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Exploring the role of lived time and co-presence in culturally consumptive mixed reality environments

STEPHEN HIBBERT

A thesis submitted to the University of Huddersfield in

partial fulfilment of the requirements for the degree of

Doctor of Philosophy

The University of Huddersfield

Submission Date: May 2021

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Abstract

This thesis considers the role of mixed reality in the culturally consumptive context of a contemporary outdoor sculpture park. It grounds the discussion of an augmented mode of experience by utilising a philosophical framework, derived from Henri Bergson and Francisco Varela, which distinguishes between two different senses of virtuality. The first of these is focussed on technology, whilst the second addresses issues of temporality and the specious present. These senses of virtuality are then applied to the development of a mediated mode of ocular and auditory experience, in an attempt to construct a syncretic experiential archive of subjective artistic encounters, that take place in the context of the park. Consideration of a syncretic mixed reality setting facilitates a need for a mode of design which can accommodate issues of embodiment alongside our sense of lived time. In this sense the thesis pushes against the abstracted and reduced forms of time and space that typically result from their technological representation or mediation. Precedents for understanding this mode of embodied temporal experience are seen in the works of Keiichi Matsuda, Janet Cardiff and George Bures Miller, Paul Trillo, and Tacita Dean. Underlying this technologically virtual structure is a more encompassing sense of temporality that likewise conditions our more subjective and ever-evolving durational experience. The thesis claims that our subjective sense of time is itself subject to variance via a myriad of factors affecting perception and cognition. This complex scenario is investigated via a practice-research mode of enquiry and incorporated into the simulated and speculative design outcomes that together constitute the thesis's more practical dimension. The thesis's speculative design artefacts are intended to provide a less authoritarian form of cultural commentary and contextualisation and are developed by a mode of selection and actualisation that is facilitated by Dunne and Raby's adoption of Hancock and Bezold's 'cone of futures'. As a part of its enquiry, the thesis develops a novel methodology that combines a cybernetic enquiry system with more speculative cycles of making. This methodology is intended to be positioned as one of the study's outcomes, and to be applicable in a wider context.

The methodological cycles in question look to overcome the various obstacles that present themselves within the study's technically challenging scenario. This is achieved through the development and adoption of a novel search strategy which is informed by a mode of abductive reasoning. By utilising the process of abduction, a series of artefacts are produced which gradually inculcate the notion that modes of technological virtuality can affect our sense of temporal virtuality in so far as the mediation of embodied experience, via modes of augmentation, can influence, interrupt, and affect our subjective experience of lived time.

Ultimately, it is intended that the study's methodology and its focus on speculatively designed outcomes, might be applied more broadly in the context of artistic research, as well as providing a layered system of enquiry that could be usefully adopted in the context of design for both the cultural and heritage industries.

The practice outcomes in themselves could serve both as artwork and as prototypical navigation tool. In the first instance these artefacts can be seen as filmic visualisations of a mixed reality experience that serves to challenge modes of perception, habitation, and immediate presence. In this sense they depict an aesthetic experience which could be realised through the commissioning of a full-scale interactive artwork. However, given the context of the culture industries, and environments of cultural consumption (e.g. sculpture parks, museums, heritage environments) such outcomes might have functional as well as artistic agendas, and with this in mind the works could also be viewed as prototypes for a potentially new mode of navigation, resonant with a set of artistic and cultural concerns, that is enabled by the properties of mixed reality in altering and adjusting an inhabitants visit to a sculpture park.

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Dedication

I dedicate this thesis to my wife Rachael, for having the selflessness and patience to let me write this text in relative peace, in amongst everything else she tirelessly does for our family, I am truly grateful.

Acknowledgements

The process of developing this work has meant a series of people have been involved at different points in its evolution, but none more so than my supervisor Dr. Spencer Roberts. Dr. Roberts has been a constant source of support and insight, allowing my rambling thoughts on the nature of a mixed reality to coalesce into something it would never have been otherwise. From my initial musings on what an augmented future might look like, Spencer opened the door to a series of authors writing on the subject of virtuality that explored so many avenues of thought, and in so doing enriched the entire meaning of the work you see here. Thank you Spencer!

Around eight years ago I came to this institution looking for a new challenge, and found it thanks to my co-supervisor, Dr. Anneke Pettican. In the intervening years I have learnt so much, but in particular have always valued the way in which Dr. Pettican is able to visualise a thought or making process, mapping out seemingly complex elements using simply a pen and a sheet of paper. Anneke, I thank you for both your help in mapping out this work, and everything else you have done in supporting me over the years.

To my course team in the Department of Art and Communication, we have all shared this journey in some shape or form over these last few years, and despite all the challenges that come with this line of work, your support has given me both the time and resolve to get this work to where it is, thank you all.

Exploring the role of lived time and co-presence in culturally consumptive mixed reality environments

This thesis seeks to explore the effects of mixed reality (MR) on the inhabitant[1] and investigate some ways in which design might be used to both illustrate and expand the potentials of lived-time in the context of communities who collectively inhabit a series of differential realities.

It uses a practice-research approach that incorporates a form of layered and iterative film making to present aspects of a world that are perceived through a speculatively designed mixed reality. Processes of layering and iteration are evident both in the cycle of production, and in the artefacts themselves. These layers are applied firstly in the technologies that enable such a world to exist and secondly in aspects of their presentation – ocular, auditory, participatory, durational - that might offer parameters for experiential adjustment. The emerging works are framed within the first-person point of view of the inhabitant - existing within a synchronous space shared by both the physical real environment and a digital space that serves as a counterpart.

In order for this practice-research to emerge, theoretical insights and approaches were developed in tandem with the production of speculative artefacts. These insights included facets of design-research, the uncovering of precedent example works, and film-based experimentation with the role of lived time. Each were corralled to respond to the challenges presented (technological challenges, design challenges, and perhaps most importantly the challenge of integration of the durational experience of the inhabitant or

[1] Considering a definition of the term inhabitant as opposed to 'the user' which is often a phrase that is traditionally used generically in the context of Human Computer Interaction HCI and/or User Experience Design (UXD) research. One of the implications of the thesis asks that this term inhabitant is necessarily understood in its expanded, plural form of experience, unique to the individual. This is to say that each inhabitant experiences with phenomenological variation.

user into the system). This abductively[2] led cycle of enquiry is further examined in Chapter 3, and should be considered, alongside the practice-based work, as one of the main outcomes of the thesis.

Personal positioning statement

Given the centrality of lived experience to the thesis, it seems important to offer a more personal and subjective account of how the study arose, before switching to the third person voice that is more readily associated with academic writing and conventions.

The impetus for this research was my need to determine and populate some of the distinctions that arose, pre-doctorial study, in earlier phases of investigation - in particular, the initial investigation of virtual and augmented reality that informed the production of the short film *Another Reality* (Figure 1)(Hibbert, 2014). This film formed the culmination of a years long interest in emerging technologies and their application. I have always had a fascination with the way in which computers are in some way able to both enable, augment, and disrupt personal experience, even when these experiences are rudimentary in their presentation. In 2014 I discovered the work of Mark Weiser. Weiser famously proclaimed a possible future in his paper "A computer for the 21st century" in which he discusses a world filled with connected devices able to 'weave themselves into the fabric of everyday life until they are indistinguishable from it' what he termed the dawn of ubiquitous computing (Weiser, 1991). This paper proved pivotal to a change in how I perceived technologies, not because of what it necessarily said, but more in the way that a speculatively designed future was being imagined beyond the capabilities of the technology existing at that time whilst still remaining probable in terms of its integration into a mundane environment. Whilst this world is now filled with

[2] Abductive reasoning is commonly defined as a notion of inference in the face of anomaly, first put forward by Charles Sanders Pierce. This is in contrast to strategies of inductive and deductive reasoning. The use of this taxonomy is covered more extensively in Chapter 3 (P.87).

ubiquitous connected devices, particularly with respect to the integration of social connection and embodied experience, how far might this concept of woven interconnection extend in the future? The emergence of early forms of mixed reality appeared to offer some kind of potential answer but was only being partially explored. Whilst the objective qualities of this technology appeared relatively clear in terms of representation (at least in certain use cases), the interrogation of subjective experience in the application of mixed reality seemed limited, presenting many more challenges, and perhaps opportunities for creative exploration and discovery.

The creative exploration of lived time

Lived time, to use the words of Henri Bergson (1911, 1984), involves a recognition of the difference between how we experience time, and its mechanised and spatialised representation (perhaps best illustrated by the notion of 'cinematic time' and the equidistant cells on a film strip). Bergson's philosophy, regarded by some as vitalist, anti-mechanistic, and proto-phenomenological was at the height of its popularity in the early twentieth century. Bergson was awarded the Nobel prize for literature in 1927 for his work *Creative Evolution*. Having fallen out of favour in philosophical circles due to the metaphysical leanings of his writings, interest in Bergson was revived in the late twentieth century by the favourable engagement with his work that was conducted by Gilles Deleuze. Bergson's primary concern was with the temporal dimension of both experience and materiality, and a resistance to overly analytic, formalistic modes of enquiry, along with overly deterministic approaches to experience and the material world.

According to Bergson, if we consider this more subjective dimension of lived time, or the way in which the individual actually experiences temporality, we then have to recognise the phenomenological effect and psychological variability of its perception, as well as the resultant differential durational qualities of the realities being experienced (Bergson, 1913, 2001). It might be thought that by its very nature a space that is inhabited as a mixed reality must in some way involve this variability of perception.

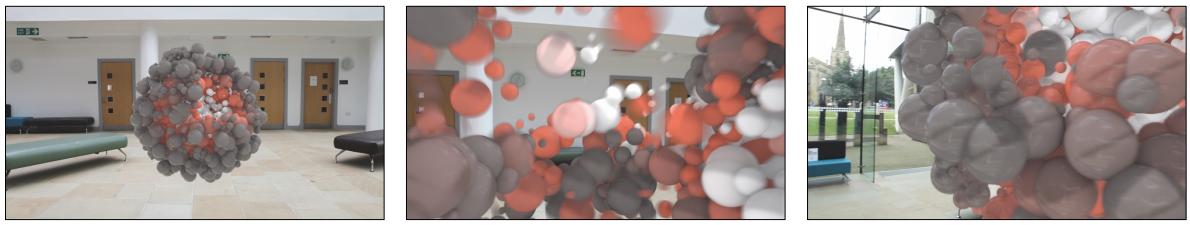
However, this thesis begins with the observation that questions of temporality are for the most part neglected in the production of augmented and virtual environments, having been occluded by more dominant concerns with space.

This raises questions across many different disciplinary fields, but the emphasis here is on revealing how a variety of manifestations of the world – or a multiplicity of durations - might intertwine and problematise both our perception and understanding of space. The problem can be contextualised through consideration of different senses of the term 'virtuality' as it operates in technological, psychological and philosophical contexts. As a professor of digital rhetoric and media study Alex Reid is interested in capacities for persuasive communication arising through the inter-relationship between the human, non-human, and environment. Addressing these different registers of virtuality in his book *The Two Virtuals*, Reid has distinguished the 'virtual-technological' – which is typically employed in the discussion of networked, computational media; and the 'virtual-actual' – which appertains to the more phenomenological and philosophical realm of thought (Reid, 2007). Reid uses these distinctions to address the interrelated nature of temporality, the way it appears to us, and our embodiment within it. As we shall see, the separation and conjoining of the human and non-human is central to the discussion that is developed through this thesis' intertwining contexts of study.

Initial conceptions of mixed reality

The ability to interact and influence an experience of some kind, even if the conditions for that experience have been predetermined in some way, influences our understanding of the world surrounding and within us. This ability to mentally project ourselves within an 'alternate reality' exists of course across various media from books, to cinema, to videogames. A mixed reality appeared on paper to be one day the ultimate manifestation of projection, between the natural and man-made realms, but this aspect, of exploring embodied experience augmented by immersive technology is still rather underexplored.

Figure 1.
Another Reality (2014). Dir. S. Hibbert.



Note. Frames from the film show a first-person view of the inhabitant walking through the digitally generated spherical sculpture. When in close proximity the sculpture is displaced.

My earlier work *Another Reality* was an attempt to present a pathway into this exploration as each scene progressively moves from representation to the immersive conclusion that removes the real. The conclusions from this initial work raised a number of potential avenues for exploration, particularly with respect to addressing competing conceptions of virtuality arising out of a diverse array of fields, and a need to consider socio-temporal aspects of virtual and augmented realities. Ultimately, this led to the aims with respect to this thesis which are to address the way in which a practice-based form of design research might encompass a deeper understanding of a series of intertwined computational, philosophical and design-oriented contexts of study. In practice this manifestly emerges as a method of production that can be applied both in the context that is applicable to a cultural industries process of investigation into immersive experiences, and a visitor/audience focussed series of works which introduce notions of the distortion to perception that are potentially enabled by such technologies. The purpose being to understand how these creations - informed by technological, designerly, and philosophical approaches to reality - might illuminate different aspects of both real and digital spaces.

Process of investigation

With this in mind the thesis introduces a small series of example works that might be explored through these intertwining contexts of study. As stand-alone artefacts, these experiments deliver experiences to the inhabitant/viewer that intend to challenge or expand conceptions of embodiment and objective representation, by confronting them with a richer, pluralistic and more subjective sense of temporality. In understanding

them through the theoretical framework of this thesis, they serve as applications, and are intended to illustrate how an expanded theoretical consideration of mixed reality, might productively generate and deliver a richer temporal experience to an audience.

A design research methodology is proposed that makes use aspects of Speculative Design (Dunne & Raby, 2013; B. Gaver et al., 1999) whilst synthesising them with the design thinking of Kees Dorst (2011) and design cybernetics theory of Wolfgang Jonas (2014), as a means of developing designed artefacts which might interweave processes and awareness of lived time with the digital modelling of an environment, resulting in a pluralistic representation of an inhabited mixed reality.

