapters through comparison with design pattern approaches. These are considered through preliminary evaluations in design workshop settings.

6.1.1 Patterns in Architecture and Urban Design

The pattern approach to design has its origins in the work of architect Christopher Alexander, who described a set of solutions to particular, recurring problems. In his influential book "A Pattern Language" (Alexander, Ishikawa & Silverstein 1997), he sets out a comprehensive list of 253 individual, detailed patterns that together make up a whole language for designing towns, neighbourhoods and individual houses. The patterns are organised into topics, and can be combined to form complete designs, continuing the grammatical metaphor of language. The book is volume 2 of a set, and is intended to be the practical instruction book to accompany volume 1, "The Timeless way of Building", which sets out fundamental principles and provides theoretical discussions on how to build towns and buildings. One of the interesting points that emerges from reading Alexander's (and his co-authors) introduction to "A Pattern Language" is the democratic intentions that underpin the authors' approach, which seems to run parallel to the ideas within the open source software movement that was emerging around the same time. "A Pattern Language" is a set of guidelines presented to be widely used, judged and modified without losing the central essence of the original intent. The authors explicitly express their hope that people will read and use the language, and will also add to it, creating a shared, evolving, common language.

The format of design patterns is consistent for clarity and simplicity. Each of Alexander's patterns is comprised of sections rather quaintly separated by three

typographic diamonds (although they look more like quatrefoils), and subsections, setting out; context, problem, solution, and relationship of the pattern to other patterns. The elements are illustrated with simple diagrams.

6.1.2 Patterns in Software Engineering

It is clear that Alexander intends design patterns and the pattern language to be used by a wide range of professionals, practitioners and anyone with an interest or stake in the design of our environments and habitat. It is partly, perhaps, this accessible style and engaging presentation that has resulted in the wide influence of Alexander's design pattern approach in other fields such as software engineering. In 1995, the so-called "Gang of Four", Gamma, Helm, Johnson and Vlissides, published "Design Patterns, Elements of Reusable Object-Oriented Software", a book setting out software programming examples following the format of Alexander's design patterns. This heralded several other published sets of design patterns to address various programming problems. The design pattern approach turned out to be a good fit with the move towards object-oriented programming, where "off the peg", concrete design solutions can be quick to implement, and yet sufficiently abstract that they can be used flexibly in numerous situations (Tidwell 1999)

6.1.3 Patterns in HCI

In the late 1990s, Jenifer Tidwell published "Common Ground: A Pattern Language for Human-Computer Interface Design", making a case for the benefits of a pattern language in the field of Human Computer Interaction (HCI) design. By this stage in the development of HCI, although still a young field, claimed Tidwell, the principles of good interface design were well known and described. For example, Jakob Neilsen's (2005) influential list of usability heuristics for user interface design was published in 1995, and presented as "broad rules of thumb". These robust and practical guidelines still form the basis of evaluation checklists for many usability professionals, and are used in educational settings to present interaction design concepts. The problem for novice designers, according to Tidwell, lay not with understanding the principles, but with the remembering and the effective application of all these concepts. Experienced designers have assimilated a lot of knowledge of successful techniques and solutions,

and have developed deep contextual understandings, but designers new to the field do not have such a rich internal resource to draw upon. A design pattern language for HCI and interaction design may be helpful here. Defined by Tidwell as "a set of interrelated patterns, which share similar assumptions, terminologies, and contexts", this method of collating good practice serves as a shared vocabulary, a practical toolkit and a solid disciplinary foundation.

Lawson, (2004) discusses the way that experienced practicing architectural designers make frequent use of shorthand. They use particular words to refer to a wide, shared knowledge of concepts, representing, "a complex set of ideas that were common ground within the practice." He also observes that experienced collectives of architectural practitioners tend to use small and minimal sketches to communicate amongst themselves. This is in stark contrast to the advanced CAD models and high resolution presentations that are required to adequately communicate ideas to clients, stakeholders and users. This, Lawson suggests, is because experts "recognise" rather than "analyse". They already hold a large conceptual knowledge, which they can draw upon and apply; "the use of known precedents that have been studied and about which the expert has schemata" (Lawson 2004 p448). A schema for a particular situation includes known patterns, or "gambits" to use Lawson's term.

6.2 The Framework for Optional Interactions with Public Installations

This section presents the suggested design framework - the Optional Interactions Design Framework - for the design and evaluation of "optional interactions" with publicly sited, non-utilitarian installations. The literature review chapters identified approaches that can be used to inform the design of such systems. These kinds of encounters, where an engaging experience of interaction itself is the design goal, as discussed in the literature review chapters, can be regarded as forms of dialogue between people and interactive systems. The framework extends this dialogical model by incorporating system features that suggest aspects of "lifelikeness", whether human, animal or undetermined, to the user. These aspects are categorized as animate or sentient, referring respectively to their physical and behavioural attributes, or to their apparent intelligence. It is proposed that these aspects may prove to be useful in the

design of public installations; as attractors to initiate interaction, and as sustainers, to support engagement with the system.

The framework is based on the themes identified from the literature review and from the thematic analysis of interview with interactive artists. The Framework in its simplest form is a list, shown below, of concepts that can be used to inspire and structure new design concepts.

1. Consideration of "optimal" experience, and the state of flow.
2. Stages of engagement, enticement and attraction, and encouraging sustained engagement.
3. Interactions framed as social encounters, affected by spatial aspects.
4. Action oriented engagement, in opposition to goal orientation.
5. Complexity, difficulty and ambiguity as resources for engagement.
6. Apparent lifelikeness, sentience and agency.

6.3 The Framework used in practice in design workshops

The Optional Interactions Design Framework was trialled in two design workshops in educational settings. This section describes the workshop and the evaluation, including use of a variation of the "creativity support index", (Cherry and Latulipe, 2014) and qualitative feedback.

6.3.1 Using the Optional Interactions Framework with designers

Previous discussion has shown how the Optional Interactions Framework can be used to inform and structure the design of creative, interactive installations, demonstrated through two case study examples. A further research question concerns whether this framework can be usefully employed to structure and support the design work of novice designers. This section describes an evaluation with student interaction designers along with reflections on two questions:

1. Did the framework support the development of high quality design outputs?

2. Did the students consider the approach to be beneficial for the development of their assessed courseworks?

6.3.2 Student workshops: Introduction

The Framework was trialled in two classroom design workshops and this section describes the evaluation, including use of the "creativity support index" questionnaire, and qualitative feedback. Reflections on the success of the framework are discussed along with consideration of further work.

6.3.3 Background and Context

The workshop was presented to two different groups of students, on consecutive weeks. The students who attended the workshops were part of the same cohort of students studying an undergraduate module titled "Responsive Environments" (Scottish Credit and Qualifications Framework level: 09). This module is part of the "Digital Media and Interactive Design" subject group, within a school of computing in a Scottish university. The module is a blend of practical creative design work and theory. For their assessments, the students submit a project-based coursework comprised of the design and conceptualisation of a responsive environment. They create working prototypes to support their design, and are also required to produce a critical report.

The module was chosen for this evaluation as it addressed the topic of interactive designs, with an emphasis on spatial aspects, which aligns with the focus of this thesis. This is supported by the stated learning outcomes of the module:

> LO1: Design multimedia projects that make appropriate use of physical, aural, visual, time-based and interaction components to convey a message and reinforce its content.

> LO2: Identify the appropriate technology to design a product or installation.

> LO3: Develop working prototypes to appropriately augment an interactive product or installation.

> LO4: Appraise their work in relation to current practice and theory.

Teaching is delivered through a combination of lectures, tutorials and practical sessions. The description aimed at students of the Responsive Environments module is:

"You will be introduced to the application development and production of Responsive Environments. For the purpose of this module Responsive Environments will be understood in terms of both installations and physical products that interact with people who use them, pass through them or come into proximity with them. You will be introduced to key issues, current debate and practice within design for computer-driven responsive environments. Students will gain an understanding of constraints and possibilities within the physical adoption and integration of computing technologies."

6.4.4 The assessed coursework and the workshop topic

Students are often pragmatic, and tend to prioritise participating in activities that contribute towards the completion of their assessments, and so the workshop was structured and presented to be aligned with this motivation. It was considered that students were more likely to engage with the activity, and also to give more focused and appropriate feedback, if the task was perceived as contributing to their established learning goals. The assessments in this module were in the form of formative and summative practical work and written reports, submitted at different points in the duration of the module. The summary below shows how the timings of the workshop related to the assessment activities.

Assessment Part 2. Phase 1: 23rd February (Week 7)

Assessment Part 2. Phase 2: 16th March (Week 10)

Workshop 1: 25th March (week 11)

Workshop 2: 1st April (week 12)

Assessment Part 1: Monday 6th April (Week 13)

Assessment Part 2. Phase 3: 20th April (Week 15)

The workshop was presented during the normal timetabled sessions for the module. In selecting these slots, the existing planned teaching activities had to be taken into account. As some of the comments from the student feedback suggested, it would

157

perhaps have been more beneficial for the students to experience the workshop earlier in the semester so that they could incorporate some of the ideas that they generated more directly into their assessment work. However, the main aim from the point of view of this research was to ensure that the participating students were an appropriate group for the evaluation. It could be surmised that it was beneficial to the evaluation that the students had had a longer engagement with the Responsive Environment module topics, and so were more receptive to the workshop experience.