In concrete terms, the thesis discusses the practical dimension of work that explores the possibilities for the navigation of richly temporal, mixed reality environments, whilst creating a collective archive of subjective experience in the form of audio and video recordings of encounters with works, from a series of visitors to a contemporary sculpture park. Within this explorative practice the project looks to progressively incorporate strategies of speculative design, actuated by cyclical processes of abductive 'framing' as the foundation of its methodological approach (Paton & Dorst, 2011). This allows for an evolving process of artefact production that serves to inform the problem context.

Here, this is evidenced by practical work attempting to synthesise the 3D capture and filming of an environment with the open-ended incorporation of recorded spoken testimony captured from visitors to the site, by compositing these materials together. It was intended that the inclusion of a plurality of first-person voices would multiply possibilities for subjective temporal disruption within the digital plane. The emphasis within the practical work was not purely upon the metrification and veridical representation of a space, but rather was concerned with stressing the subjective dimensions of virtual, and mixed reality encounters. In incorporating recorded responses to artworks situated at an outdoor gallery space the practical work sought also to supplement absences in the scanned data. As a part of its abductive strategy, the

project presented the sculptural works themselves as partially formed voids or absences in the digital model of the landscape, and such absences were accompanied, or 'fleshed out' through the use of disembodied audio descriptions of audience member's first-person experiences of the spaces around those physically occupied by the sculptural works. The thesis begins from the premise that artworks embody multiple interpretations and generate diverse responses, and cannot be straightforwardly closed down, captured, or reduced to a single point of meaning. The absences generated by this system therefore enable a capture and layering of a plurality of subjective, vocal projections, which influence and perturbate the viewers 'in the moment' perception of the void. Partly this is intended to have a pedagogical function in the context of the sculpture park, and partly it is intended to provide a concrete means of addressing the issues of plurality of experience that a mixed reality provides.

Dissemination of aspects of this work began with a paper published in JCSG Proceedings 2015 (Hibbert, 2015). The outcomes of this more technical investigation led to the construction of a research poster "Adopting a research 'AS' design methodology for speculative mixed-reality environments" (Hibbert, 2016). This explored some initial findings in the potentially productive combination of two design research approaches. In essence this poster attempted to combine:

1. a specific cybernetic process of design research termed 'research AS design'(Jonas, 2014) [sic]
2. a Speculative Design approach to making, as popularised by Anthony Dunne and Fiona Raby (2013)

It ultimately suggested that the 'research as design' approach was in some sense lacking and it was necessary to develop a methodology that incorporated a stronger temporal emphasis that was provided by the 'cone of futures' discussed by Dunne and Raby.

The paper *Towards an adaptive practice-based methodology for speculative design frameworks* (Hibbert, 2017) then expanded and developed this proposed methodology. Following this the conference paper *The Image is a Moment – the art of the visual*

encounter (Hibbert & Powell, 2018) explored issues of temporality in relation to the experience of artefacts and notion of art as a temporal technology. This latter paper was delivered as part of the TransImage 2018 Conference at the University of Edinburgh.

With guidance from the findings of both the artefacts and its published elements, the thesis ultimately determines a generic methodological approach that might be used in the context of practice-oriented research projects. It concludes that temporally enriched approaches to virtual and/or augmented environments challenge more functional and conventional approaches to technologically augmented experience, but nevertheless have particular value in the context the arts and cultural industries.

Synopsis

In the process of creating new propositions for complex, ill-defined or open-ended problems, a Mixed Reality (MR) perceptual apparatus brings with it numerous challenges that are both conceptual and technical in character.

If we consider the term virtual in the context of a MR scenario, a virtual-technological reality has, following Reid (2007) been described as "an overlay of synthetic (digital) content on the real world that is anchored to and interacts with the real world" (The Foundry, 2015). This is in stark contrast to the virtual-actual conception of reality, which has primarily philosophical routes and considers our embodied, phenomenological perception of the world, whilst stressing its openness and potentiality. Indeed, for theorists such as Massumi (2002), who embrace this perspective, "nothing is more destructive for the thinking and imaging of the virtual than equating it with the digital (technologies)".

Despite their seeming opposition, the *overlap* between these two conceptions of virtuality provides the core for a definition of a mixed reality, with the mutual co-location and interaction between that of the physical, phenomenal, and the digital, idealistically seeking to merge into one shared space. Commonly this is often depicted to be a space unique to each individual, with the resultant virtualised space utilising some form of

wearable technology device that has the capacity to interfere with a participant's own individual sensorium and their individual perception of the real (Ohta & Tamura, 1999). Importantly, from the perspective of this study, technological conceptions of the virtual often give rise to highly metricised spaces that are intended to have an 'objective' character, but it is this notion of universal measurement, with respect to both time and space, that is typically contested by philosophical and phenomenological accounts of virtuality (following Bergson, 1911). At its core is the opposition between representation (accurate modelling of space/place – the reproduction of the same/identity) and differentiation enabled by time's ability to endlessly produce the new/novelty. This is manifested in the production of new forms, and affects, and in the variability of memory and our emotional lives.

Given this opposition, when considering the production of MR experiences, it is argued here that, within certain parameters, the designer has a quasi-surgical relationship to the wearer (also referred to here as inhabitant of a mixed reality) and to the wearer's experience, and that as such, the technology has the potential to deliver highly personal/subjective/customised phenomenal perceptions. Whilst philosophical perspectives on temporality often emphasise the potential of subjectivity as an escape from measure, this thesis asks if the pluralistic modes of temporal-subjectivity might in some sense be actively incorporated into augmented reality (AR) and MR environments.

Accordingly, it is claimed here that MR scenarios offer great, as yet unexplored, potential for the exploration of differential modes of being, or modes of being within a human frame that possesses idiosyncratic spatio-temporal characteristics.

Aim/Hypothesis

A vivid conceptual imagining of virtuality has existed in the arts and narrative fiction for many years. We see literary examples stemming from Wizard of Oz' author L. Frank Baum's illustrated novel *The Master Key* (1901) to *Snow Crash* (Stephenson, 1992); to various more contemporary examples such as the *Black Mirror* anthology series

(Brooker, 2016) and the Marvel 'Cinematic Universe' series of films[3] (Framestore, 2019; Russo & Russo, 2016).

In many instances the fabulatory worlds that science fiction presents to its audiences are based around the generation of stories via new potentials for thinking and making that can be found in the real world. These works in turn influence and offer a way of experimenting with ideas around temporality as well as techno-philosophical ways of thinking[4].

In recent times there have been a number of important technological innovations that might allow *representational* forms of mixed reality to exist that have the potential to seamlessly integrate into a domestic setting[5]. In recent years mobile computer vision processing, the integration and miniaturisation of motion sensors, the increasing pixel density of screens, and the increasing capability of mobile cameras have all enabled a growing sense of technical realisation for MR devices capable of continual human immersion. This has become possible as both augmented and virtual reality technology has continued to evolve into untethered wearable devices, and all whilst becoming more capable of ingesting/sampling and synthesising real-time sensor-based data taken from the environment around them (Microsoft, 2015, 2019c). As a result, there is a strong consensus between technologists, psychologists, philosophers, designers and anthropologists that mutually co-located interaction environments are becoming technically feasible (Bimber & Ramesh, 2005; Case, 2015; Costanza et al., 2009; Ishii, 2008; Reid, 2007; Sandor & Klinker, 2009; Sena, 2016). As the use of this technology continues to infiltrate into our physical environments and our sensorial apparatus, designers find themselves at the forefront of exploring, and proposing how society might integrate and implement such technologies (Case, 2012; Disrupt & Jak Wilmot, 2019;

[3] Indeed, with regard to mixed reality we aren't limited to these observations, as briefly discussed in Appendix

[4] James Burton examines this connection in extensive detail in his book *The Philosophy of Science Fiction. Henry Bergson and the Fabulations of Philip K. Dick* (Burton, 2015)

[5] Matsuda explores some of this aspect of a domestic MR in his speculatively designed work *Hyper Reality*.

Fleischmann & Strauss, 2001; Weiser, 1999b). Typically, designers have approached this issue by examining or demonstrating the capabilities of a specific device with a specific task in mind, leading to a visually impressive but relatively narrow set of application scenarios. For example, if we briefly consider the promotional work for Microsoft HoloLens mixed reality device, we can see that whilst the initial demonstrations of this technology attempted to reveal a diverse range of consumer and professional level applications (Microsoft, 2015), its manifest application scenarios and the resulting realignment of its promotional material have meant that HoloLens uses have reverted to a distinctly industrial focus (Dieter Bohn, 2019; Greicius, 2016; Lanman & Luebke, 2013; Studio 216, 2017).

The question arises, however, whether the applications for such technologies should remain purely computational, industrial, and representational in character - as seen in work evidenced by NASA JPL, Volvo (Figure 2), and Boeing (Dieter Bohn, 2019; Greicius, 2016; Varjo, 2019b) - or if there might also be fictional/ speculative/ fabulatory/ therapeutic[6] roles for mixed reality technologies. Accordingly, the practical dimension of this study refers to and applies aspects of a number of recent technological innovations which have been focused predominantly upon an increasingly refined and better metrification and synchronisation of spaces (see Chapter 4).

[6] Whilst a therapeutic role for Mixed Reality falls outside of the scope of this thesis, it is interesting to note this seeming 'middle-ground' between the purely representational and the opposing non-representational examples explored here. Examples that connect to this area of study can be found more in the realm of VR, specifically termed VRET (Virtual Reality Exposure Therapy) for example in modes of desensitisation used to treat certain phobias (Botella et al., 2017; Maples-Keller et al., 2017; Miloff et al., 2016).

Figure 2.
Varjo XR Head Mounted Display footage (2019)



1. Real view of cockpit and road

2. Realtime depth mapping of cockpit allows digital overlay to be created

3. A digitally rendered cockpit is displayed in real-time alongside a real view of road ahead.

Note. Varjo Promotional images that demonstrate the process of integrating real-world viewpoints with real-time generated computer graphics. This industry focussed application is at time of writing the most widely seen scenario for mixed reality use cases.
Retrieved July 2, 2019, from https://varjo.com/xr-1/

However, it also attempts to facilitate the disruption of such spatial metrification through the utilisation of a number of direct and accessible technological strategies, which involve the creative use of spoken audio and the incorporation of, equally surgical, voids and absences into scanned and captured landscapes. The purpose of this disruption is to facilitate the continually evolving experience of the inhabitants within a mixed reality, and also to foreground the diversity inherent in subjective experience. This in some sense pushes against centralised, hegemonic design centric notions such as the user - as a universal category - a notion which itself arises out of the Kantian conception of the universal human subject.

Given its pluralistic focus, this thesis requires an alternative multi-disciplinary approach that explores the issue through various specialisms. It is suggested here that such a strategy might be usefully employed by contemporary designers attempting to engage with a richer repertoire of experiential factors appertaining to immersive, digitally mediated perception.

Whilst this need for plurality might seem initially quite specific to the experience provided by a mixed reality, this in fact is encountered in many designed spaces. If we

briefly consider this in the context of architecture, "architecture … suggests possibilities, channelling communication, and providing impressions of acceptable activities, networks, norms and values" (Ankerl, 2013). Spaces may be designed for a particular embodied function, but also serve as a symbolic point of representation. A sports stadium for example is designed to enable both the functional needs of the individual/team/crowd to experience competition, whilst in its symbolic interaction it also exists as a representation of status, self-expression, and connection to a team or sport. Architects, cognizant of this plurality must explore and determine suitable strategies within which they might suitably realise both the functional and symbolic means of interpretative experience (R. W. Smith & Bugni, 2011). Further to this, Sanford Kwinter (2003) proposes that the classical modernist view of the subject of Architecture should be (re)considered to have the potential to deliver an emergent, potentialistic, and open space. If we consider this in the context of a manifest mixed reality discussed in this thesis, the potential to re-orient a constructed space becomes even more potent.

To facilitate this re-orientation the methodology enables us to ask questions of mixed reality and then develop practice-based artefacts of investigation. This process raises several practical-theoretical points which also serve as catalysts for the research questions of the thesis itself, namely:

i. How might we explore the creative potential of absence in a Mixed Reality environment? (see: Chapter 3: Tracking movement through the space, P.154)
ii. Can virtual-technological platforms express a richer philosophical sense of virtuality? (see Chapter 4: The different levels of spoken audio – from the perspective of curator, maker, visitor. P.164); and Chapter 5: Future exploration and analysis, P. 178)
iii. How might the spoken word be used to incorporate a richer sense of lived time into computer mediated virtual environments? (see 'Practice Phase Four: The Layering of Spoken Audio', P.161)

The hybrid methodology the author proposes provides the designer with a suitably adaptive approach, which can incorporate the intertwining contexts of investigation, and in this instance the production of a temporally sensitive mixed reality scenario.

As we will see in Chapter 1, whilst computational media can be viewed as gradually becoming more socially enabled over recent years, the emergence of virtual reality (VR) in the 1980's and 90's was concerned more with expanding private experience. Crucially then, the plural approach investigated here involves exploring and analysing not only the technical details of how MR environments will work, but also visioning how future MR spaces might be manifestly designed to be inhabited, or perhaps more importantly, *co-habited* continuously in time.

Research Novelty

Whilst the research conducted here acknowledges the significant and necessary application of engineering work undertaken to create capable MR apparatus, the focus here is not on designing a current or future technically superior device. Rather, in contemplating the constraints of designing for the human who inhabits a mixed reality, a designer must *compensate* for the shared virtual-technological and virtual-actual space (Hansen, 2006; Reid, 2007)**.** Understanding how to design for this shared space is inherently complex and relatively under-researched. This study considers how the varying disciplinary contexts of artistic research, technological interfacing, and portable application might be synthesised in the development of a number of experimental visualisations. To this end, it explores a variety of technical and theoretical territories, whilst analysing a number of practice-based works and precedents with specific reference to aspects of perceived 'lived time'. These materials are combined with methods derived from the domain of speculative design, to enable the exploration of a complex scenario, namely the experience that MR enables for a person visiting a contemporary sculpture park.

Lived time is a particularly important aspect to consider in the context of virtuality, as typically the language of technology that employs these terms has a tendency to emphasise, or dwell almost exclusively upon the spatial parameters of enquiry, and to be focused on 'objective' discovery (Flavián et al., 2019; S. Mann, 2002; Milgram & Kishino, 1994). The incorporation of lived time into virtual environments fosters a mode of

empathy that encourages an appreciation of different subjective perspectives, and the temporal variability of any experienced moment (Bourriaud, 1998; Gere, 2006; Hibbert & Powell, 2018). Therefore, whilst there are various examples, from the literature arising out of the fields of ecology (Griffiths, 2000), philosophy and architecture (Kwinter, 2003), and physics (Rovelli, 2018) that look to explore this aspect, its investigation in a practice-based design scenario is rather more limited. This neglect of lived time is particularly evident in the fields of Human Computer Interaction (HCI) and Experience Design (UXD) where there is a preference toward measurable outcome. However, there are exceptions such as the work of Daniel Buzzo (2017). Buzzo's thesis collects together a portfolio of published works that explore changing perceptions and representations of time enabled by forms of technology. Some of the earlier published works such as *Lost Time Never* (Buzzo, 2017, p. 32) explore lived time within the context of pervasive media, acknowledging the loss of human experience. Buzzo ends this summary of the paper with an appeal to "bring back time into media and acknowledge the lived experience of time" otherwise he warns that "we are at risk of becoming spectators of the remediated versions of our own lives".

Within this thesis the research novelty is found through the intertwining contexts of study, aligned with the approach towards mixed reality as a technology of seeing that enables a new way of thinking about both the design and influence of mixed-reality mediated environments. This is achieved through the generation and positioning of artefacts within the setting of the arts, cultural heritage and the cultural industries, which combines an interest in the aesthetic and the temporal with a set of educational and commercial concerns. Typically, artefacts encountered in these contexts have multiple roles, manifesting as part artwork, part navigation tool, part education project. They also frequently require some dependence upon on audience, for example design

studio Moniker's interactive *Sculpture Cam* project (2016) and the video walk artworks of Cardiff and Miller as discussed in Chapter 2 [7].

The particular site of enquiry, within an open-air sculpture park, also serves to contribute to aspects of this thesis. Most pertinently it enables us to explore how a system of mixed reality, that interferes with modes of habitation and experience, can be more widely investigated within a culturally consumptive context of study.

[7] In a sense these ways of thinking also connect to the quasi-Bergsonian approach of sculptors such as Henry Moore and Barbara Hepworth, whose biomorphic artworks have a particularly close connection to much of the philosophical and phenomenological theory underpinning this thesis, and to the main practice-research site itself.

Chapter 1 State of the Art Review

Determining the Intertwining Contexts of Study

As signposted in the introduction, this thesis seeks to investigate the interstitial point at which a mixed reality combines, between the embodied form of phenomenological perception and its technological manifestation. Accordingly, the research undertaken intertwines three different contexts of thinking – the potential of technology, the role of design, and the influence of lived time – and seeks ultimately to understand and examine the point at which these three perspectives intersect. With a fuller account of these contexts in mind it is argued later in this thesis that a more suitable process of methodological enquiry might be practically applied. One that allows for the cyclical processes of iteration and refinement appropriate to the discipline of design by leading with a form of abductive inference.

Among others, central writing that feeds into this enquiry are:

- The emergence of speculative design aligned to new technology - from 'ubiquitous computing' conducted at Xerox PARC by Mark Weiser (1999a; 1996a, 1996b); through to the speculative investigations of a 'proximate future' by Bell & Dourish (2006); and the more recent *Design Probes* created by Dunne and Raby (2013)
- A concept of an at once embodied and processual phenomenology that has developed from William James and his foundational definitions of lived time and the specious present (1890), through to J.J. Gibson seeking to define the importance of relational environmental-material properties of perception (1979), and more recently Francesco Varela (1999) discussing a neurophenomenological definition of the specious present.
- Charlie Gere on the intermixing of Art, Time and Technology (2006);
- Mark B.N. Hansen (2004a, 2006, 2012) on New Media aesthetics;
- Alex Reid forming a distinction of the virtual from the technological to the actual (Reid, 2007)

A concrete definition of the term mixed reality is somewhat elusive, as it relies on a second definition which in itself is not straightforward, namely that of hyperreality. In

order to more fully understand this term, we must first turn (briefly) to this connection of definitions, noting how the phrase 'mixed-reality' emerges largely via the implementation of hyperreality. The word 'reality' in particular has various connotations that denote its use, both in terms of the physically real environment that makes up the world we live in, and the virtual real psychological construct of conscious thought. As Oberly (2003) discusses, reality is *conventionally* defined in a circular fashion by the Oxford English Dictionary as "The quality or state of being real", "having actual existence" or "having a place in the domain of reality" (2008b). These definitions have subtle distinctions, but each of them points toward the elusive nature of a concrete definition. This lack of clarity then results in "a slippage in how we define reality, which then becomes amplified in discussions of the hyperreal where "the distinction between real and imaginary implodes" (Oberly, 2003).

Prominent design theorists Anthony Dunne and Fiona Raby continue to co-develop speculative works that use design as medium stimulate discussion and debate. They also take issue with any overly narrow definition when discussing the distinction between what is defined as real or unreal:

> What is this real world, and where is it? More importantly, this suggests there is also a 'not real world': where does this not exist? And who decides what is real and what is not (what can and what cannot not exist)? (Dunne & Raby, 2018, p. 50)

For the purposes of this thesis 'real' might be considered as 'actual' in relation to the virtual. A mixed reality's 'virtual' depends upon a technological actual. In this sense, the actual is the condition for the (technological) virtual – this virtual depends on actual interactions/foundations (the making of the technologies) and a technological infrastructure. Once produced, however, the technological virtual has a kind of independence, being capable of having its own interactions and producing actual effects. This relationship is reversed in continental philosophical writing on virtuality, where the virtual, considered as a realm of potentiality, is often positioned as the ontologically

primary element of reality, whilst actuality is positioned as an in some sense a secondary order of the real.

As a consequence, a definition of the term hyperreal in this context is itself difficult to pinpoint, with several theorists offering differing strands of enquiry, perhaps most fundamental is Baudrillard's concept of the hyperreal within the writing around *Simulation and the Simulacrum* (1994). Gane (2010, p. 95) explains that Baudrillard's definition foregrounds the increasing normalisation and prioritisation of the simulation, reducing or removing the real from view. From the mediatization of history, to culture of consumption, Baudrillard argues that the models of the real have taken the place of the real. Therefore, if we first consider the distinction between real and virtual from a theoretical perspective, the concept of hyperreal simulation is characterised by Oberly as: "a blending of 'reality' and (virtual) representation that consider aspects of the real and its representation, where there is no clear indication of where the former stops and the latter begins." (Oberly, 2003).

This 'representation' would appear in our context to be constructed via a technologically generated virtual manifestation. In his book *The Two Virtuals* (2007) Reid considers the difference in terms generated by the word Virtual when examined in the context of New Media. Reid argues that the first wave of VR technology in the 1980's sought to explore the expanded definition of virtuality as 'a space of possibility' rather than the purely technical manifestation that is often employed today in the context of HCI and UXD[8]. The notion within this first wave was of a 'private-space', where much of the interest in a 'post-internet' world now lies in how a virtual space might allow us to further interconnect and perhaps enhance or further enable digital-social connection. This can be seen to be enabled by applications such as *AltspaceVR* (Microsoft, 2019a) and more recently Facebook's *Spaces* and *Horizon* experiments with VR (2019; 2019).

[8] Further exploration of this first wave of VR is covered in the book 'Virtual Worlds' by Benjamin Woolley (1993)

Whilst a defined reality-virtuality continuum (Flavián et al., 2019; Milgram et al., 1994) employs these terms, blending a conception of reality and digital technology, the devices that adopt the term mixed reality, both historically and at time of writing, have come to define this term almost exclusively as an applied technical integration of a head mounted display[9]. However, such devices are perhaps more accurately located somewhere toward the centre of the reality-virtuality continuum (Flavián et al., 2019), as technologies that are to some extent capable of digitally capturing a physically real space within a machine processed set of digitally generated (virtual) layers, and integrating a virtual representation of this space in amongst or over the inhabitant's view (Magic Leap Inc, 2018; Microsoft, 2019c). Understandably, the over-riding focus in engineering devices within this technical context is more concerned with recording and resolving a myriad of sensorial inputs, both biological-actual (human), and technological-device mounted, that might otherwise prevent a seamlessly integrated, cohesive, comfortable, and immersive experience (Kress & Cummings, 2017). The ultimate focus being primarily geared toward successfully achieving a mixed reality experience that seamlessly combines the two environments, giving no clear indication of where the 'real' stops and the 'technological' representation begins. There appear to be many examples of such applications being developed for industrial use, a clear recent example being developed by Norwegian technology company Varjo. Their *XR* series of head mounted display systems have been extensively engineered to seamlessly integrate virtual objects into a real world space, with the integrated head mounted camera system attempting to read the lighting conditions from the real world and then accurately applying them onto the digital objects in real-time in order to blend the real and virtual spaces together (Varjo, 2019b).

[9] Extensive research exists over the evolution of the Head Mounted Display (HMD) originating with Sutherlands *Sword of Damocles* system in 1968 (Sutherland, 1965, 1968) and popularised via first wave of VR in the late 1980's and early 1990's by VPL Research (2019; Wooley, 1993). More recently there has been a significant resurgence in the diversity of HMD classifications (Kress & Cummings, 2017).

As Reid states the 'virtual' in terms of its more modern theoretical conceptions "lies in the periphery of more familiar postmodern concepts, such as deconstruction, the rhizome, and simulation" (2007). Reid's use of the term virtual, applied via a technological/actual context, is useful here in that it refers to both this technologically mediated construction of a co-lived space and also the embodied nature in which we continually consume and filter information.

For the purposes of this thesis the term mixed reality is understood to be one that exists as a rich area of theoretical discussion, and in its current technological manifestation it is concerned with achieving a truly seamless sensorial human experience that marries the two modes of virtuality together, alongside technology and actuality - although arguably it is still far from fully achieving this aim.

The Potential of Technology

The potential of technology is often a cause for speculation, as new breakthroughs in various fields of research are applied to tools, services and processes and the possible scenarios for application are theorised, explored and promoted by designers (Matsuda, 2018), engineers (Boeing Research and Technology, 2018) and authors (Dunne & Raby, 2012). The realm of a technologically mediated mixed reality has recently become a relatively high-profile area of technological investment. The future potential of such a system of interaction and immersion is seemingly being addressed in both the scientific advancement of mobile devices and the connected, if somewhat fantastical claims, of potential future application scenarios. In this context there has been a particular focus upon the domestic application of such technologies (Fleischmann & Strauss, 2001; Matsuda, 2010d; Plante, 2015). Whilst much of this hyperbole is perhaps fuelled by the commercial interests of device makers, this nevertheless appears to be driven by a desire to fulfil the technological promise of what, only a few years ago remained purely in the realms of science fiction (Figure 3). Indeed, whilst the endeavour to create an interactive holographic interface in the style of a Hollywood feature film may be far beyond the prosaic application scenario of many day-to-day mixed reality uses, there

Figure 3.
Fictional and real wearable holographic systems



Note. (Left) (Russo & Russo, 2016) The potential of wearable augmented and mixed reality devices in film is often depicted as easy to wear and simple to use without encumberments.
(Right) (Microsoft, 2015) PR photo for the Microsoft Hololens (v1.0) head mounted display system was initially promoted as a future device that would seamlessly integrate into a domestic application scenario.

nevertheless is, in both scientific and dramatic scenarios, a concern with the management and mediation of the spaces of the virtual-real and the virtual-technological, in a way that either is, or at least appears, efficient and intuitive, for example in the development of car navigation systems (Figure 4).

A Cartesian World View and the Overlap with Digital Modes of Representation. These areas of research and visualisation are collectively fuelled by the increased implementation and combination of sensor-based data accumulation, network-based information retrieval, and use of machine learning (Ablavatski & Grishchenko, 2019; Kartynnik et al., 2019) in affecting the reading and predicting of personal, object, and environmental data.