6.3.5 The workshop structure

The workshop was presented to students as comprising part of their planned timetabled activities, as a session that would relate directly to their compulsory assessment. The intention was that the workshop was presented as a normal or routine part of their student experience, to minimise effects of "specialness" that might influence their perceptions of the event. The only additional incentive, communicated to the students in advance, was the provision of some small snacks to encourage attendance. The students have a range of communication channels to keep them informed about their module activities, including social media channels, email and the university's virtual learning environment (VLE) that enables teaching staff to send out updates about times, locations and other information about classes. These channels were used to send out notifications of the workshops.

Advance information given to students before the workshop event:

> *"This is a practical, activity-based workshop where you will be working on developing experiential scenarios for public spaces. You don't need to prepare anything in advance, but it would be helpful to bring laptops if you can.*

> *Your coursework explicitly states that you should draw on the design workshops presented during this module. Participating in this workshop will particularly help you to develop creative, interactive concepts that can feed into your coursework."*

6.3.6 Details about the workshop:

Group 1 25th March

15 participants, 8 male, 6 female, 1 other/prefer not to say

Median age 24, age range 20 to 30

Group 2 1st April

10 participants, 9 male, 1 female,

Median age 22, age range 20 to 32

On the day:

Timetable:

10.00 - 10.30:   Presentation, what's happening today (Framework)

10.30 - 11.00:   Brainstorm to generate at least 6 different concept ideas.

11.00 - 11.30:   Each group presents their 2 best ideas

11.30 - 12.45:   Each group develops their chosen idea into a presentation

12.45 - 1.15:   Final concept presentations

1.15 - 1.45:   Finish and feedback

The Design Brief presented on the day:

"Today you are to develop an outline concept for an interactive experience in a public space. The space can include any part of the foyer and outdoor public space at Merchiston Campus.

Your concept should entice people to engage with the system, and then it should hold their attention in a way that provides a positive experience. Your concept should not be "functional", instead the activity of interaction itself should be rewarding to people.

You will work in groups of 2 or 3."

6.4 Workshop Evaluation

The main purpose of carrying out this workshop evaluation was to understand whether the main concepts contained within the Optional Interactions Design Framework would be of value to designers. In this particular instance, the context is concept generation in the early stages of the design process. Workshops are a well-documented and established method in design education, but there is scope for development of scaffolding activities, to provide inspirational starting points, and to introduce theoretical concepts and methodologies to students.

As the full version of the Framework contains rather too many concepts to be tackled within a one-off workshop, the two most interesting elements of the framework were focused on. These addressed social encounters and lifelikeness, numbers 3 and 6 in the framework, focusing on social aspects and lifelikeness:

> 3. Interactions framed as social encounters, affected by spatial aspects.

> 6. Apparent lifelikeness, sentience and agency.

The workshop evaluation was carried out using a version of the Creativity Support Index (CSI) as described by Cherry and Latulipe (2014). This psychometric survey was designed by the authors in order to evaluate the ability of a creativity support tool to assist a user engaged in creative work. The authors' describe creativity support tools (CSTs) as "a*ny tool used by people in the open-ended creation of new artifacts*" (p21:2). These can be physical tools such as paintbrushes, musical instruments or typewriters, or they can be software applications. Such tools can be used in many different domains, can support a variety of activities, and are similar in their categorisation to productivity support tools, such as word processing applications. Measuring productivity tasks is rather more straightforward than measuring creativity tasks, as they tend to be well-defined and measurable, whereas creativity is more difficult to define and evaluate. This was the authors' motivation for developing the Creativity Support Index.

Cherry and Latulipe assert that their index is designed to be flexible so that it can be used to study a variety of tools, and incorporated into many experimental evaluation approaches. It is presented in their work as primarily a way of assessing the suitability

of tools used during the generation of creative artefacts. For use in the workshop these questions were modified to suit the context of the workshop, and the ordering was randomised. The headings were removed so that the students were not influenced by the motivation behind the questions.

Cherry and Latulipe's original CSI questions:

Collaboration

1. The system or tool allowed other people to work with me easily.

2. It was really easy to share ideas and designs with other people inside this system or tool.

Enjoyment

1. I would be happy to use this system or tool on a regular basis.

2. I enjoyed using the system or tool.

Exploration

1. It was easy for me to explore many different ideas, options, designs, or outcomes, using this system or tool.

2. The system or tool was helpful in allowing me to track different ideas, outcomes, or possibilities.

Expressiveness

1. I was able to be very creative while doing the activity inside this system or tool.

2. The system or tool allowed me to be very expressive.

Immersion

1. My attention was fully tuned to the activity, and I forgot about the system or tool that I was using.

2. I became so absorbed in the activity that I forgot about the system or tool that I was using.

Results Worth Effort

1. I was satisfied with what I got out of the system or tool.

2. What I was able to produce was worth the effort I had to exert to produce it.

The modified questions as presented in the workshop questionnaire:

1. The workshop approach allowed other people to work with me easily.

2. I would be happy to participate in this kind of workshop on a regular basis.

3. It was easy for me to explore many different ideas, options, designs, or outcomes during the workshop.

4. It was really easy to share ideas and designs with other people during the workshop.

5. The workshop was relevant to the Responsive Environments practical coursework.

6. I was able to be very creative while doing the workshop activity.

7. My attention was fully tuned to the activity during the workshop.

8. I enjoyed participating in the workshop.

9. I was satisfied with the end result of the workshop activity.

10. The workshop approach allowed me to be very expressive.

11. The workshop was helpful in allowing me to track different ideas, outcomes, or possibilities.

12. I became very absorbed in the workshop activity.

13. The end product was worth the effort that I had to put in.

14. Participating in the workshop will help me to produce better work for the module coursework.

The students were asked to respond using a standard 5 point Lickert type responses; strongly agree, agree, neutral, disagree, strongly disagree. In addition, there were some free text boxes available for any further comments that the students wished to make.

The workshop was presented twice, with roughly half the class attending each session. The evaluation plan was to run the session in the same way each time, with the only difference being the addition of a paper version of the Optional Interactions Framework presented in a design pattern structure, handed out to students in the second session. Both sessions proved a slide based introduction to a few of the concepts behind the Framework to provide inspiration for the activities. By introducing one change, it was hoped to elicit quantitative data that could show whether the use of a more structured version of the Framework as supporting material would make a difference to way the students perceived the creative activity.

6.5 Results; data and observations.

The Lickert scale responses were attributed numerical scores as follows:

> strongly agree: 2
> agree: 1
> neutral: 0
> disagree: -1
> strongly disagree: -2

The questions were organised under Cherry and Latulipe's original groupings for analysis, and the scores were averaged to address the differing attendance numbers at each workshop. This provided a set of comparable numbers that could be visualised in bar chart form:
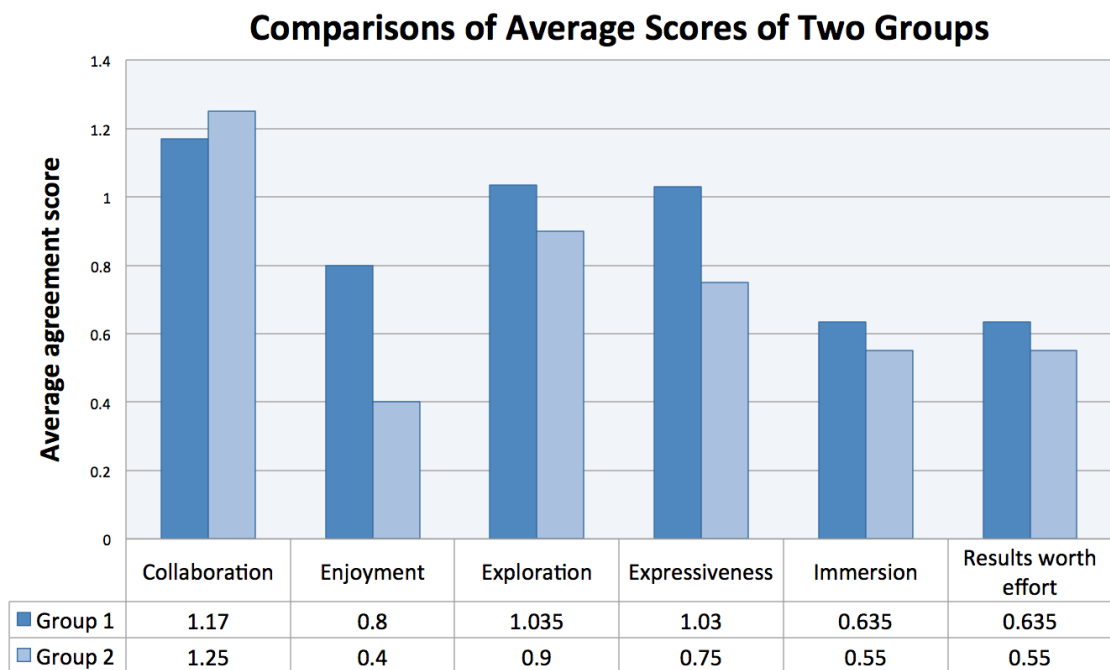
Comparisons of Average Scores of Two Groups

	Collaboration	Enjoyment	Exploration	Expressiveness	Immersion	Results worth effort
Group 1	1.17	0.8	1.035	1.03	0.635	0.635
Group 2	1.25	0.4	0.9	0.75	0.55	0.55

Figure 6.1 Comparison of CSI scores from groups 1 and 2

Both groups were introduced to the Framework Concepts through a 30 minute talk supported by a slide presentation at the start of the workshop. Group 2 also had copies of a printed handout with more detail about the framework in a simplified "design pattern" format.