> "Our phones and cameras are being turned into eyes and ears for applications; motion and location sensors tell where we are, what we're looking at, and how

Figure 4.
Car Navigation systems have started to adopt holographic displays



Note. A traditional GPS system augments the wayfinding. (Möckel, 2012)

A prototype 'ghost' holographic navigation system developed by Jaguar Land Rover (2014)

Navion holographic windscreen system currently being tested by a number of manufacturers (Wayray, 2018)

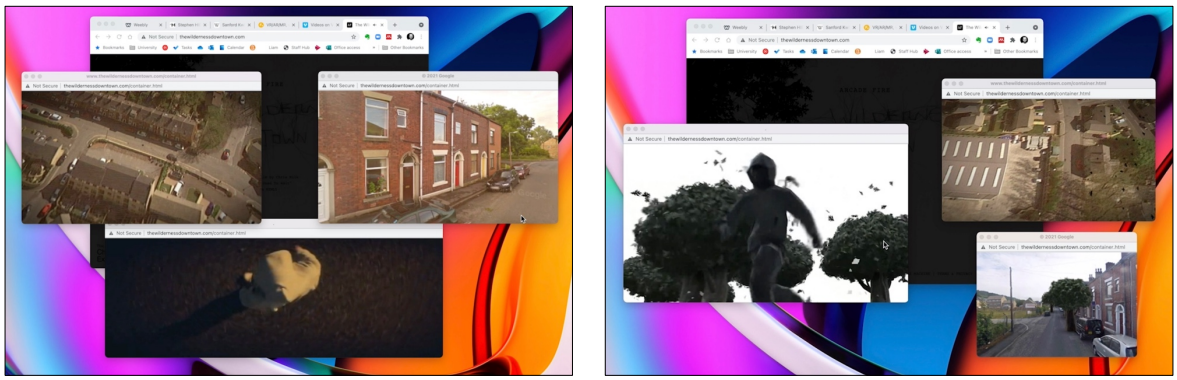
> fast we're moving. Data is being collected, presented, and acted upon in real time." (O'Reilly & Battelle, 2009)

Assuming that technology continues to evolve, and that the expansion of human perception through the augmentation of immediate experience continues along its present curve, an intimate, pervasive and perhaps insidious augmentation of the experiential moment might soon be possible. We will see this explored in the fictional work of Matsuda in Chapter 2 where the inhabitant's experience is overwhelmed with prompts and alerts based on their digital profile. However, a real-world example can be seen in the rise of wearable personal health tracking devices. Whilst the goal for many of these devices is to inform the user of their health related metrics, this also suggests an augmentation of experience that has for some become a concern, with its potential to allow device makers to more accurately profile an individual based on the lifestyle habits that are tracked, in some cases with the goal of further monetising related forms of healthcare (Maddox, 2015). It has also been suggested that this mode of personalised healthcare via active tracking of data and a device's feedback may overtly influence the way in which the user acts in response (Sharon, 2017).

The ability to augment and expand spatial perception can be seen via the use of the location recording and tracking technologies built into various mobile systems. For example, in this personal tracking context, the use of a mobile mapping application presents the user with suggested routes and destinations based on previous patterns of movement. These suggestions arise out of internal device data being employed in combination with an amalgamation of data from external sources. Within this viewpoint there is an embedded role for technology that revolves around a practical need for predictable repetition of experience. Whilst practically useful, this role for technology generally opposes creative/experimental ways of being – and in this sense it could be said to constrain the potential moment being experienced.

Therefore, whilst a technical implementation and a practical application of tracked information data is to some extent necessary in order to fully understand the

Figure 5.
The Wilderness Downtown (2010)



Note. On playback of the music video a set of browser-based windows dynamically appear and disappear on the user's desktop. Each window on has a mix of elements – containing both pre-recorded video and location-based images, retrieved from Google's servers, that have visual effects composited over them. Retrieved March, 2021, from http://www.thewildernessdowntown.com/

parameters of these technologies, at least within the framework of this thesis, the tendency to focus on the accurate translation of data belies the challenge of encompassing all facets of a mixed reality experience. Its inherent limitations appear to lie within a reliance on a world view that is overtly influenced by dualistically separated, Cartesian modes of thought and operation. This reliance on distinct isolated components, which are then applied and coordinated in a systemic fashion, has great utility in many realms of digital manufacture and processing. From the pixels that map onto gridded space, to the depth sensor that maps agency in an environment using the principles of Euclidean geometry, we see this method of mapping using mathematical components as practically useful. But the limitation of such a data centric and metrified version of space and time is that it precludes a version of mixed reality that might also compensate for, or exploit the potential of, the phenomenologically embodied, analogue, and variable interpretation of the same space.

An interesting example that utilises location-based technologies in order to generate a richer and more diverse sense of place can be seen in Arcade Fire's music video *Wilderness Downtown* (Milk & Arcade Fire, 2010)(Figure 5). Directed by media artist Chris Milk, the interactive film presents audiences with visuals tailored to the audience input. Localised scenery, derived from the viewers home location (which is requested immediately prior to playing the film) is extracted from the Google Maps and Street

View applications, and integrated into the film sequence. In this sense it generates a highly personalised and psychologically specific mode of intimate experience.

Despite the promise of this early experiment in generating a virtual sense of place, the potential for technology to genuinely expand or engage intimately with human temporal perception remains more challenging to define. Technological modes of time perception assume a measured, practical, repeated constant of time, whereas human modes of temporal perception incorporate underlying modes of variability (as discussed further in the section 'The influence of lived time'). Accordingly, the technological expansion of temporal perception relies upon a technologies 'attitude' to interpreting time as a more fluid and adjustable factor[10]. Consequently, more temporally aware technologies might provide the potential to open out the lived moment toward alternate / speculative futures and a richer multiplicity of human experience.

With this in mind, it perhaps makes sense to pause for a moment to consider what might be learned from the ways in which non-immersive digital platforms have been utilised, in order to unearth the potentials of MR. From the earliest origins of the world wide web via chatrooms/discussion boards, the potential for user interaction has provided the means to encounter a multiplicity of experience. The most marked innovation of 'Web 2.0', with its user-generated content, alongside the emergence of crowd funding and opensource access, has been the way in which it enabled a decentralisation of content generation, the harnessing of collective intelligence (O'Reilly & Battelle, 2009), and a gathering of experience in its plurality, in the context of 'a vast and interweaving exchange' (Song & Kidd, 2009). This aspect of postmodern technological culture has in many cases unsettled the tradition of authoritarian 'single' or 'universal' experiences, resulting in the foregrounding of emotion as a register of

[10] Whilst the idea of a technology possessing an attitude might seem outlandish, Ian Bogost's object-oriented ontology explores the idea that technologies themselves might have some form of subjectivity and some form of perception.

communication as seen with the almost exponential growth of emojis and related forms of pictographic communication.

The incorporation of this ever-unfolding, emotional, and expansive amalgamation of crowd-sourced, digitally fed information, into the context of the MR experience raises a number of interesting questions. We might ask if the resulting experienced image might become increasingly chaotic and further distanced from any sense of defined, or definable meaning. However, attempts to manage the volume of data arising out of the Web 2.0 context have given rise to new forms of algorithmic conformism which are based upon collective purchasing patterns and the pull of emotional influence which arguably encourage more regular patterns of predicted repetition. Ultimately, we might ask if the combined influence of augmented temporality in this post Web 2.0, more immersive context, could result in a reduced and near identical and more uniform mode of inhabited experience.

Using a hypothesis for an advanced augmented reality system, first proposed via a self-initiated project brief which explored the question of the future of augmented reality systems, the author of this thesis developed a project visualisation film *Another Reality* (Hibbert, 2014). Each scene of the film illustrates how a system capable of presenting content to the user can evolve from its two-dimensional root into a four-dimensional immersive experience. We witness a progression from the traditionally mediated two-dimensional content that is provided by a standard smartphone device, to the four-dimensional immersive capabilities of mixed reality content.

In basic terms then, the narrative of the film is presented as a journey that first introduces the required devices, then presents an augmented reality mode of interaction with digital assets and concludes with an illustration of the potential for a mixed reality mediated environment to translate the user's inhabited space from the real to one entirely filled with virtual forms of representation. Whilst this summarises the overall narrative, it is worth considering in a little more detail how each scene negotiates these points of transition.

The film's first scene examines the portability of such a MR system. The untethered wireless connection, which serves as the backbone of the separate black boxed devices which together form a system, is capable of implementing a mixed reality interaction.

Each component device within this system was based on (then current) mobile devices, that in a future more advanced state of development, might offer the potential mode of interaction that was depicted on screen. In addition, the film sought to anchor context sensitive information within the mixed reality world. In this fashion, the film acts as both descriptor and explorer, proposing some of the hypothetical characteristics and capabilities of a mixed reality system. Narratively speaking, the film's first section acts as a jumping off point for the audience, attempting to clearly introduce the devices as everyday items that enable some form of interaction. As this was a project visualisation, the film needed to establish the untethered, mobile principles of the proposed mixed reality system. This was achieved through the creation of three-dimensional digital mock-ups of its component devices, and then motion-matching a virtual camera with first person video footage.

The second scene of the film, 'Controllable', then introduces a series of mocked-up interactions that reflect the system's capabilities. These interactions, whilst basic, were connected to more theoretical work, a summary of which was then included in the paper 'Combining the virtual and physical interaction environment' (Hibbert, 2015). The method of speculatively designing this MR sought to inherit elements of AR based interaction by utilising a design concept that might assemble a hybrid system from 'off-the-shelf' devices (Holmes et al., 2017; Izadi et al., 2011; Thalmic Labs Inc, 2014). The perspective of Speculative Design will be covered in more detail in the methodology section of this thesis, but it is worth at this point drawing attention to the connection between this perspective's methodology, the temporal dimension of actualising futures, and the employment of digitally virtual technologies in the manifestation of its artefacts and materials. The devices proposed within *Another Reality* were envisioned as being able to collectively provide the capability for an individual participant to continuously

inhabit and interact with an augmented virtual space that could accommodate spatially integrated virtual features.

Given the information available and the terminology of the time, this was envisioned as a kind of bespoke Augmented Reality (AR) system that would implement the use of various devices in concert, functioning together to operate a theoretical interface through what might be called "a symphony of interaction between multiple smart mobile devices." (Chen & Grossman, 2014)).

An evaluation of this second scene examined the potential to operate such a system given the right conditions but left a number of questions concerning the potential for systems to be realised in a way that might transcend the confines of applied industrial scenarios, and which in the context of this thesis has come to factor in notions of differential presence and the co-habitation of MR spaces. Since producing this work, a number of device manufacturers have revealed attempts to technically overcome some of these interaction limitations[11], but despite significant technical advancements, several reports indicate that these systems remain distinctly limited, in either untethered mobility, immersive capability, or refined interaction (Lang, 2019).

The third and final section of the film, 'Immersive', speculatively suggests how a system of this kind, delivering content that is responsive to a mixed reality environment, might be able to integrate with and potentially overwhelm the actual environment it captures. The user of this hypothetical system is able to navigate around the actual environment, observing and disrupting the digital content from different positions within the actual space, before the digital content itself expands and overwhelms the user. This sequence ends with what we might now term a 'collapse of the actual', as the digital representation of the actual building is seemingly swept away by the mixed reality

[11] Contemporary examples (as of early 2019) include Microsoft Hololens (Microsoft, 2019c) and Magic Leap One (Magic Leap Inc, 2018))

system, being replaced first by a series of abstract nodes, and ultimately by a plane of nothingness.

Whilst the film as a whole attempted to harness modes of interaction and immersion and present them in a dramatic fashion, its principal purpose of digitally generating and presenting an immersive mixed reality system, nevertheless provided a series of potential avenues for further enquiry. In particular, spatiality is often presented in quite plastic/mutable terms within the film, enabling transformation/imagination/morphing between structures, and one of the aims of this study is to approach temporality in a similarly fluid fashion.

Other questions stemming from this prototypical work concerned the need to establish the current state of technological capability with respect to enabling an acceptable co-habitable mixed reality environment. This initial concern was however overridden as the focus of the thesis shifted towards the conception of a device's potential capability beyond the spatial confines of what might be termed conventional applied use (beyond specific industrial task uses for example). This led to a search for immersive example works that might implement a kind of temporal mutability. Illustrative examples that support these questions around the potential of technology are discussed further in Chapter 2 Example Works, in particular with regard to the work of Keiichi Matsuda.

To summarise, in this section we have seen that investigating the potential of technology and related modes of visualisation can offer multiple channels of enquiry that productively inform the context of a technologically mediated mixed reality, however we have also seen that a more capable, problem sensitive, research strategy will require further investigation into design requirements which fall outside of the Cartesian orientation of broadly technological modes of research into MR production.

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The Role of Design

The practical context of this thesis primarily situates itself within the context of the lived experience that occurs on a trip through an outdoor sculpture park. This particular situation offers a number of potential avenues of enquiry for the designer, particularly when focussed on understanding the modes and motivations of the visitor/user(s).

In one sense this enables a spatial experience that evolves through the visitor's freedom to roam across the park's open spaces. Each participant's journey results in the discovery of spaces in a random and unstructured fashion, and these spaces often yield opportunities for encounters with the park's artworks. Each visitor, or user may discover these works at their own pace, progressively generating their own individual sequence of encounters.

This unstructured and arbitrary pattern that makes up the user journey through the space can nevertheless be corralled by designed points of reference. These points serve as junctions in the journey, offering potential alternate and to some extent predetermined pathways of experience. All of the features that are maintained and developed as part of the park's existence - paths, gates, signs, notices, areas that are cultivated and areas that are wild - offer the users such points of reference. In this fashion, the open 'right to roam' landscape of the sculpture park also has a more systemic, yet carefully integrated level of designed affordance – which serves to prevent people from inadvertently getting lost whilst on their trip.

As the artworks themselves are intended to lure an audience, they can in this sense be likewise seen from the perspective of affordance or landmark, acting as points of spatial division within the broader navigation system that the park's designers provide. However, there is another sense in which the works offer a form of imaginative flight, and as such might be thought as offering a kind of 'anti-affordance'. To remove the artworks from the park would be to remove a key point of navigational reference, as well as a key point of imaginative escape.

At the heart of design is the consideration for the context of user, application, and environment. This has particular regard to designing for the mixed reality scenario, addressed in this thesis. Designing for a Mixed Reality requires the designer to continually account for both a user's embodied space and what we might term the 'representational space' provided by a MR device (as we have seen above). Whilst the design of an interface that uses principles of affordance and the context of perception might offer some solution, again there appears to be a barrier to use in most applied examples. It is perhaps for this reason that many MR applications effectively remove themselves from having to both obtain information from, and integrate with, a natural environment, and instead become installed in more artificial quasi-laboratory settings where the environmental variables can be more easily controlled.

This paradoxical situation was first considered via 'the frame of perception', as put forward by J.J. Gibson (1979) linking to the continued development of natural affordances grounded in intuitive use as presented by Donald Norman (D. Norman, 1988; D. A. Norman, 2013). In a revised introduction to 'An Ecological Approach to Visual Perception' William M. Mace writes:

> "What featured was Gibson's (then) novel notion of a perceptual system. He contrasted "imposed" with "obtained" information, emphasizing the latter. With "obtained" information, the animal goes to it, as it were, rather than the stimulation coming to or being merely impressed on the animal's receptors." (J. J. Gibson, 1979)

Then Norman, expanding upon and developing Gibson's notion of 'affordance' toward his own concept of signifier, stated in *The Design or Everyday Things* (D. A. Norman, 2013, pp. 76–77)

> Although it is best when people have considerable knowledge and experience using a particular product—knowledge in the head— the designer can put sufficient cues into the design—knowledge in the world—that good performance results even in the absence of previous knowledge. Combine the two,

> knowledge in the head and in the world, and performance is even better. How can the designer put knowledge into the device itself?

Understanding this fundamental principle of perception from a phenomenological point of view underlines the importance of how the user comes to see and understand. This in turn presents the situation in which a traditional process of design needs to accommodate for both the designed objects fundamental properties, and its surrounding environment, as these two facets become interconnected so they seem intrinsically intertwined. In applying this traditional design process to the problem of the governance of a mixed reality environment, that is situated within the experience of moving through an open-air sculpture park, the embodied interaction of both the inhabitant's perception and its technological augmentation is intended to be applied to a journey through a space that, when *untechnologically* encumbered, can be intuitively navigated. With this in mind, following the aforementioned theories of affordance, the 'imposed' representational digital reality must be approached and recognised in its context within the 'obtained' physical environment (replete with its existing environmental affordances). Therefore, when applying an *objective* design for this eventuality, the designer must be aware of the physical boundaries (the real-world objects and features) that exist and allow the interface to provide further affordances and opportunities for action which do not conflict with those already ecologically present. By offering relevant cues as to the governance of any digital user-object interaction by the user, intuitive synchronicity is the goal to be maintained.

As a result of this objective, ecological dimension, it is important to further reflect upon the embodied and affective aspects of Gibson and Norman, whilst also expanding on the *subjective* dimension of embodied phenomenological experience. This will be facilitated by exploring the role of MR as a speculative design fictional tool (as opposed to limiting its capabilities by constraining them to objective modes of representation). It is here that the setting of artworks, situated within a sculpture park, provide the best opportunity to examine these intertwined affordant elements of experience.

Embodied Interaction

Embodiment lies at the heart of all visual representations of reality, and the intuitive interaction that has to be designed to support a mixed reality system requires a method of analysis which diverges from the commonly pursued scientific model of advancement typically used in the engineering of new devices and technologies. The term 'reality' as it operates within the technologically mediated *Reality-Virtuality Continuum* (Milgram & Kishino, 1994) operates across a spectrum encompassing the purely real/actual world to a purely technological virtual world. Accordingly, any attempt to replicate or enhance reality, requires the appreciation of constraints - in both technological application and the ontological nature of being.

From the perspective of this research project, it is suggested that the issue of mixed reality interaction and the limits of its application can be expanded and better understood if considered through the application of a method of phenomenology that involves and implicates human subjectivity. This aspect of lived experience explores "the nature of human experience in the concrete phenomena of daily life" (Stienstra, 2015). Indeed, by pursuing this phenomenological route of investigation, the underlying issues appertaining to a purely technological approach to the design of a mixed reality system that relies upon a form of embodied sense-making, are brought to the surface. That is to say that technology design alone can often appear to lack the proper considerations in terms of the contextually defined embodied environment the human participant is inhabiting. This aspect of creating a function of technological innovation without understanding the context or form of use highlights the central problem of many new products. The affordances required must therefore be scrutinised from more than just a technical viewpoint.

Mark B N Hansen's work spans many fields including the subject of phenomenology influenced by new media and attendant technologies. In particular Hansen describes how he has recently sought to establish a discourse that updates Husserl's model of time-consciousness to incorporate the influence of a "massive technical inscription of time"

(Hansen, 2020) provided by modern computational processes. Hansen's earlier work *New Philosophy for a New Media* (2004a) debates a techno-scientific study of 'embodied sense making' from a media-philosophical perspective. Hansen states that language is "only one modality of our contact with the world" and contemporary theory needs to "grasp the fact that technology is irreducibly linked to the structure of the embodied experience" (Vaccari, 2004). Therefore, the whole concept of how a mixed reality system might idealistically serve as an extension of human computer interaction requires an understanding of how this system seeks to interpret and predict both informational context and response, while at the same time being understood as a virtualised extension of human embodiment. Indeed, this is further developed in Hansen's more recent work. In *Feed-forward*, Hansen (2014) argues that computational media does not readily seek to predict human computer interaction but rather presents information that it has itself sensed, acted upon and presented. As Hodge notes in his review of Hansen's work this approach presents to the audience:

> "a rethinking of subjectivity and agency in concert with nonhuman phenomena …. In this new world, networked computation senses, tracks, and records the present in order to predict and shape the future in large part independently from human action" (J. Hodge, 2016)

Whilst these actions might be able to suitably reconfigure the information received, the very fact that this data is 'independently' acted upon at all impacts the subjective experience of the user in some way.

In some sense this mode of describing the world via independent acts of processing might be seen to also have some alignment with Bogost's position on Objected Oriented Ontology, specifically as he puts forward in his book *Alien Phenomenology* (Bogost, 2012). In considering the relationship between human and nonhuman actors Bogost discusses an ontologically flat mode of operation using the concept of 'unit' to describe all things. In so doing we see both devices and people as equivalent with neither prioritised over the other. This creates a phenomenological groundwork with which to

discuss the unit-operation or 'interoperation of stuff', how things are continually read and acted upon without either privileging the other. By seeing the world of mixed reality through this particular lens, we are granted an insight into how a mixed reality perspective or 'way of seeing' could be productively applied. Here a mixed reality view could be used as a kind of funnel for manifesting and analysing a co-existent object relationship in a non-biased way (a way that doesn't privilege either technological or actual senses of reality). Here the mixed reality acts as the repository for co-existent inter-operation, with only the subjective 'quality of interaction' determining the individual objects manifest 'experience'.

More recently in 'Seven Principles to Design for Embodied Sense-making' Caroline Hummels (2015) proposes a framework that uses phenomenology as a basis for design thinking in embodied interaction, rather than relying on the form of Cartesian thinking that is often applied in the context of the computer science based approaches more often assigned to this field of investigation. The principles Hummels defines - social situatedness, scaffolds, traces, interactive imagery, dialogical system, 1st person perspective and catalysing engagement - all provide different subjective frames through which to explore the design of artefacts.

Hummels' paper argues that this concept of sense-making as an extension to human embodiment could be seen to be in conflict with the current use of Cartesian thinking in informing the gridded/ analytic methods of computer science application. These computer-science-based methods of design, when applied to designing processes of control within an immersive environment, limit the potential embodied modes and contexts of application. This is because they rely primarily upon a method that "breaks up task and action complexity into component parts and processes" (Hummels, 2015). Hummels recognises however that the Cartesian approach allows for a more straightforward technological application of guidelines to define how interface-based technologies may evolve – at least in very narrowly specified, non-social contexts. Further examples supporting this approach (Dijk et al., 2013) critique the potential

application of interactive technologies beyond specific use case scenarios. Hummels goes on to suggest that the Cartesian approach operates to the detriment of the more open, social, and holistic exploration of technological environments that she is keen to investigate.

Hummels position in some sense extends and supports earlier findings that draw attention to the limitations of AR interface scenarios. Historically however, the failings of AR systems have been largely attributed to limits in their technical sophistication, especially when interpreting acts of physical communication. Hummels takes a slightly different line however, suggesting that the way in which we think about such systems and their employment, in what are often complex and ambiguous social situations, is as much to blame as any limitations in the technology. The kind of situations that Hummels describes have perhaps been ignored or neglected due to the vast amount of abstraction required to deal with the sheer amount of social and ergonomic data implicated in the situation, and the need for this to be continually processed and relayed to a corresponding virtual representation. Arguably it is this combination of limited technology and limited perspective that has hampered the effectiveness and application of AR interface scenarios (S. Mann, 2002; Randell, 2005; Seneviratne et al., 2017).

Briefly considering the adjacent field of Virtual Reality and its resurgence in commercial applications, reveals that some of the ergonomic limitations that compromised early VR development are gradually being overcome. There are, however, still significant obstacles to surmount in the search for genuine 'presence' (Abrash, 2014) in the form of the creation of virtual worlds which mimic individual human sensorial cues, and subsequently enable a user's complete ergonomic immersion into a 'virtual reality' (if reality is to be considered in a purely metricised or Cartesian sense of the term).

In order for this version of immersive presence within a virtual world to be achieved, certain cues are needing to be factored into the design. Although traditional Cartesian cognitive task analysis frameworks such as *GOMS* (Moran et al., 1983) and *Fitts Law*

(Fitts, 1954) can be applied to measure human computer interaction response times, these remain somewhat application specific, relating to linear input measurement, as opposed to the dynamic multimodal interaction required in a virtual or mixed reality setting. They likewise do not fully account for the brains rapid cycle of retention and protention when determining human-individuals endogenous dynamics and their relation to human awareness within an environment.

Francisco Varela's work stands at the intersection between philosophical thought and the neuro-biological processes that occur. Here, Varela is also useful in the context of his foregrounding of groundlessness that is a constituent part of everyday experience, in contrast to the problematic relationship between inner and outer 'grounded' Cartesian forms of representation (Varela et al., 1993, p. 144).

More specifically in the context of time based cycles of awareness, Hansen (2004a) discusses the work of Francisco Varela (1999) and his model of time-consciousness which attempts to determine the duration of the lived 'now' (the notion of lived time, which is further discussed below). This neuro-phenomenological model of recording and predicting the human brain's calculation and perception of its surroundings is one of the elements attempting to be resolved in the design of recent virtual reality head mounted display-based technologies. In his article *The latent power of prediction* (Lavelle, 2013) Professor Steve Lavelle discusses his continuing work on sensor fusion and motion planning. This work is concerned with determining computational solutions that might generate the ability to predict future movement and render the appropriate 'future-image'. Lavelle states that this could lead to a potential alleviation (at least in part) of certain head movement related perception issues (i.e., nausea, dizziness, disorientation) when rendering a VR or AR scene to a head mounted display.

This correspondence, between cognitive behaviour, technical design, and engineering, evidences the complex challenge facing an intuitive mixed reality environment. Even the notion of what is defined as 'now', and however rich or thick that might be, is contingent on subjective variability that confounds forms of linear measurement.

Dan Torre (2017) investigates notions of temporal variability via the discussion of animation and the construction of animated worlds. He looks to apply process philosophy in order to better understand how Animation might be considered a dynamic construction, subject to a myriad of different processes. Developing his process philosophical framework, Torre argues that the animated form distorts linear constructs of time such as that which is suggested by the equidistant still on a strip of film. Central to Torre's position is an understanding of the layering of reality that has a strong application in relation to MR and AR.

> (Whilst) the cinematic presentation of moving images can describe time, it could also be argued that, in terms of process, the sub-frame (or layer) defines another succession of time… However, because animation is an additive process, many subsequent layers can be added – each possessing its own duration and speed, each providing us with different conceptions of each particular event. (Torre 2017)

In this sense we can see how a view of the world mediated through mixed reality might be similarly layered combining both recorded archival and real-time captured data in in its delivery of the virtual, and how this might apply both with respect to time and space.

In addition Torre notes that the animate, processual nature of cognition itself "derives from its capacity to amalgamate motion and image in new ways" (Torre, 2017, p. 113). Torre alludes to the processual nature of the cognitive construction of a moment when discussing our ability to conflate or synthesise image and motion.

> We may notice only briefly a person sitting on a train, yet subsequently we dream about them that night; and even though we have never seen them walk or even move much, we may imagine them walking around and gesticulating wildly. When this occurs, it is most likely that we are assimilating various diverse memories. Perhaps we have taken the walk cycle of our cousin and the lip-synced mouth movements of our neighbour, applying them to the person

> whom we only briefly noticed sitting across from us on the train. (Torre, 2017, p. 113)

This example of how we interpret and project onto a lived 'now' exemplifies the human capacity for cognitive separation, implicating fragments of memory and radicalising the 'thickness' of the present and its perceived duration. Reflecting upon this process of construction of the present moment, troubles any straightforward objectivist take on the spatio-temporal.

The temporal interference, provided by a virtual-technological mixed reality device, both influences and enables a new way of seeing lived time. With this in mind, we might ask how we might design experiences for a mixed reality that accommodate and contend with an embodied interaction that has the capacity for temporal variability. Similarly, we might explore the value of speculatively designing for the affordances of diverse and highly subjective mental process systems such as perception, memory, and reasoning, and ask if a more subjectively temporal approach might nevertheless help to design elucidative solutions some of which are addressed later in this research.

The influence of lived time

From the perspective of this study, technologies which can both augment and virtualise our interpretation and perception of the world are intertwined with what Bergson (1911, 1984) termed 'lived time' or 'duration'. Given that the focus of the practical element of this study concerns encounters with sculptural artefacts within real and MR landscapes and is likewise concerned with the accumulation of a collective spoken word 'residue' of such encounters, the notions of the artwork as a technology of lived time come to the fore. An understanding of sculptural encounter, and audience recollections of sculptural encounter, is going to be valuable, but this section also examines the more abstract curatorial and theoretical writings on the encounter per se that can be valuably applied to a mixed reality context, and more specifically the mixed reality context discussed in this thesis. Therefore, these abstract examples serve to

examine aspects of other spoken word / visual encounters with the artworks, and the contribution that is provided by the managed ecology of a sculpture park environment.