On looking at the quantitative data, the first finding is that the students seemed to rate the workshops positively on all the categories, with none of the scores falling into the negative range. The students also seemed to find the workshops particularly useful for collaboration, exploration and expressiveness.

However, the results are problematic for a few reasons. Firstly the difference in numbers attending the workshops was significant; 15 and 10, and the gender balance was also very different. Although the total numbers are adjusted to take account of the differences, the first, larger workshop, had a busier and more sociable atmosphere. The students worked collaboratively in small groups, and the difference in the social structures between the two workshops makes direct comparisons unreliable. It is clear that Group 1 enjoyed the workshop more and this can be attributed to the pre-existing social connections amongst the group, supported by observation. In the feedback comments for group 2, the low attendance was mentioned as a negative factor.

Secondly, from the data it is not possible to unpick whether the positive effects could be attributed to the use of the framework, or simply the workshop experience as a whole. In the free text areas of the questionnaire, many of the students mentioned collaboration, groupwork and exploring ideas as being the "*best or most useful aspect of the workshop*". "*…seeing examples of related work*", was also mentioned as a positive aspect.

The main insights gained from the exercise were observational, and these aspects are not revealed in the numerical data. Discussion of this aspect is presented below.

The first point was that the students that attended the first workshop had a rather different educational background to the ones attending the second workshop, making them more disposed to creative approaches and more receptive to collaborative working. Secondly, from observing the students at work, it was clear that they did not refer very much to the paper handouts that they were given. Both workshops provided a paper version of the brief, and only the second workshop received the paper version of the framework. To avoid influencing the students too much in their behaviours, the students were not directly encouraged to refer to these. The information contained within the brief was presented in slide format as an introduction, and after this session,

the students were keen to start work and they did not engage very much with the printed handouts, putting their energies instead into group discussions and sketching.

The most interesting insights emerged from observing the students at work, and from listening to their early concept presentations. The small groups of 2 or 3 students, each presented their ideas using large, rough sketches to illustrate their idea pitches. It was clear from these informal presentations that many of the students had incorporated ideas from the initial presentation into their work. Aspects of sociality and agency were clear in many of the design concepts, and this can be seen in the sketches in Figure 6.2.
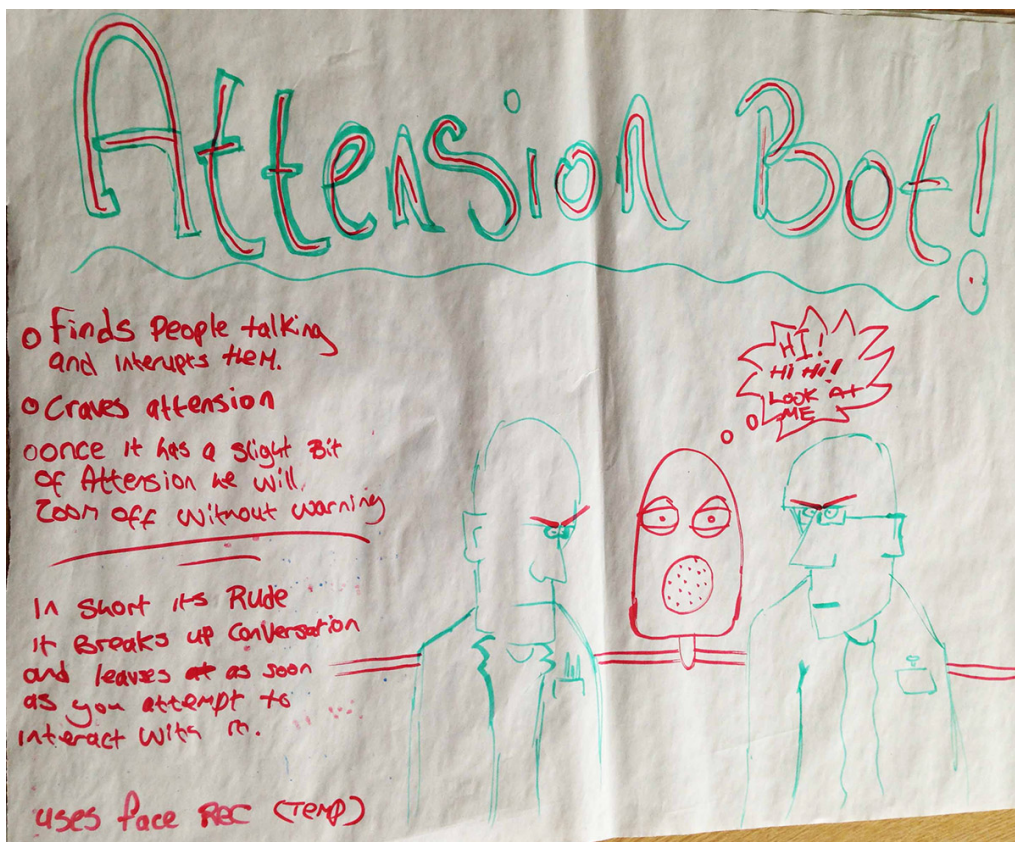
Figure 6.2a Early concept sketch: Attention Bot (Moves along a rail attached to the wall, craves attention, seeks out people to interrupt, but leaves as soon as interaction is attempted).
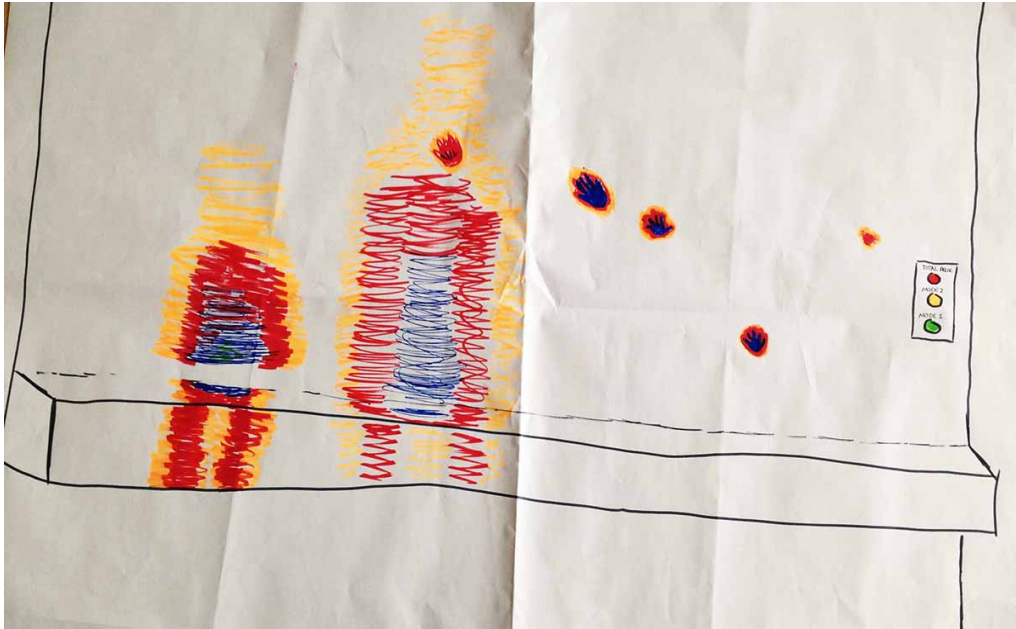
Figure 6.2b Early concept sketch: Heat detection wall and seat (The imprints of previous visitors are created by body heat and gradually fade over time).
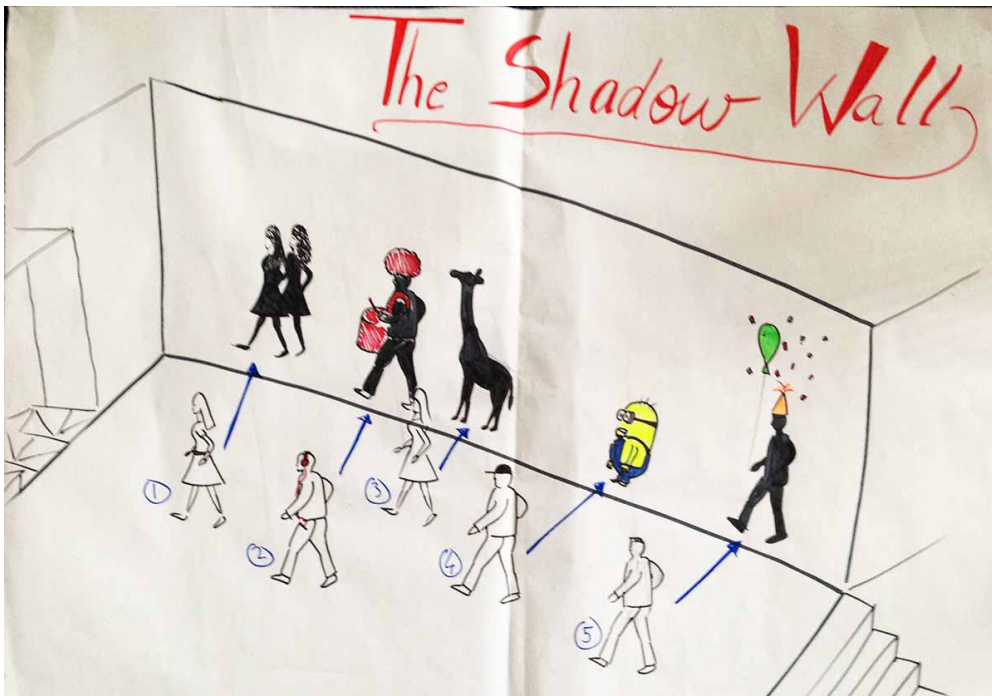

Figure 6.2c Early concept sketch: Shadow wall (The wall detects passers-by and mimics their shadows, augmented to illicit surprise and recognition).