Addressing the idea of the encounter and the influence of and on lived time, a certain amount of context is required. If we consider the framing of an encounter via the use of artworks as perceptual technologies of interpretation, we see the ever-emerging mediated experience that exists between the artist, the artwork and the viewers experience. This calls to mind two notable views on interpretation with Marcel Duchamp's concern with the 'co-efficient of art' (Duchamp, 1957), that interpretive space that is in the process of translation between artistic (or designed) idea and it's mediated representation, and Nicolas Bourriaud's assertions that 'the image is a moment' (1998), and, further, that 'contemporary art is often marked by unavailability, by being viewable only at a specific time'. This in some way connects to Dan Torre's view of how animation is experienced in reference to Norman McLaren's assertion that "What happens between each frame is much more important than what exists on each frame" (Sifianos, 1995). Torre goes on to state that:" it is the difference between the frames that generates movement. But for this effect to occur, it has to be acknowledged that the space between the frames also embodies time" (Torre, 2017). By this measure, the influence of lived time is a key register during the moment of encounter.

The moment

According to Bourriaud, "Art is a state of encounter" (1998). The very concept of 'the encounter' – whether presenting itself as an act of chance or a predetermined instance of experience – is inextricably and necessarily both a spatial and temporal phenomenon. Whilst arguably the spatial component of such a moment might be fairly easily comprehended (although the application of technological devices of viewing might problematise this – as is explored elsewhere in this thesis), the temporal incidence of the encounter is more remarkable, as it evades straightforward rationalisation. As Bourriaud noted, "It is no longer possible to regard the contemporary work as a space to be walked through […] It is a period of time to be lived through, like the opening to unlimited

discussion."(Bourriaud, 1998). The encounter is materially (in the relational sense) to be composed in what might otherwise be described as a moment – an exact point in time, or, "A particular stage in the development of something or in a course of events" (OED, 2008a). This latter definition is noteworthy as it positions the encounter as a catalyst or starting point in a journey; at once an instance in and of itself, and yet, no sooner occurring than immediately succeeded by a subsequent instance.

Edmund Husserl's foundational work in defining phenomenology appears to offer a distinct framework for exploring the presence in the moment, initially foregrounding that kind of in the moment subjectivity and the introduction of retention as being distinct from memory. As Sigrist explains, "While memory is a mode of consciousness by which we are aware of the past, retention is a feature of our conscious experience of the present" (Sigrist, 2012, p. 208).

Husserl addressed this idea and that of the sequential temporal moments within a lifeworld which make up experience (or what we might call the 'journey of experience') in his early explorations in phenomenology, as Zahavi translates:

> […] perception is an experience, a temporal conscious process, and its immanent contents are the moments or phases that together make up the concrete […] physical process. (Husserl, 1904; Zahavi, 2003)

Given the evolving nature of a time and space, which is in part mediated by the technologies of viewing afforded by mixed reality, it is argued here that the mediation afforded by the artist/designer can further catalyse the imminently occurring moments or phases, in particular when consideration is made for the human ability to cognitively separate an encounter with an artwork. Torre's argument around a 'mediation of actuality' might be recognised in a Derridean[12] sense via the implication that elements of

[12] Whilst the work of Jacques Derrida falls beyond this thesis, his work continues to be invoked specifically in the context of the deconstruction of experience in the digital age, and more generally in terms of our relationship with technology and digital media.

the past collectively 'haunt' an experience. Thus, whilst Husserl's definition of perception remains a distinctly pure sequence of construction, Torre, like Derrida, and Bergson before him, argues that the moment is never pure and is always altered/haunted in some way in the context of its presentation. Whilst this seemingly problematises any straightforward notion of the technological presentation, Torre's theory actually presents the artist designer with an opportunity to explore the creative power of media, as it presents perception and cognition as multi-layered, multifaceted constructs.

With this in mind we can better understand the influence of technologies of seeing by considering work which examines lived time in a technologically mediated fashion.

Mediation of the Encounter

Working from Robert Smithson's original *Spiral Jetty* land artwork (1970) and film of the same name, Tacita Dean's seminal works *Trying to Find the Spiral Jetty* (1997) and *JG* (2013a) attempt to catalyse the moment of capture. This, and a selection of subsequent responses to this semi-fictional journey through time and space, have a conceptual identity that is based around the – abstract, inconclusive and often evasive – perception of the passing of time and which, in turn, are differently affected by their varying relationships with the media (and other) technologies they might be seen to employ.

The moment of encounter then exists as one that can be influenced via the emerging image constructed by the artist/designer and that of the viewer/audience and their reading of the work. In many of Tacita Dean's works there can be read a commentary on temporal consciousness and a relationship to the concept of a 'slippage of time', whereby they ask the viewer/listener to consider how we construct our idea of 'the present' in our minds. This serves to underline the complexity and subjectivity of this process and the extent to which a series of fragments – some of them possibly real, some of them probably imagined – make up what we understand as experience of the encounter. Furthermore, they reiterate the sense that what we might consider to be that grounding presence of the image; that seemingly concrete, visual element of 'the encounter', is no

more universal, objective, or comprehensive than the elusive timeframe in which it is perceived by the viewer.

The functioning of this relationship is then further expanded around and through the use of technologies: those technologies of seeing that exist via the traditional method of viewing the work in a curated environment, or those technologies that might be considered via newer kinds of relationality, for example in the enabling of collective audience viewing, collapse of geographic distance, or the 'shared time' enabled by the potential of globally networked communication.

In 2013 Tacita Dean notes in an interview about her project *JG* – a video-work collaboration with the author J.G. Ballard which functions as a response to Smithson's *Spiral Jetty*, that:

> Nowadays, there is a parking area and signposts, and Google Earth has allowed for the one unimaginable view of the artwork that would have defied even Smithson's atavistic expectations: God's view. *Spiral Jetty* has a new vista for the satellite generation.(Dean, 2013b)

This more recent view of the work, enabled through the use of digital, networked technologies, is a stark illustration of how the [potential] encounter can be transformed via a new medium. However, interpreting this as a relatively recent technological development belies a continuing evolution in ways of seeing that can be found in both Smithson and Dean's film works – *Spiral Jetty* and *JG* respectively – both pieces being technologically analogue responses to Smithson's *Spiral Jetty*.

Smithson's reason for documenting the earthwork sculpture has been described as a process of excavation, as Mara Hoberman states: "The sun, the spiral, the salt buried in lengths of footage." Smithson, it seems, felt compelled to rescue the physical reality of his artwork from 'bits and pieces of Utah, out-takes overexposed and underexposed, masses of impenetrable material' (Hoberman, 2014).

This again marks a moment of mediated capture within the lifespan of the long-lived earthwork. This is documentation for the purposes of cyclic exhibition, something that clearly resonates with the documented process of capture in Dean's *Trying to find the Spiral Jetty* audio work. *JG* on the other hand draws on Smithson's extended metaphor of the spiral in which he states, "A film is a spiral made up of frames."(Smithson, 1979, p. 148), whilst at the same time deliberately entangling footage within 'found objects, and fanciful environments' (Hoberman, 2014)

Dean explains about *JG* that:

> It needed to be made now [in 2013] because its medium and its form is the analogue of the underlying equation of our universe, and [one which is now] breaking up and saying goodbye.(Dean, 2013b)

The insistence of Dean to film *JG* using an analogue method of capture on rolls of 35mm film is integral to the formation of all of her film-based work. The pre-occupation with the analogue media of celluloid film, specifically distinguishing it as a unique medium of delivery, rather than a interstitial point of technical evolution (in film-making), is a key aspect of Dean's process of image capture (Foundas, 2015). She observes, here, that the very medium through which we are able to experience *JG* is itself an unstable, transient vehicle for experience, and one which is enduring what might be described as 'slippage' – an endangered representation of the world which has the potential to disappear just as it seems to have pinned down or committed to permanence of an experience. It is important to emphasise this mediating mode of technology as temporal capture, whilst also taking account of the fact that technologies can also further enable and amplify rapid modes of relational change.

Whilst the physicality of the film stock itself might be facing an uncertain future, the medium of delivery ensures a linear and fixed length timeline of both construction and interpretation of the encounter. The *lived time* duration of each viewer's individual experience of each work, their individual notion of time, is expected to be forgotten. As Dean states:

> I don't like the word duration, I prefer length […] I like to push people to observe and to let go of their current notion of time. And sort of surrender to my time which happens if you watch a film of mine (*JG*), and surrender to it. (Pew Center for Arts and Heritage, 2013)

John Mullarkey illustrated this response to cinematic time when he conducted a philosophical experiment that explored the variability of durational/temporal experience (Mullarkey, 2009, p. 152). Mullarkey once screened a two-hour film composed of fifteen-minute inter-cut segments from Paul Greengrass' hyperkinetic *The Bourne Ultimatum* (2007) and Bela Tarr's ultra-slow *Sántátangó* (1994). This resulted in Mullarkey: "become[ing] part of its [The Bourne Ultimatum's] time, an accelerated viewer, no less than my watching *Sántátangó* drew forth an effort in the reverse direction of slowing down".

For Mullarkey there is much durational variability in the subjective perception of time and there is a sense in which cinema provides a means of both exploring and manipulating temporal subjectivity, instantiating a "deep reconfiguration of our viewing thresholds", and highlighting the "artificial poles between nature and culture".

Mullarkey is interested in the way in which film can engage with what Laura Cull has termed 'differential presence' through an exploration of the plasticity of any given individual's perspective (Cull, 2009). In this sense, Mullarkey and Cull's notion of 'differential presence' resonates strongly both with Tacita Dean's notion of surrendering to time, and the more subjective temporal framing of this thesis.

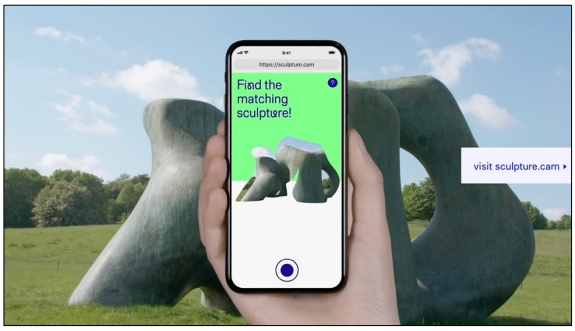
Returning to Dean's allusion toward 'surrender', we can see how this remains dependant on the viewer's pre, during, and post-expectant view of the encounter. This dependency is determined via the Derridean 'haunting', or perhaps as Torre states a form of what Alfred North Whitehead termed 'causal efficacy' – "a process by which our previous knowledge and memory assists us to contextualize our experiences" (Torre, 2017). Dean hopes with this work to draw the viewer out of their own time and into hers. If the viewer is to experience the changing nature of the work in the way Dean

intends, certain parameters that serve to mediate the encounter, related to the medium of delivery and directing a way of seeing, must be obeyed.

In a sense this mode of parametric control of the experience can be seen in newly emerging works that depend on viewer participation. The interactive web app *Sculpture Cam* (Figure 6) created by design studio Moniker (2016) asks participants to upload their own photos of selected works they are challenged with locating across the Yorkshire Sculpture Park site. The resulting photos (and the geolocated metadata from a visitor's device), each taken from alternating angles, are then compiled by the Sculpture Cam system into a 360-degree animation, collaboratively creating what might be termed a 'photographic sculpture' that emerges and is altered via a recalculation of the variations invoked by each new image and their adjustment in viewer position and time of day that the photo is taken. Despite the use of pre-determined templates or framings to guide the user's photographic positioning, the results are (seemingly knowingly) fragmented, incomplete, and only partially stable giving a sense of the specificity of every individual audience encounter.

The resulting output provides an interesting juxtaposition of the viewed experience. Viewers outside of the park are able to view the outcomes remotely on the website, whilst visitors inside the park contribute their geolocated images and enrich the resulting output and potential future visitor encounters.

Figure 6.
Sculpture Cam web app (2018). Moniker/The Space/YSP



Note. Retreived 19th September 2019. Example outcomes of this project can be viewed at: https://sculpture.cam/

It should be noted here that a mixed reality mediated encounter within an industrial setting is itself caught within the temporal process of calculation, with the role of the mixed reality focussed designer being to apply parameters that seek to *influence* the conscious processes of viewing and interpreting. This is most clearly demonstrated when witnessing a mixed reality experience that uses a process of interaction requiring the user/inhabitant to behave and act based on linear patterns of probability. If we further consider this industrialised application of mixed reality technologies of capture and use of surrounding data and selectively integrating contextually relevant information, we see the mediation of viewing and interpreting can be redefined for various scenarios of contextual interaction. Evidence of this can be seen in the applied research work carried out by Volvo in partnership with technology company Varjo (Varjo, 2019b). Varjo's *XR* system has been promoted as a head mounted display device capable of depth and light measurement to replicate a photo-realistic version of the vehicle cockpit. In this case the system is employed alongside eye and hand tracking of the user toward measuring the User Experience of prototype cockpits and user safety. "With *XR-1*, Volvo is able to perform UX studies by keeping as much as possible of reality – the real road, nature, road signs and more – and only exchange [sic] the things they want to evaluate, for example a new display or interior." (Varjo, 2019a)

Following the intertwining contexts of study already stated above - the concept of lived time defined here has a particular emphasis on the idea of what Bourriaud (1998) calls moment M – the *temporal* point of encounter in an experience. This can be expanded by the inclusion of the concept of the specious present when considering influencing factors in lived-time-perception for each work; in that both human experience of time and technologically mediated time serve to influence our perception and understanding of the moment.

The specious present

When encountering and interpreting the seemingly ever-latent meaning of images, subjectivity is a fundamental concern. If we each have a distinct and independent physiological experience of time dependent on a multitude of individual factors, then our encounters could be perceived as continually evolving. The sensorimotor body, with or without the aid of technology, is being continually recombined to read, predict and interpret the environment around us. Varela terms this continually emerging encounter with the 'present' as the 'the horizon of integration' (Hansen, 2004a, p. 26; Varela, 1999).