The implications of this are discussed in the next section.

6.5.2 Reflections and conclusions.

In reflecting on this workshop evaluation experience some valuable insights emerged that are relevant to the use and application of the Optimal Interactions Design Framework.

In terms of the outputs, the first workshop group produced the most fully developed and rich ideas. It was apparent from observing all the groups at work that individual, personal and social factors and attributes of the students themselves, and their own social networks and previous experiences, had a substantial influence on the success of the workshops. However, allowing for these individual differences, the experience supports the ideas from design patterns literature, in that patterns should be used to act as reference resources for designers rather than stand-alone teaching resources. They are useful for structuring understandings where designers have already absorbed and understood these ideas, and the patterns in this situation are more like a reminder system that can help them to recall ideas, as in the discussion from Tidwell earlier in the chapter. The students responded well to the face-to-face presentation of the concepts, supported by examples and video materials. However the full range of the 6 point Optional Interactions Design Framework presented far too much material for a one-off workshop event, and only two or three key ideas could be assimilated within the scope of the workshop.

To develop the full Optional Interactions Design Framework further it seems very likely that it could form the basis of a more detailed and developed educational presentation, such as part of a 14 week undergraduate module involving 100 - 200 hours of study over a semester. In this way students could be introduced to the full range of concepts in order to understand them more thoroughly, including a more detailed examination of the themes and subthemes that emerged from the thematic analysis of the artists' texts (table 4.1). Depending on the educational stage of the class, this analytical work could be extended, with students working collaboratively in small groups on their own thematic analysis of further texts. This could enrich and develop the existing framework, or develop alternative frameworks for other design contexts, as an educational exercise in design research methodology.

Chapter 7: Further work and Conclusions

7.1 Discussion

This chapter pulls together the findings of all the research work and sets out the more general implications for the design of interactive systems in public spaces. It looks further forward and speculates on the wider work that is likely to be required in the future in this research domain, drawing on the findings of this thesis. Recommendations are put forward about the key research questions to be addressed along with some suggestions about how to approach these.

7.1.1 Overview of the research questions

The starting point for this work was the idea that the work and the approaches taken by artists working with interactive and computational media might have something important to contribute to the domain of interaction design, particularly when addressing optional interactions in public places. The thesis asserts that we are currently at an important point in the development of urban and public spaces. Computational technology has reduced drastically in size and cost over the past couple of decades, while its power and connectedness has increased dramatically in line with Moore's Law. As is so often the case, the actors that are best placed to take advantage of these developments tend to be driven by commercial interests, and are not necessarily those who have our civic, collective or social interests as their main driving force. This thesis asserts that it is imperative that other voices and interests are given the opportunity to influence how people experience the urban and public spaces that they have shared access to. To do this well, interaction designers need to have access to a broad range of both practical tools and conceptual motivations and understandings. The interaction design agenda that will shape our experience of technologically enhanced, shared and social spaces is too important to be decided only by market forces.

To address this important issue, this thesis has argued that creativity and artistic approaches have an important, and currently under examined, role in interaction design

research and practice. These approaches may be unconventional, and in some ways problematic to assimilate, in comparison to traditions of HCI research, but our own experience of the world tells us that art practice can be exciting, enriching and valuable. It can also be confusing, infuriating and baffling, depending on our own particular standpoint and personal tastes. But it is this rich variety and interdisciplinarity that leads to new understandings and ways of making sense of the world, and it is why the arts continue to receive public support and funding, even though this is constantly under pressure and scrutiny.

This thesis addresses interactions that are optional. These are not productivity and efficiency oriented, instead they are about providing enriching, action oriented, social experiences, contributing to our engagement with our environment. The thesis has presented the argument that interactive, media art practice has much to teach the HCI and IxD communities about designing such experiences. In order to do this, the thesis has presented an investigation into how artists think and work, and how they create experiences. The research began by analysing what artists had to say about their own approaches with the aim of identifying relevant insights to inform interaction design, which lead to the identification of a thematic landscape. Concepts and ideas were identified through a scrutiny of the literature, and these were incorporated into a design framework. In particular the idea of "lifelikeness" and the related concepts of sentience and agency, as design resources were found to be underrepresented in the academic literature. In contrast, this emerged as a strong theme in the words of artists, expressed in the two concepts of animalistic behaviour and of intelligent sentience, along with independent agency. As a contribution to interaction design research knowledge, these findings have been distilled and structured in the form of a six point framework; the "Optional Interactions Design Framework". This framework acts as a bridging concept between theory and practice.

To illustrate the Framework in practice, three case studies of interactive installations that utilised the themes were presented and described. This design work demonstrated that artistic influences can be important in influencing the design of interactive installations situated in public, social and shared spaces.

Finally to complete the thesis, insights gained from the two previous phases of work were presented and examined in the form of a workshop for interaction designers. The aim of this activity was to test out whether the ideas and the knowledge gained through the process of the development of this thesis could be communicated appropriately to other researchers and design practitioners. This investigation demonstrated that the Optional Interactions Design Framework has validity as a method for informing interaction design practice.

The three main research questions that the thesis aimed to address are summarised here along with a discussion of the conclusions.

1. What are the experiential themes and methods that interest contemporary artists working in the medium of digital interaction?

The themes were identified through qualitative analysis of interviews with working artists and through a review of literature and artistic practice. These themes are expressed in the form of the 6 point Optional Interactions Design Framework:

1. Consideration of "optimal" experience, and the state of flow.

2. Stages of engagement, enticement and attraction, and encouraging sustained engagement.

3. Interactions framed as social encounters, affected by spatial aspects.

4. Action oriented engagement, in opposition to goal orientation.

5. Complexity, difficulty and ambiguity as resources for engagement.

6. Apparent lifelikeness, sentience and agency.

2. How can the challenging interactions found in digital art be exploited in the design of engaging human-computer interfaces?

The Optional Interactions Design Framework is presented as a response to this question, and the thesis asserts that it can be used as a structuring "bridging concept", which provides intermediate-level knowledge, translating between theory and practice.

3. Can insights uncovered in considering these first two questions be framed in a way that is useful to the designers of optional interactive experiences sited in public space?

Reflections on the experience of implementing two workshops with interaction designers address this question, with the conclusion that the Optional Interactions Design Framework can be useful to the practice of designing experiences sited in public space.

7.2 Understanding user engagement and future work

This work has focused on understanding the practices of artists in their creative work as a potential resource for design practice. The thesis has demonstrated that this insight can potentially be useful to inform concept development in interaction design. In choosing the approaches of well-regarded artists as the subject of scrutiny, this inquiry has bypassed close examination of whether these approaches are actually effective in supporting the kind of audience engagement that is of interest here. The assumption is that the reputation of the artists is a sufficient enough indicator of this. It is argued that this is not a problem within the scope of this thesis as there is enough merit in an examination of these artists approaches to justify this study. However, the effectiveness of the artworks created by the particular artists considered in this thesis, in terms of user engagement, is a consideration that should not be forgotten, and this could form the basis of further complementary studies.

Following on from this idea of examining audience engagement in real world settings, this thesis has not reached the stage of evaluating how users might interact with the designed systems that were informed by this work. From an HCI perspective, this would seem to be an obvious next step in the research process. Questions to be explored would include whether the designs that result from the application of knowledge emerging from this work somehow encourage more engaging systems than designs developed that are not informed by this approach. The structuring and design of such a comparative research project would be challenging if it were to yield useful and meaningful results. This would be a very interesting topic to attempt, and could form

the basis of another thesis of the scale of this one, as it would require the untangling many interwoven issues around the nature of engagement and experience.

7.2.1 The Framework used in education

The design workshops were illuminating, but further workshops could be carried out to uncover further insights, and to validate findings. They enabled reflection on the possibilities of the overall approach of this thesis within an educational setting, and provide direction for expansion of this work in a future educational project.

In particular, the design patterns approach would seem to lend itself to a longer and more in-depth method for introducing the concepts to interaction design students. Alexander originally intended his design pattern approach to support underpinning understanding, rather than to be used as a checklist to be consulted during a design project. It would be interesting to test this out by using a design pattern framework to structure an undergraduate or masters level module, running for an entire semester. This would allow students to examine and try out a whole pattern book in a more considered and deeper way, perhaps adapting and adding to the set of patterns as they gain in knowledge and practical experience. In this way a design pattern framework can become a 'scaffold' (Wood et al, 1976) for learning. This educational theory describes the use of a tutorial approach to problem-solving kinds of learning, where support and assistance is provided to learners in order that they can complete tasks beyond their current competence. A key component of this process, argue Wood et al, is that the novice must be able to recognise a solution to the kind of problem being tackled, before being able to apply the steps necessary to achieve the desired outcome. In other words, comprehension must precede production. Design patterns are a potentially useful classroom tool here in that they present a range of possible solutions in a format that explains their application and utility, and also present examples of how they might be applied.

This thesis is situated squarely in the domain of interaction design rather than in the domain of design education, and so this topic has not been addressed directly in the literature review at the start of this thesis. However, at this point in the discussion it is useful to provide a brief overview of some aspects of design education in so far as they

relate to the work presented here. The culmination of this thesis is the presentation of some insights that may of use to interaction designers engaged in a particular subset of that domain, that of public spaces. In particular, this work would seem to be particularly relevant to novice designers, and therefore it may be useful in an educational context. This discussion, therefore, relates to university level education, but it is not exclusively directed at that sector, and the comments here should be taken to be addressed to a wider audience. As previously mentioned, this is not a primarily pedagogically focussed thesis, and so this discussion tackles only a fairly limited portion of that highly specialised field. The aim here is simply to suggest possibilities for the application of this work, and it is hoped that further exploration of the research could take this aspect much further.

Studies of design students identify various strategies that they adopt and the deficiencies that may need to be addressed in the educational setting. Cross, for example, (Cross, N. 2004), describes the common stages of problem definition, information gathering, and solution generation that students go through when dealing with a design project. Cross suggests that novices (students) and experienced designers show differences in how they transition between these stages, with the experienced designers exhibiting more use of organised and structured strategies. In his overview of relevant studies, he says that expert designers seem more likely to consider both problem and solution in a more integrated way, through "solution conjectures", rather than through problem analysis. This latter phase, including information gathering and problem scoping is where some students can get rather "stuck", and unable to progress successfully on to concept generation. These findings suggest that providing structured strategies to help move students forward in the process could be beneficial. Using design patterns as a teaching approach may help students to develop a more solution focused approach to their work, without losing sight of the need for understanding the context and demands of the design problem.

Project work is often at the heart of design education and there is tension between, on the one hand, allowing freedom for students to direct their own learning in an exploratory manner and providing guidance and support on the other.

7.2.2 Developing the data analysis method further

One aspect that became apparent during the study is the potential richness of existing interview data that is freely available. This merits further investigation in its own right, using the thematic analysis method, informed by grounded theory approaches, to elicit further and deeper insights about how practitioners conceptualise their work, and how they go about implementing it in practice.

7.3 Conclusion: Significance of this thesis to HCI

The third of the three research questions stated at the outset of this thesis addressed the issue of insights that are useful to designers. This issue of "usefulness" within the context of academic research is worth examining in more detail here, as this is one of the key underpinning ideas of this thesis, and it also raises a wider question about the direction of HCI research at the current time.

There is often a tension between the vision of academic research on the one hand as the freedom to expand knowledge of abstract theoretical concepts without pressure to test them in practice, and on the other hand, the view of research activity as a way to improve our lives by uncovering new knowledge in order to change how we structure the world around us. By using the words "design" and "useful" it is clear that this thesis is primarily placed in the latter category of research, along with other applied science, technology and engineering disciplines. However the research undertaken in this thesis aims to show that as researchers we should be careful not to draw our disciplinary boundaries too tightly. It is argued that the discipline of HCI has had a tendency to fetishize the empirical and experimental methods of the fundamental sciences, perhaps because of a lack of confidence in the role of HCI in the academic world.

However, there are a growing number of voices that are now counselling against this over reliance on positivist approaches, and are calling for a broader, more interdisciplinary way of carrying out research, especially where the end results are intended for deployment in the "real world". In particular, current directions in design research have much to bring to HCI. William Gaver (2016, p194) argues that science and design answer to different forms of accountability, and that they produce different sorts of "facts". While science makes assertions about an objective world, where two

incompatible accounts cannot both be true, design is concerned with introducing new entities and activities into the world. As long as these function or are effective in some way, they are valid, and can be judged alongside other alternatives. Design research methods and techniques, argues Gaver, can be as creative and varied as the outputs that they inform, and he warns against *"closing down the productive indiscipline of design"*.

During the Renaissance, educated people were expected to be polymaths, literate in a broad range of philosophies, including both arts and sciences, and it was only relatively recently, in the 19th century, that the split occurred that prioritised narrow, specialised knowledge over a broad education that included a range of subjects and an understanding of both the practical and the theoretical. Due to the increasing pace of technological change, and the rise of the information society that promotes instant dissemination of knowledge, we now find ourselves firmly in the age of the "wicked problem". While deep knowledge of particular specialisms will always be required, many of us – practitioners, educators and researchers – are tackling work that, in order to be successful, must take account of a very wide range of contextual issues, which brings us back to the research question of "usefulness to design". This thesis has attempted to show that HCI and interaction design research benefits from an open-minded approach to methodology, and that effective research needs more than empirical proof of narrow hypotheses. This issue is discussed further in chapter 4, where the differences between the research goals of "explanation" and of "understanding" are examined.

In his essay addressing the contemporary use of ethnographic methods in HCI, Paul Dourish (2014 p12) highlights several concerns, notably for the purpose of this thesis, the concern with subjectivity and reflexivity as components of the research method, and the interpretive stance of the researcher. These, he states, are a considerable departure from traditional HCI approaches, particularly in terms of the stance towards investigation and knowledge production. The issue of generalisation is a particular problem for HCI according to Dourish, due to its focus on particular events and contexts, whereas design-oriented HCI prioritises practical models that can be applied to a range of fresh situations, as is indeed the goal of this thesis. The framework presented here is intended to provide a structural model that could be applied to new

situations by other designers. In addition to this, the description of the process of developing the framework itself is also intended to be of benefit to designers by revealing how, through methodical examination and interpretation, underlying ideas and inspirations behind creative works can be better understood.

Ben Schniederman (2016) talks about the growing need for blending knowledge and methods in a manner that goes beyond the current calls for interdisciplinary collaborations. He makes a compelling case for combining approaches from the disciplines of science, engineering and design: *"Each discipline has a proud history of success, but the challenges of our time require novel combinations, broad thinking, and creative validation methods to achieve high-impact research results"* (p45). He even goes on to suggest (p48) that STEM subjects (science, technology, engineering and mathematics) could include art or design to become STEAM. This adjustment will require a shift in research cultures and attitudes, as well as an open-minded approach to the development of new methodologies.

7.3.1 A call for blended, hybrid methods.

As this thesis reaches its conclusion, a call is made to researchers regarding this question of methodology. HCI and interaction design should continue to work on the development of novel, blended, and hybrid research methods that draw on mixed techniques such as triangulation, comparison and interpretation for their validity. Through combining methodologies the disciplines of HCI and IxD can produce new ways of understanding contexts, applications and people, and thereby generate deeper and more useful insights that can inform the design of interactive systems in myriad situations. This way of working does require greater confidence in furthering interdisciplinary ways of working. As Gaver (2016, p196) says *"discipline is a matter of establishing boundaries around methodologies, creating areas of stability for consolidation, while indiscipline is a mechanism for transgressing those boundaries and allowing new territories to be explored."*

References

Alexander, C. Ishikawa, S. Silverstein, M. (1977) A Pattern Language: Towns, Buildings, Construction (Center for Environmental Structure) Oxford University Press. New York.

Amis, M. (1987) Einstein's Monsters. Random House Inc (T); 1st Edition. ISBN-10: 051756520X

Art + Com Studios (2004). Floating.Numbers. Retrieved May 2015 https://artcom.de/en/project/floating-numbers/

Auger, J. (2013) Speculative design: crafting the speculation, Digital Creativity, Journal, Taylor & Francis. Vol 24, Issue 1, 11 – 35

Bannon, L. (1991). From human factors to human actors: The role of psychology and human-computer interaction studies in system design. In J. Greenbaum, & M. Kyng (Eds.), Design at Work. Cooperative Design of Computer Systems (pp. 25--44), New Jersey: Lawrence Erlbaum Associates.

Bardzell, J. (2009) Interaction Criticism and Aesthetics. CHI 2009, April 4–9, 2009, Boston, MA, USA.

Bartneck, C. (2009) My Robotic Doppelgänger – A Critical Look at the Uncanny Valley. The 18th IEEE International Symposium on Robot and Human Interactive Communication, 2009. RO-MAN 2009. Page(s): 269 - 276

Baty, S. (2010) An interview with Bill Verplank. Retreived June 2015 from: http://johnnyholland.org/2010/12/an-interview-with-bill-verplank/

Bell, G. & Dourish, P. (2007) Yesterday's tomorrows: notes on ubiquitous computing's dominant vision. Pers Ubiquit Comput (2007) 11: 133. doi:10.1007/s00779-006-0071-x

Benford, S. & Giannachi, G. (2008) Temporal Trajectories in Shared Interactive Narratives, CHI 2008 April 5–10, Florence, Italy. ACM

Bilda, Z., Edmonds, E. & Candy, L. (2008) Designing for Creative Engagement, Design Studies

Blackwell, Alan F. HCI as an Inter-Discipline. CHI EA '15 Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems. Pages 503-516. ACM New York, NY, USA 2015doi>10.1145/2702613.2732505

Blade Runner, 1982, Feature film directed by Ridley Scott, Warner Bros. USA

Bleeker, J. and Nova, N. (2009) A synchronicity: Design Fictions for Asynchronous Urban Computing, The Architectural League of New York http://www.situatedtechnologies.net

Blythe, M, A. & Hassenzahl, M. (2003) The Semantics of Fun: Differentiating Enjoyable Experiences in in Funology: From Usability to Enjoyment, 91-100 Mark A. Blythe, Kees Overbeeke, Andrew F. Monk, Peter C. Wright (eds) Kluwer Academic Publishers.