The temporal aspect of the moment of encounter can be difficult to define with any absolute certainty or indeed measured clarity. Whilst the spatial parameters of a material situation might be in some way definable, the duration of encounter is not. At best, we might be able to propose a set of parametric factors which exert a kind of *influence* upon the breadth of the temporal encounter. These parameters are by nature fluid and ever changing, being dependent to some extent upon factors such as pre-knowledge and present (or current) environmental or social distraction. This suggests an expanded conception of relationality that supplements and extends the more social orientation of Bourriaud – factoring primarily human social relationships, but also hinting at non-human/non-anthropocentric forms of relationality and factoring them into the discussion. In investigating this fragmentary engagement with the present, the concept of the specious present serves to engage and perhaps better define the parameters that

influence duration. The specious present, was famously proclaimed by William James (1890) as:

> […] no knife-edge, but a saddle-back, with a certain breadth of its own on which we sit perched, and from which we look in two directions.

According to James, the specious present brings with it a bi-directional awareness of what we might call the 'pre-latent' and 'post-experienced' image. The combination of this broader form of awareness, however, has had to evolve alongside advancements in technological capture.

If we first consider some philosophical definitions of time set out by Bergson and later Deleuze:

> Time is based on 'durations', or periods of present existence, from which other times emanate. Understood this way, time can be seen to be both singular (fleeting 'real' presents) and infinitely multiple.(Hodges, 2008)

When considering the communication and interpretation of the 'real' present image and the potentially infinite multiple durations of a latent image, it is important to first recognise how periods of time can be viewed from two different perspectives. At its heart this is a recognition of the difference between the mechanised representation of time or 'cinematic time', and how we experience it, a 'lived time', to use the words of Henri Bergson (Bergson, 1911, 1984).

Time as a mechanised realisation relies on an absolutist, mathematical understanding. This relates to both the Newtonian definition – that time is a fixed quantity, whilst still being present in the Einsteinian definition which further expanded, and (only) apparently relativised, the physical measurement of time. For Einstein, time squashes or stretches dependent upon frame of reference (speed) – but nevertheless remains a precise unit of measurement due to its algorithmic relationship with the speed of light as an alternative physical constant. However, as we shall soon see, this has more recently been questioned when referring to time at a quantum physical level.

If, however, we first consider a more experiential definition of time, the way in which the individual actually experiences temporality; otherwise known as 'lived time', we then have to recognise the phenomenological effect or psychological variability of its perception. Arguably, this variability is felt in our experience of, or encounter with, the real presented image, the duration of which in itself is influenced by qualities of anticipation or expectation that are derived from an engagement with a pre-encounter latent image. This results in a phenomenological, affective experience which influences our interpretation of the encounter itself and its duration and goes on to influence our subsequent encounters with the world.

The duration of this specious present, the 'breadth of awareness', (or breadth of what James terms 'the saddleback'), was modelled by Francisco Varela as lasting approximately 0.3 seconds (Varela, 1999). Building on the work of Bergson and Husserl, Varela's model looked to biologically measure a cycle of impression, retention, and protention when determining a human individual's 'endogenous dynamics' and its relation to human awareness within an environment (cited in Hansen, 2004). Varela's measurements are interesting from the perspective of this research if we consider them in the light of Bergson's notion of durational multiplicity. It is important to remember that whilst Bergson began by presenting duration as an aspect of subjective psychological time, he later ontologised this into a depiction of the workings of matter (Mullarkey, 2000). Thus, a single supra/all-encompassing duration became a qualitative multiplicity constituted by innumerate temporal enfoldings. Similarly, whilst Bergson depicted the world as a matter-flow of images, he noted the distinctive relationship that we have with our own bodies – seeming to be able to grasp this particular image (my body) from both without and within (both objectively and subjectively, as it were) (Bergson, 1911, 1988, 2001). Thus, Varela's cycle could be positioned as quasi-Bergsonian in so far as it has objective underpinnings but nevertheless connects the role of affect, memory, and prediction in determining the qualities of perceived image and its subsequent subjective interpretation by the individual.

Building on the Bergsonian and Derridean complication of the specious present to include the involuntary interference of memory in the construction of the moment, we might coin a term 'the inter-specious present' that emphasises the fragmentary and impure dimension of any experience of time, however 'thick'.

The work of Francisco Varela therefore further establishes a definition of 'lived time' moving beyond the earlier philosophical definitions from Bergson, Husserl, James and others. When considering individual experience of time, Varela's more recent research increasingly discussed a kind of 'neural relativity' of temporal perception (Varela, 1999).

Despite its biological orientation, this material-phenomenological definition of time is highly personal, and subject to individual differences – as such it is clearly at odds with any measured constant definition. This differential experience of time also correlates in some way with more modern scientific interpretations of time and aspects of temporal relativity which call into question the traditional measured constants. For example, for a number of years theoretical physicists such as Carlo Rovelli have argued that the study of quantum physics should remove time from calculations involving quantum gravity "the best strategy for understanding quantum gravity is to build a picture of the physical world where the notion of time plays no role at all" (Rovelli, 2011).

Rovelli further argues for a specific alternative definition of time that is universally unique to our current place in the universe. "Our time must emerge around us, at least for us and at our scale". Rovelli expounds on this in his book 'The Order of Time':

> There is no single time: there is a different duration for every trajectory; and time passes at different rhythms according to place and according to speed. It is not directional: the difference between past and future does not exist in the elementary equations of the world; its orientation is merely a contingent aspect that appears when we look at things and neglect the details. In this blurred view, the past of the universe was in a curiously "particular" state. The notion of the "present" does not work in the vast universe there is nothing that we can reasonably call "present." The substratum that determines the duration of time

> is not an independent entity, different from the others that make up the world; it is an aspect of a dynamic field. It jumps, fluctuates, materializes only by interacting, and is not to be found beneath a minimum scale. (Rovelli, 2018)

In this sense we might interpret the scientific interpretation of the rhythm of time to influence the phenomenological perception of the inter-specious present as an ever emerging form of what Rovelli calls 'proper time', that which "is dependent on proximity (to mass) and speed at which you move." (Rovelli, 2018, p. 38). Whilst this may seem a leap in terms of interpretation of the physical capability of our neural architecture it would seem to offer a parallel in terms of our neural processing of the encounter and the resulting affect to the thickness of the present.

Returning to Varela, there is a consideration and conjunction of the suppleness of the human experience of time with the more determined description of the biological hardware of our neural architecture – closely linking this to the affective basis of temporal experience and our embodied sensorimotor capabilities. That is to say, Varela's account stresses the way in which affectivity opens us to the allure of immediate objects in an environment, whilst the refocusing of attention depends upon a perceived mode of temporality which serves as a 'horizon of integration'. This is itself dependent upon dispersed, fragmented and highly plastic neurological 'patternings' or assemblages – ultimately resulting in an ever emerging and unstable mode of subjective temporal perception.

In the context the production of MR experiences there is an interesting resonance between the constraining nature of the neurological 'hardware' referenced by Varela and the technological hardware required to augment the physical world. There is a similar affinity between the rich phenomenological perception of time instituted by Varela's theory and the communicative aims of my practical work. That is to say, the emphasis upon the affective allure of objects chimes with the call of objects and voids in the digital landscape of the sculpture park, as does Varela's stress upon the interpenetration of a diverse array of temporal scales in the perception of any event.

This ranges from the 1/10 scale of imperceptible neurological events, to the 10-scale for the reporting of events using short-term memory, which will be important when we consider the incorporation of residues of experiences in the form of spoken audio in the context of the MR environment.

It is important to remember that the technologies which augment or influence our perception of time are nevertheless inextricably linked to the experienced encounter. As Gere discusses in Art, Time, and Technology (2006) our relationship to time can be thought of in both a mechanised or technologised fashion but remains distinctly connected to the self-referential 'lived time' in which the individuals experience of temporality is dependent on awareness and attention at a given moment. This dependency on awareness and attention can likewise be further linked back to the definition (or duration) of the (inter) specious present.

Conclusion on the Influence of Lived Time

Technologies as we define them here – those that augment our experience of time and subsequently the perceptual shape of encounter - offer a critical set of parameters that influence an understanding of the image.

As Gere suggests, further developing an argument by Bataille, the urge to make art when considered alongside the production of more design-oriented tools are collectively implicated in the emergence of our conceptions of time:

> the earliest forms of artistic prehistoric human evolution and the origins of tool use came about and gave rise to conceptions of time being perceived through 'all gradations of objective existence, ranging themselves in the proper order'(Bataille, 1955) (Gere, 2006)

These 'gradations' allow the human to frame their personal experience of lived time and present it others through its embodiment in some form of designerly artefact, providing a capacity for this mode of temporality to continue beyond the artist or designer's existence. According to Gere, this shared humanistic perspective and

relationship with time brought about through the augmentation and use of tools (or technologies) alter how we might perceive, experience and understand the temporal dimensions of the encounter, and by extension how we might influence the design of an experience.

The work of Smithson and subsequent responses by Dean in many ways reflect Gere's position, providing examples of how an audience's latent image can be interfaced with the latent image of a specific tool, design or artwork – illustrating how the subjective perception of time can be both seeded and influenced by technologies. Interestingly this also provides a framework for considering artworks themselves as technologies – or as tools for manipulating or communicating temporal and subjective experiential qualities. These mechanisms serve to either augment or virtualise, and ultimately influence the perception of time and space, and as a result of this, the encounter itself. This is further explored in the following chapter where a series of example works seek to test these mechanisms alongside the other contexts of study.

In the context of a mixed reality experience, and its duration affected latency, time derives itself both from and towards the ever-evolving encounter. In considering technology's capacity to affect ways of seeing, and its function as a mechanism of augmentation or virtualisation, we discover that the way we interpret an encounter is contingent upon a complex amalgamation of subjective and technological factors – factors which can be manipulated to creative effect.

These are factors that can be speculatively examined via a practice-based approach to ways of seeing via mixed reality mediation. The site of enquiry, in this case the outdoor sculpture park, provides an opportunity to digitally capture interpretations of the 'when' and 'where' of a work, and question how these interpretations influence an audience's experience of the park.

Thus, in considering the lived experience and its potential for variability, via both the temporal and spatial dimensions of an encounter, the concept of the specious present – the ever-evolving present and its relational duration - is seen as a key context of study.

This concept informs the shape and duration of a mixed reality encounter, which as we have seen both defines and is defined by the artist/designer and the technologies employed.

Conclusion for State-of-the-Art Review

Subsequently, and with particular regard to viewing this problem through the lens of a mixed reality space, these intertwining contexts of enquiry offer the potential to alter our understanding and approach to the problem of designing for a mixed reality. Incorporating the frames of lived time, the role of design, and the potential of technology, beyond specific use case scenarios, enables a broader discussion concerning our approach to the subjective nature of multiple realities. This discussion will be better understood after we have considered some example works that might be analysed using these contexts. This consideration will take place in Chapter 2 of this thesis.

Chapter 2 Example Works

This chapter serves as a point of reference in order to better understand how artworks might be interpreted via the intertwining contexts - the potential of technology, the role of design, and the influence of lived time. Each of the artist/designers discussed, in some way demonstrate how practice-based work can explore a subject, in this case the use and modes of technology as a means to convey aspects of human embodiment and the influence of mediated representation.

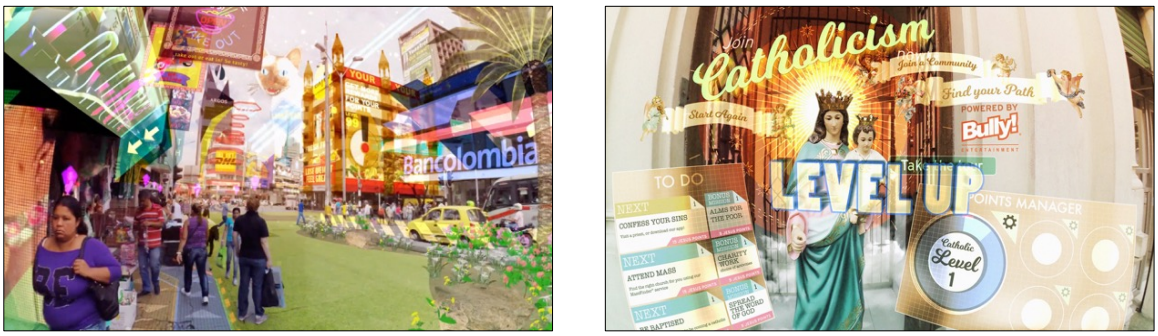
Within each specific work there is a process of documenting spatial and temporal experience from a first-person, subjective point of view.

The first film *Hyper Reality* by Keiichi Matsuda (2016) implements extensive use of visual effects to present a hypothetical future mixed reality scenario. This work is driven by a need to speculate around the idea of domesticity in a semi-permanent mixed reality.

Secondly, I will be looking at Janet Cardiff and George Bures Miller's video works. These films employ a more makeshift technique of Augmented Reality integration where a filmed walk is performatively 'retraced' by the audience who are situated within the same geographic space. Cardiff and Miller's audience are directed to follow the narrator's cues and instructions, whilst all the time watching through the viewfinder of the camera. This seemingly makeshift strategy is highly effective in producing a perceptual integration of the space. A strange kind of intimacy takes place in this context, as the environmental integration is established at the level of the psychological/perceptual, much as the spatially separated images that are presented to each of our eyes are unconsciously and virtually combined to produce our conscious spatial experience.

Finally, this section will address work by artist Film-Maker Paul Trillo. Trillo's work takes on a fictional narrative journey, attempting to explore and present aspects of the internal monologue of the individual human experience. This serves as a counterpoint to the earlier two examples, with more of a focus on the vocal expression of subjective

Figure 7.
Hyper-Reality (2016). Dir. K. Matsuda**.**



Note. Digital effects are added to frames from the film illustrating an fictional future augmented reality system. Retrieved January 17, 2019, from http://hyper-reality.co/

psychological time and a foregrounding of the way in which the emergence of fragmentary moments are influenced via emotion and memory.