Bødker, S. (2003)When second wave HCI meets third wave challenges, Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles, p.1-8, October 14-18, 2006, Oslo, Norway doi: 10.1145/1182475.1182476

Boehner, K. DePaula, R. Dourish, P. Sengers, P. (2005). 'Affect: from information to interaction'. In AARHUS '05, pp. 59–68, New York, NY, USA. ACM Press.

Bolter, J.D. & Gromala, D., (2003), Windows and mirrors: interaction design, digital art, and the myth of transparency, MIT Press Cambridge, MA, USA.

Boxer, Steve. How Candy Crush gets you hooked - six addictive tricks. The Guardian. 4th June 2014 http://www.theguardian.com/technology/2014/jun/04/candy-crush-angry-birds-mobile-games (retrieved 1 Sept 2015)

Braun, V. and Clarke, V. (2006) Using thematic analysis in psychology. Qualitative Research in Psychology , 3 (2). pp. 77-101. ISSN: 1478-0887 http://dx.doi.org/10.1191/1478088706qp063oa

Brignull, H. (2011) Dark Patterns: Deception vs. Honesty in UI Design. Interaction Design, Usability, 338

Brignull, H. & Rogers, Y. (2003) Enticing People to Interact with Large Public Displays in Public Spaces. Human-Computer Interaction, INTERACT'03, IOS Press, pp17-24. (Special issue on Interaction Design) 29: 525 - 540.

Caillois, R. (2001). Man, Play, and Games. Urbana and Chicago: University of Illinois Press. (originally published in 1958; translated from the French by Meyer Barash).

Carroll, J. M. (2014): Human Computer Interaction - brief intro. In: Soegaard, Mads and Dam, Rikke Friis (eds.). "The Encyclopedia of Human-Computer Interaction, 2nd Ed.". Aarhus, Denmark: The Interaction Design Foundation. Available online at https://www.interaction-design.org/encyclopedia/human_computer_interaction_hci.html

Carroll, Lewis. (1865) Alice's Adventures in Wonderland

Chalmers, M. and Galani, M. 2004. Seamful interweaving: heterogeneity in the theory and design of interactive systems. In Proceedings of the 5th conference on Designing interactive systems: processes, practices, methods, and techniques (DIS '04). ACM, New York, NY, USA, 243-252. DOI=10.1145/1013115.1013149

Chen, J. (2007) Flow in Games (And Everything Else). Communications of the ACM,

Cherry, E. and Latulipe, C, (2014) Quantifying the Creativity Support of Digital Tools through the Creativity Support Index, ACM Transactions on Computer-Human Interaction, Vol. 21, No. 4, Article 21, Publication date: May 2014.

Churchill, E., 2010. Today's flâneur: from HCI to place-based interaction and human-place interaction. interactions, 17(4).

City | Data | Future, Interactions in Hybrid Urban Space, the UrbanIxD exhibition catalogue, 2014. ISBN 978-0-9562169-4-6

City Bug Report, 2012, Media Architecture Institute (MAI) and Aarhus University/PIT/CAVI Aarhus, Denmark http://cavi.au.dk/research-areas/city-bug-report/

Clark, T. (1966) Interview with Allen Ginsberg, The Paris Review, 37 (Winter, 1966), 52-53

Colson, R. (2007) The Fundamentals of Digital Art. AVA Books SA, London

Cross, N. (2007) Designerly Ways of Knowing (Board of International Research in Design) Birkhäuser GmbH, ISBN-10: 3764384840

Csikszentmihalyi, M. (1990) Flow, the Psychology of Optimal Experience, Harper Collins

Dalsgaard, P. & Dindler, C., 2014. Between Theory and Practice, Bridging Concepts in HCI Research. In the 32nd annual ACM conference. New York, New York, USA: ACM Press, pp. 1635–1644.

Dalsgaard, P. & Hansen, L, K. (2008) Performing Perception – Staging Aesthetics of Interaction. ACM Transactions on Computer-Human Interaction. 15, 3, Article 13

Damasio, A. (1994) Descartes' Error: Emotion, Reason and the Human Brain. 2nd Edition (2006) Vintage, Random House, London

Decode: Digital Design Sensations (2009) http://www.vam.ac.uk/exhibitions/future_exhibs/Decode/ (retrieved feb 2010)

Dewey, J. (1934) Art as Experience, Penguin Group (USA) ISBN: 0-399-53197-1

DiSalvo, C. (2012) Adversarial Design (Design Thinking, Design Theory) MIT Press. DOI:10.1080/14626268.2013.767276

Dourish, P. (2004) Where the Action Is: The Foundations of Embodied Interaction, MIT Press, Cambridge, MA, USA

Dourish, P. (2004). What We Talk About When We Talk About Context, Personal and Ubiquitous Computing 8, Springer-Verlag London Limited.

Dourish, P. (2007) Responsibilities and Implications: Further Thoughts on Ethnography and Design. Designing for User experiences, Chicago, Illinois, ACM New York, NY, USA

Dourish, P. (2014) Reading and Interpreting Ethnography. In: Ways of Knowing in HCI. Eds Olson, J.S. & Kellogg, W. A. Springer, New York. DOI 10.1007/978-1-4939-0378-8

Dunne, A. (2005) Hertzian Tales, Electronic Products, Aesthetic Experience, and Critical Design. MIT Press, Cambridge, Massachusetts.

Edmonds, E. Muller, L. and Connell, M (2006) On creative engagement, Visual Communication Vol 5, No 3; p307 - 322, Sage DOI: 10.1177/1470357206068461

European Commission (2015) Digital Agenda for Europe: ICT & Art - the StARTS platform. https://ec.europa.eu/digital-agenda/en/ict-art-starts-platform Last updated on 30/07/2015

Falco 2014 http://www.falco.co.uk/projects/the-big-switch-on-nine-falco-cycle-counters-go-live/ (accessed July 2015)

Falk, J. H., Dierking, L. D. (1992) The Museum Experience. Whalesback Books, and imprint of Howels House. Washington DC. USA.

Fallman, D. (2003). Design-oriented human-computer interaction. In CHI '03 Proceedings of the SIGCHI conference on Human factors in computing systems (pp. 225-232). ACM. New York, USA

Findeli, A. (2016) The Myth of the Design Androgyne. In: Joost, G. (Ed.), et al. 2016. *Design as Research. Positions, Arguments, Perspectives*. Berlin, Basel: Birkhäuser. ISBN 978-3-0356-0738-3

Gaver, W. (1996) Affordances for Interaction: The Social is Material for Design, Ecological Psychology 8(2), 111-129

Gaver, W. Beaver, J. Benford, S. (2003). Ambiguity as a resource for design. CHI2003 April 5–10, 2003, Ft. Lauderdale, Florida, USA. ACM.

Gaver, W., Sengers, P., Kerridge, T., Kaye, J., and Bowers, J. (2007). "Enhancing Ubiquitous Computing with User Interpretation: Field Testing the Home Health Horoscope". CHI 2007 Proceedings, Home Spirituality

Gaver, W.W., Dunne, A., and Pacenti, E. (1999) Cultural Probes. Interactions Magazine. vi(1), pp. 21-29. ACM New York, NY, USA

Gaver, W. (2016) Indiscipline. In: Joost, G. (Ed.), et al. 2016. *Design as Research. Positions, Arguments, Perspectives*. Berlin, Basel: Birkhäuser. ISBN 978-3-0356-0738-3

Giddens, A. (1991) Modernity and self-identity: self and society in the late modern age, Cambridge

Glaser, B. G., Strauss, A, L. (1967) The Discovery of Grounded Theory: Strategies for Qualitative Research, Chicago, Aldine Publishing Company.

Goffman, E. (1963) Behavior in Public Places, Notes on the Social Organization of Gatherings. 1966 edition, The Free Press, Simon & Schuster Inc. New York. USA

Greenberg, S. et al., (2014). Dark patterns in proxemic interactions. DIS '14 Proceedings of the 2014 conference on Designing interactive systems. New York, New York, USA: ACM Press, pp. 523–532.

Greenfield, A. (2012) "The City Is Here For You To Use: 100 easy pieces" https://speedbird.wordpress.com/2012/12/03/the-city-is-here-for-you-to-use-100-easy-pieces/ (accessed Sept 2015)

Grudin, J. (1990) The computer reaches out: the historical continuity of interface design. CHI '90 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Pages 261-268, ACM, New York, USA.

Guest, G. MacQueen, K.M. Namey E.E, (2012) Applied Thematic Analysis. SAGE Publications, Inc

Hall, E. T. (1966) The Hidden Dimension (2nd ed). USA. Anchor Books.

Hansen, M. Rubin, B. (2001-) The Listening Post http://www.earstudio.com/projects/listeningpost.html (retreived feb 2010)

Hassenzahl, M. (2001) The Effect of Perceived Hedonic Quality on Product Appealingness. International Journal Of Human–Computer Interaction, 13(4), 481–499 Lawrence Erlbaum Associates, Inc.

Hassenzahl, M. & Tractinsky, N. (2006) User experience – a research agenda, Behaviour & Information Technology, 25(2).

Helgason, I., Bradley, J., Egan, C. (2011, March). This Pervasive Day: Design and Development Case Study. Paper presented at i-Docs, A Symposium on Interactive Documentary, Watershed Media Centre / Bristol, UK.

Helgason, I., Bradley, J., Egan, C., Paechter, B., Hart, E. (2011). This Pervasive Day: Creative Interactive Methods for Encouraging Public Engagement with FET Research. In: Fet 11 essence. Elsevier.

Helgason, I., Smyth, M., Speed, C. (2012). Aspects of Lifelikeness: A Framework for Optional Interactions with Public Installations. Designing Interactive Systems DIS 2012, Newcastle, UK.

Heritage, in Giddens, Turner (1987) Social Theory Today, Stanford University Press. USA.

Hespanhol, L. & Tomitsch, M., 2015. Strategies for Intuitive Interaction in Public Urban Spaces. pp.1–16.

Höök, K. Dalsgaard, P. Reeves, S. Bardzell, J. Löwgren, J. Stolterman, E. Rogers, Y. 2015. Knowledge Production in Interaction Design. In Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '15). ACM, New York, NY, USA, 2429-2432. DOI=10.1145/2702613.2702653 http://doi.acm.org/10.1145/2702613.2702653

Hornecker, E . Buur, J. (2006): Getting a grip on tangible interaction: a framework on physical space and social interaction. In: Proceedings of ACM CHI 2006 Conference on Human Factors in Computing Systems 2006. pp. 437-446.

Hornecker, E. (2008, October). "I don't understand it either, but it is cool"-visitor interactions with a multi-touch table in a museum. In *Horizontal Interactive Human Computer Systems, 2008. TABLETOP 2008. 3rd IEEE International Workshop on* (pp. 113-120). IEEE.

Hornecker, E. Stifter, M. (2006) Learning from Interactive Museum Installations About Interaction Design for Public Settings, OzCHI'06, November 22-24, 2006, Sydney, Australia.

Jacucci, G. & Wagner, I. (2007) Performative Roles of Materiality for Collective Creativity. C&C 2007, USA

Ju, W., Lee, B.A., and Klemmer, S.R. Range: exploring implicit interaction through electronic whiteboard design. *Proc. of CSCW '08*, ACM, USA (2008), 17-26.

Kay, A. C. (1972) A Personal Computer for Children of All Ages. Proceedings of the ACM National Conference, Boston

Korsgaard. K. Brynskov, M. (2014) "City Bug Report: Urban prototyping as participatory process and practice." MAB14Proceedings of the 2nd Media Architecture Biennale Conference: World Cities 2014, Aarhus, Denmark.

Krueger, M. W. (1977) Responsive Environments. National Computer Conference.

Lavie, T. Tractinsky, N. (2004) Assessing dimensions of perceived visual aesthetics of web sites. Int. J. Human-Computer Studies 60 269–298

Leeuwen, T. Van, Jewitt C, (2001) Handbook of visual analysis, Sage Publications Ltd

Levin, G. (2009) Interviewed in catalogue for Decode: Digital Design Sensations, V&A, London UK.

Lindgaard, G., & Dudek, C. (2003). What is this evasive beast we call user satisfaction?. Interacting with computers, 15(3), 429-452.

Liu, Y. Goncalves, J. Ferreira,D, Xiao, B. , Hosio, S. , Kostakos, V. (2014) CHI 1994-2013: mapping two decades of intellectual progress through co-word analysis, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, April 26-May 01, 2014, Toronto, Ontario, Canada [doi>10.1145/2556288.2556969]

Löwgren, J. & Stolterman, E., (2004), Thoughtful interaction design : a design perspective on information technology, MIT.

Löwgren, J. & Stolterman, E., (2004), Thoughtful interaction design : a design perspective on information technology, MIT.

MacNN "Apple MacBook sleep indicator set to human breathing rhythm" http://www.macnn.com/articles/10/08/27/dell.misses.mark.times.lsd.to.strenuous.activity/ (downloaded July 2015)

Mantzavinos, C., (2016) Hermeneutics. In: *The Stanford Encyclopedia of Philosophy* Edward N. Zalta (ed.), forthcoming URL = <http://plato.stanford.edu/archives/fall2016/entries/hermeneutics/>.

Microsoft, Productivity Future Vision. Retrieved May 2015 from: https://www.microsoft.com/enterprise/productivityvision/default.aspx#fbid=d2pk7ao3U4s

Mignonneau, L. & Christa Sommerer, C. Designing Interfaces for Interactive Artworks. IEEE KES 2000 Knowledge Based Engineering Systems Conference. Proceedings (University of Brighton, UK, 2000), pp. 80-84.

Mignonneau, L. & Sommerer, C. (2000) pp. 80-84 Designing Interfaces for Interactive Artworks, IEEE KES 2000 Knowledge Based Engineering Systems Conference Proceedings, University of Brighton, UK.

Minority Report, 2002, Feature film. directed by Steven Spielberg. 20th Century Fox (North America). DreamWorks Pictures (International)

Moeller, C. (2004) Do Not Touch. http://www.christian-moeller.com/display.php?project_id=49 (retrieved feb 2010)

Moeller, C. 1992, Kinetic Light Sculpture, installation. http://www.christian-moeller.com/display.php?project_id=30 (downloaded July 2015)

Moggridge, B., (2007), Designing Interactions, MIT Press Cambridge, MA, USA.

Muller, L,. (2008) The Giver of Names: Documentary Collection, Audience interviews http://www.fondation-langlois.org/html/e/page.php?NumPage=2133

Nielsen, J. (2005) http://www.useit.com/papers/heuristic/heuristic_list.html (retrieved feb 2010)

Nielsen, J. 10 Usability Heuristics for User Interface Design. Nielsen Norman Group. Retrieved May 2015 from http://www.nngroup.com/articles/ten-usability-heuristics/

Norman, D. A. (2005). Emotional Design: Why We Love (or Hate) Everyday Things. Basic Books, 1 edn.

Office of Fair Trading, Principles for online and app based games https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/288360/oft1519.pdf (downloaded July 2015)

Overbeeke, K. Djajadiningrat, T. Hummels, C. Wensveen, S. Frens, J. (2003) Let's make things engaging, in Funology: From Usability to Enjoyment, 7-17 Mark A. Blythe, Kees Overbeeke, Andrew F. Monk, Peter C. Wright (eds) Kluwer Academic Publishers.

Paulos, E. (2007). HCI Cannot Be Used To Evaluate Art. Human Computer Interaction Institute. Carnegie Mellon University. http://repository.cmu.edu/hcii

Picard, R. W. (2003). Affective computing: challenges. Int. J. Hum.-Comput. Stud. 59(1-2):55,Äì64.

Picard, R. W. (1997). Affective Computing. MIT Press, Cambridge, MA, USA.

Ponelis, S. R. (2015). Using interpretive qualitative case studies for exploratory research in doctoral studies: A case of Information Systems research in small and medium enterprises. *International Journal of Doctoral Studies, 10*, 535-550.

Popper, F. (2007) From Technological to Virtual Art. MIT Press

Räsänen, M. Nyce, J. N. (2006) A New Role for Anthropology? – Rewriting "Context" and "Analysis" in HCI Research. NordiCHI, Changing Roles. Oslo, Norway. ACM New York, NY, USA.

Reeves, S. et al. (2005). 'Designing the spectator experience'. In CHI '05: Proceedings of the SIGCHI conference on Human factors in computing systems, pp. 741–750, New York, NY, USA. ACM.

Rodgers, P., & Smyth, M. (2010). Digital blur : creative practice at the boundaries of architecture, design and art. Faringdon: Libri Pub. UK.

Rogers, E. M. (2000) The Extensions of Men: The Correspondence of Marshall McLuhan and Edward T. Hall, Mass Communication and Society, 3:1, 117-135, DOI: 10.1207/S15327825MCS0301_06

Rokeby, D. (1991 -) The Giver of Names http://www.fondation-langlois.org/html/e/page.php?NumPage=2121 (retrieved feb 2010)

Schniederman, B. (2016) The New ABCs of Research: Achieving Breakthrough Collaborations. Oxford University Press. ISBN 9780198758839

Schön, D. A. (1992) Designing as reflective conversation with the materials of a design situation. Research and Engineering Design. Vol 3, Issue 3, Springer- Verlag, USA.

Schutz. A. (2011) Parsons' Theory of Social Action. In: Collected Papers V. Phenomenology and the Social Sciences. Ed. Embree, L. Springer, Dordrecht, Heidelberg, London, New York. DOI 10.1007/978-94-007-1515-8

Sengers, P. and Csikszentmihályi, C. (2003). HCI and the arts: a conflicted convergence?. In CHI '03 Extended Abstracts on Human Factors in Computing Systems (CHI EA '03). ACM, New York, NY, USA, 876-877. DOI=10.1145/765891.766044 http://doi.acm.org/10.1145/765891.766044

Shedroff, N. (2001) Experience Design, New Riders; 1 edition (18 April 2001)

Smyth, M. & Helgason, I. (2013). Tangible Possibilities - Envisioning Interactions in Public Space. Digital Creativity, 24, 1, 75-8 Taylor & Francis

Stolterman, E. & Wiberg, M., (2010). Concept-Driven Interaction Design Research. HUMAN-COMPUTER INTERACTION, 25(2), pp.95–118.

Stryk, L. (1994) Modern Japanese haiku. The Free Library (July, 1), http://www.thefreelibrary.com/Modern Japanese haiku.-a015575514 (accessed October 25 2015)

Suchman, L (2007) Human-Machine Reconfigurations, plans and situated actions, 2nd edition

Suchman, L. (1987) Plans and situated actions: the problem of human-machine communication. Cambridge University Press New York, NY, USA ISBN:0-521-33137-4

Vom Lehn, D. Hindmarsh, J. Heath, C. Luff, P. (2007). Engaging constable. In Proceedings of the SIGCHI conference on Human factors in computing systems. San Jose, California: ACM New York, NY, USA.

Weinrich, R. (editor) (2004) Jack Kerouac, Book of Haikus. Enitharmon Press

Wood, D., Bruner, J., & Ross, G. (1976). The role of tutoring in problem solving. Journal of Child Psychology and Psychiatry and Allied Disciplines, 17, 89–100

Appendices:

1. Design patterns handout as presented at workshops.

Publications associated with this thesis

2. Smyth, M., Helgason, I. (2013). Tangible possibilities—envisioning interactions in public space. Digital Creativity, 24(1), 75-87. DOI:10.1080/14626268.2013.769454

3. Helgason, I. (2012). Beat Haiku: Interactive Poetry Application. In: NordiCHI'12 Making sense through design. ACM 978-1-4503-1482-4/12/10: ACM Digital Library

4. Helgason, I., Smyth, M., Speed, C. (2012). Aspects of Lifelikeness: A Framework for Optional Interactions with Public Installations. Designing Interactive Systems DIS 2012, Newcastle, UK.

5. Helgason, I., Bradley, J., Egan, C., Paechter, B., Hart, E. (2011). This Pervasive Day: Creative Interactive Methods for Encouraging Public Engagement with FET Research In: Fet 11 essence. Elsevier.

6. Helgason, I. (2010). Interaction design: learning from new-media art. Paper presented at Irish Human Computer Interaction (HCI) Conference, Dublin.

Design Patterns

Name: First Attraction

Problem: Attracting attention in a public place can be difficult due to the many other things to see and hear in a busy environment.

Solution: People tend to be drawn to things that seem to be alive or living, especially if they move in a lifelike way, even if their form is quite abstract.

Example: An abstract representation of a fly is held captive inside a glass box, centrally ensnared by eight cables. The behaviour of this 'fly' is controlled by a unique and autonomous algorithm, accurately simultating the observed behaviour of real flies.When the 'fly' senses the presence of a person at its perimeter, it changes the demeanour of its flight in response. (*Fly*, 2011 Random International)
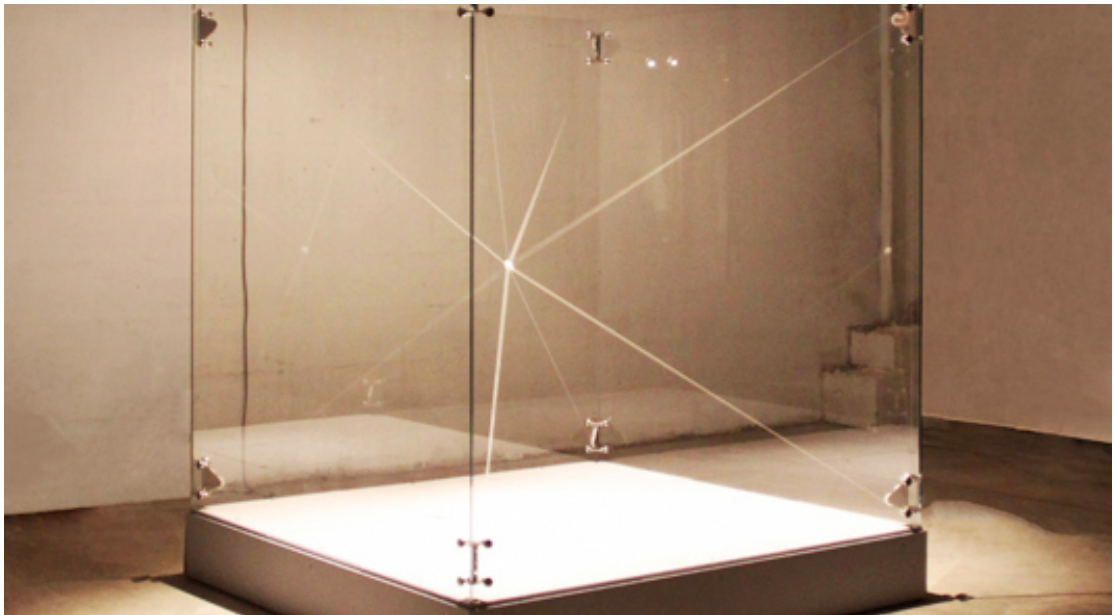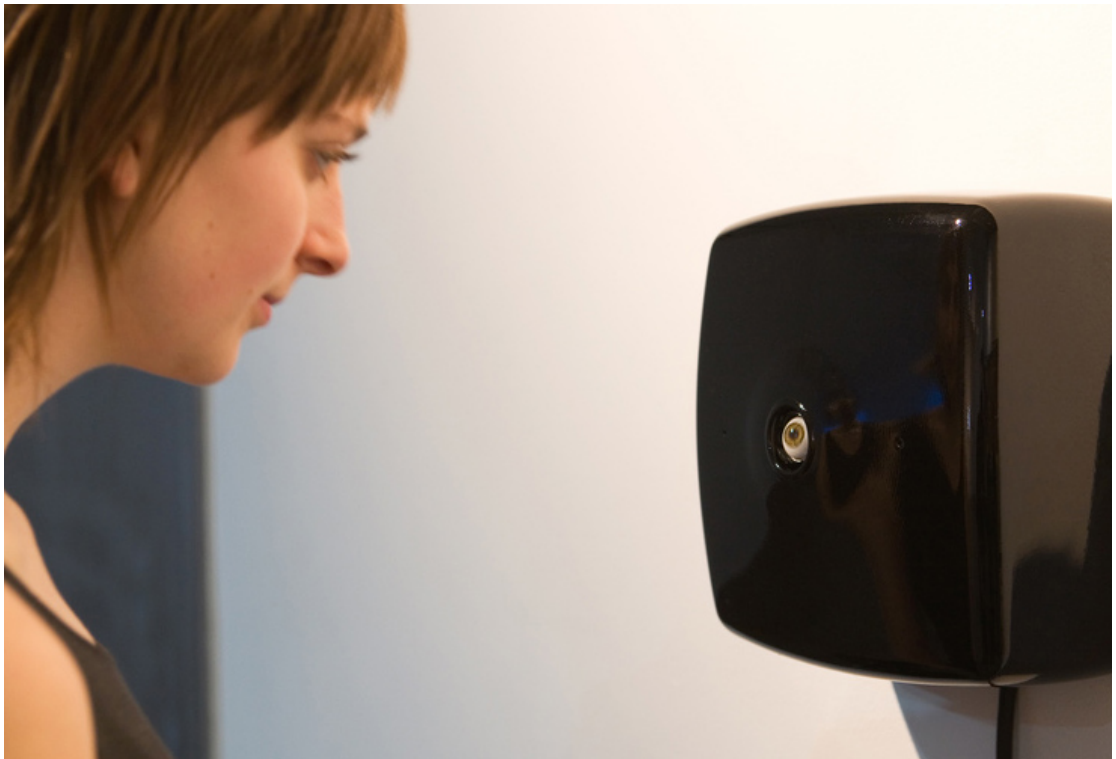
Name: Inviting interaction

Problem: Initiating interaction between a user and a system can be difficult when it is not clear that interaction is possible. This is particularly difficult in a busy public space with lots going on.

Solution: People tend to engage with systems that exhibit behaviours that are similar to social interactions between humans.

Example: *Opto-Isolator* presents a solitary mechatronic blinking eye, at human scale, which responds to the gaze of visitors with a variety of psychosocial eye-contact behaviors that are at once familiar and unnerving. *Opto-Isolator* looks its viewer directly in the eye; appears to intently study its viewer's face; looks away coyly if it is stared at for too long; and blinks precisely one second after its visitor blinks. (*Opto-Isolator* 2007: Golan Levin with Greg Baltus)

Name: Exhibiting Intelligence

Problem: How to keep users interested and engaged with an interactive installation after the novelty or surprise has worn off.

Solution: A system that mimics human intelligence and thought can sustain interest in a similar way to a social conversation.

Example: The installation includes an empty pedestal, a video camera, a computer system and a small video projection. The camera observes the top of the pedestal. The installation space is full of objects of many sorts. When an object is placed on the pedestal, the computer grabs an image and tries to analyse what the objects are. These images are matched to a database of phrases. From the words and ideas that resonate most with the perceptions of the object, a phrase or sentence in correct English is constructed and then spoken aloud by the computer. The phrase is, of course, not a literal description of the object, but everything that the computer says in some way reflects its experience of the objects.
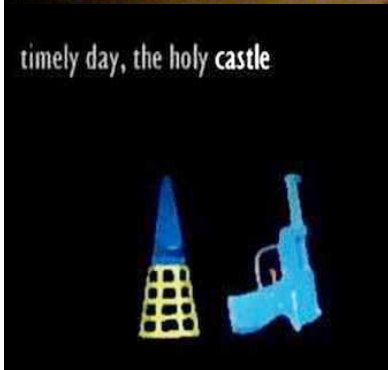
Name: Joining the Group

Problem: Developing an interactive experience that makes the user feel drawn in to an engaging activity.

Solution: People tend to be interested in the social interactions of others, and like to feel like they are part of a social group.

Example: Once visitors enter the perimeter of 'Audience', the mass of mirrors pause their activities and select an individual they find interesting. They turn to face them in an inquisitive, synchronised movement. The chosen member of the audience sees their reflection in every mirror; the subject of the installation and their own gaze. Other viewers may find themselves performing to capture the attention of 'Audience', reversing the roles of viewer and viewed. (Audience, 2008 Random International with Chris O'Shea)