01: Hyper-Reality by Keiichi Matsuda (2016)

Media Artist Keiichi Matsuda's short film *Hyper-Reality* (2016) (Figure 7) presents a speculative vision of a future where digital co-habitation and differential presence are integrated into a mixed reality world. Filmed from a first-person point of a view, the film tells the story of a person inhabiting a mixed reality whilst carrying out mundane domestic chores. The digital representation of space provides an oversaturated vision of digital stimulation, full of alerts, social media feeds, and metrics that extensively cover over the physical architecture of the environment. A myriad of geo-located, context sensitive and personalised pop-ups repeatedly present themselves as the inhabitant journeys through a small town. The sense of constant interruption and intrusion is further enhanced via the gamification of the ordinary errands being carried out. Through the eyes of the participant, we find ourselves seemingly drawn toward a constant need for some kind of virtual recognition, much as is the case in context of videogame high scores, or 'likes' on social media.

The theme of lived experience is one of the central concerns of this thesis, that also addresses the social dimension of a mixed reality enabled scenario, this differs in important ways from an enclosed virtual reality experience. In the context of the

theorisation of virtual reality there is a history of isolated privacy which relates to the Leibnizian concept of the monad. For Leibniz (1714; Rescher, 1991), monads exist in total disconnected isolation from one another, but they are synchronised in their 'internal' projection of a common world, which provides an illusion of contact and intimacy. Michael Heim's written works, which began in the late nineteen-eighties, draw on this Leibnizian idea and continue to explore the metaphysical effect of transitioning in and between the technological-virtual world and the actual-real, arguing that this transition creates a sense of discombobulation due to VR's potential for escapism and body amnesia. Heim claims that no solutions to these problems have yet been found, not even in the more recent 'third wave of VR' (Heim, 1993, 2017). However, in the context of AR and MR the inhabitant is forced to confront virtual and actual worlds simultaneously, which perhaps lessens the potential for privacy and escape and in some sense provides the solution that Heim appears to be seeking. Therefore, whilst Heim's work does not specifically relate to mixed reality scenarios, which blend this transition into a single hybrid space, it nevertheless offers a case in point of how a lived experience might marry shared worlds of privacy and social interaction within an immersive digital manifestation of reality.

The more contemporary writings of Graham Harman (2018, 2019), which also to some extent extend Leibnizian thought, emphasise the inherent privacy of the objects/entities that can be encountered within the world and the fundamental inaccessibility of their 'withdrawn' but nevertheless dynamic cores. For Harman, the interiority of other entities is 'molten', but fundamentally inaccessible. He suggests, however, that an 'aesthetic liaison' takes place between us and these independent and fundamentally unknowable objects, which is conducted upon their "phenomenal sensual surface" and attributed by Harman to the power art.

The film *Hyper-Reality* illustrates and questions the potential for lived experience that might one day be continually inhabited using technological modes of seeing and networked connection enabled by digital service providers. We see co-habitation here as

not only a private, human centric experience, but seemingly a world of continual co-existence between organic and inorganic intelligence. In Matsuda's work, human-looking AI customer service bots appear as the only points of communication and interaction with the inhabitant. Indeed, other people in the film are simply regarded as passers-by, rarely interacted with in the physical world, serving more as obstacles to be avoided on the inhabitant's journey.

In the context of the conception of phenomenal reality that is presented in Reid's (2007) *Two Virtuals*, the virtual-actual has been suppressed by an overwhelming virtual-technological representation. Matsuda's film illustrates the way in which, through the presentation of successful achievement, the virtual-technological embodies the inhabitants need for recognition and fulfilment, however illusory or superficial.

Whilst the sequence of shots in *Hyper-Reality* entirely inhabits a first-person perspective, there are a number of jump cuts interspersed throughout the film that serve to break the adhesion to an entirely real-time event. These jump-cuts fragment the linear timeline, moving the viewer forward in time toward the eventual sequence of digital breakdown of the inhabitant's mixed reality experience. Therefore, whilst the journey of the film's inhabitant (and the audience) appears to be continual, the physical space continues to change. Whilst this may be a necessary editing technique in order to move the story forward, it also serves to highlight how the digital interface is central to maintaining continuity. The consistent adherence to geometric arrangement and design of which remains the only constant, seemingly containing both the inhabitant and audience within its perceptual grip.

As the film progresses, Matsuda presents situations that cause the inhabitant to suffer increasing stress and anxiety. This is caused by the mixed reality system being infiltrated, to the point where the broadcasting of the user's points-based progress is in danger of being deleted as their system is hacked. We might consider this sense of social threat as a kind of 'virtual affordance', in that there is a recognised desire for social connection built into the designed presentation of this mixed reality. The inhabitants only

moments of respite appear to come when the mixed reality system is forced to reset itself in order to restore functionality. The digital network connection is momentarily broken, resulting in an audibly calmer inhabitant (whilst viewing a real-world religious statue). As the film closes, the users habitual need to re-connect with their mixed-reality world is made clear in so far as the inhabitant chooses to re-boot and reconnect with the system.

Within this sequential framework lived time takes on a series of layers dependent on the focus of the viewer/inhabitant. This situates the designer within the system of enquiry (which will be further discussed in Chapter 3). In this case the space/location for filming, and its narrative context for being, allows Matsuda to speculatively explore the combined effect of both the real and hyper-real qualities of lived time. Indeed, this piece, via its narrative queues, continues to question the level of overt influence and the effect of a digitally constructed and mediated system upon the individual's experience of time and space and their social connection to the real world. This system presented by Matsuda is specifically engineered to continually envelop the inhabitant/user and call attention to the "'invisible space' of electronic data flows" (Manovich, 2002; Matsuda, 2010d), providing a view of the virtual-technological world, with the system continually presenting (broadcasting) information to, and requesting data from the user (via aggregation).

The research and artwork generated by Matsuda over the last ten years has continued to speculatively analyse the effect of emerging augmented reality technology utilising the frames of domesticity and the future built environment. Indeed, given the recurring themes and iterative nature of the work shown from the *Augmented (hyper) Reality* series of projects (Matsuda, 2010a, 2010b) through to his later film *Merger* (Matsuda, 2018), it is argued here that Matsuda's critical design approach also utilises elements embedded in a cybernetic research AS design model (as is outlined in Chapter 3 of this thesis) in order to better iterate on the core concept of the domestication of mixed reality. The role of the designer within this work is one that incorporates a repeated

iterative process of critical design investigation. As Matsuda himself chooses to define: "design (is) a tool for exploring the future of technology and culture", looking to "define a new vision for reality, that exists at the intersection of virtual and physical" (2019). This technology-dependant vision is therefore in need of a continual reshaping, as both the technology and the resultant domestic habitation of the real/digital continues to be re-directed in response to societal evolution.

The consideration and employment of framing here also serves to provide a means by which Matsuda's work can be initially defined but nevertheless allowed to evolve over time. Matuda's thesis *Domesti/city: The Dislocated Home in Augmented Space* (2010d) considers a speculatively designed, perpetually inhabited, mixed reality. However, the design frame itself is defined by the changing nature of what Matsuda defines as a process of broadcast and aggregation: "I use *broadcast* to refer to the information that is projected by the user (and/or system), and *aggregation* to refer to the user-specific assemblage of feeds that forms a subjective reality." (Matsuda, 2010d, p. 39)

Matsuda states that a definition of domesticity might expand in a mixed reality mediated world, something that his later film *Hyper-Reality* seeks to illustrate, along with an increased awareness of the extent to which commercial interest might impinge on individual privacy. Matsuda alludes to this argument in his earlier thesis when arguing for an updated understanding of 'augmented space' stating that "the long-established dichotomies of public/private, home/work are merging into new forms of hybrid spaces and occupations." (Matsuda, 2010d, p. 2)

Indeed, this merging of public/private, home/work is interrogated through various films directed by Matsuda. Each critically interrogates how mixed reality might further mix the traditionally separated realms of professional and personal life (Matsuda, 2010c, 2010a). As Matsuda argues, the isolation of the domestic space from the industrial space is a relatively recent advancement in human history.

> The terms public and private themselves are becoming less useful in augmented space, as we deal with more subjective and less clearly defined distinctions. As

> the public and private spheres established in the nineteenth century merge, and space is perceived differently by each person, this terminology can no longer express universal spatial qualities. The boundaries and dichotomies through which we have constructed our cities are failing.

From *Augmented City 3D* (2010a) to *Merger* (Matsuda, 2018) we see this blurring of the public/private illustrated in increasingly confined and more desperate form. 'Merger' presents this world within a world as a spherical bubble of virtual interface as the human inhabitant becomes more consumed by the surrounding system that she exists within for both her work and social life. The urge to remain productive and included, and thereby useful and relevant to the system, results in her wanting to relinquish the corporeal confines of herself to fulfil the demands of the virtual.

In the context of this thesis then, Matuda's works can be viewed as exhibiting aspects of the intertwining contexts of study. The potential of technology to condition the point of view of the user, situated within a domestic scenario, provides a useful counterpoint to the industrial settings in which mixed reality devices appear to be primarily employed. In addition, there is a layering of duration and temporality throughout these works. Lived time has in a way become permanently intertwined with the speculative technologies shown in Matuda's work. That is to say that technological representations of reality here are used as a way to control the embodied behaviour of the user/actors. The level of control that the system has over the user is further understood when we consider the designed interactions that are taking place. In the case of *Hyper Reality,* the digital representations are designed to augment and enhance digitally networked social inclusion. This is further amplified by the designed modes of gamification that we see confronting the user.

02: The City of Forking Paths by Cardiff and Miller

Figure 8.
The City of Forking Paths. Cardiff, J., & Miller, G. B. (2014).



Note. Still frames from film. Retrieved August 13, 2018, from https://www.cardiffmiller.com/artworks/walks/forking_paths.html

Artists Janet Cardiff and George Bures Miller have a reputation for generating media artworks that explore the interaction between technology, space, and time. In creating one of their 'video walks' for the 2014 Biennale of Sydney, *The City of Forking Paths* (Cardiff & Miller, 2014)(Figure 8), the pair continued their exploration of what they term 'Physical Cinema', described by them as: "the blending of two realities, the virtuality of the video component and the concreteness of the real world." (Cardiff & Miller, 2014)

The 'video walk' requires each participant to embark on a journey, along a site-specific route through a city. This journey is augmented by pre-recorded video as the participant navigates along the route in a single take fashion. At certain pre-determined points in the intertwined physical-video journey, the inhabitant encounters unexpected events, which are seamlessly stitched into their walk, but which weave an alternate fictional narrative into the journey. The viewfinder of the camera presents a series of moments captured from a first-person point of view by Cardiff walking through the same space herself, simultaneously playing the role of camera operator, companion to the participant, and narrator of the film. Dialogue and performed events within the film emerge through the screen viewfinder and blend with the participants own walk, the surrounding buildings serving to anchor the real and recorded space together.

This notion of anchoring space via the synchronous amalgamation of both real and virtual realities serves as a key device with which to orient the user. Cardiff and Miller, as the designers of the experience, have to continually account for a user's embodied space, their orientation, and what we might term the 'representational space', provided in this case by the pre-recorded video. Addressing this self-aware and reflexive use of technology to create the feeling of being present in another hybrid reality, that both overlaps and departs from one's own, Miller explains:

> "We're interested in the philosophical aspect of how we know reality. People can be transported into a particular physical situation, and it can totally change their belief about what it is." (Cochran, 2018)

The experience presented within *The City of Forking Paths* requires a series of decisions to be made by both the user/participant and the artist/designer. The orchestration of these collective decisions is determined via the affordances that are provided to the user, by both the virtual and real environment, which go beyond the purely technical aspect of interacting with the video playback device. For instance, in one section of the video-walk we approach an empty telephone box, this is an affordance that seeks to engage the participants attention. Looking at the iPod Touch screen when pointed toward this phone box we witness a figure looking back at us from its interior. As a consequence, the presence of the figure becomes part of the ecology of the space.

As the user proceeds along the route certain allowances are made for pace, position and surrounding real world events. In their planning and making of the film, Cardiff and Miller have to take the position of user and observe where and how the experience reveals and hides itself, not only for the sake of dramatic timing, but also with regard to the personal safety of the user as they navigate through the city itself avoiding potential hazards as they go. Where Matsuda's work (discussed in the previous section of this thesis), presents the idea of a mixed reality as a space that envelops the inhabitant/user and concerns differing modes of attention dependant on context – from sitting idly on a bus to navigating a grocery store – Cardiff and Miller's work intermittently interrupts a

user's perceptual focus. This forces the participant to witness events within what could be described as a 'space of potential', filled by the mediated pre-recorded content. In this sense, the footage on Cardiff and Millers digital video camera viewfinder supplements the void of the potential space. This allowance for affordance throughout the video-walk allows for a participant's experience of the work to be generated iteratively via what Cardiff and Miller describe as editing that is 'complex and controlled' (Cochran, 2018). Cardiff and Miller themselves act out these journeys in advance continually creating new artefacts for each piece that can then be assessed and reworked.

> After we've done our rough edits in the studio, George (Miller) tries it out on location and discovers that there's way too many footsteps. His editing scripts are full of annotations to delete them. It is complex and controlled. We have test people try it out, and if they get lost, we add more instructions; if they get ahead in a section, we take out footsteps. (Cochran, 2018)

Mobile capture technology increasingly seeks to gather data from its immediate environment. This serves to both spatially position us as inhabitants, and to relate our position in the world back to us. It is within the context of this continual need to reconcile the virtually represented capture (via the video on the device being watched) and the embodied experience that is enabled by walking through the same space, that a sensorial gap becomes evident, which a mixed reality must attempt to reconcile.

Whilst perhaps rudimentary in its presentation of the mixed reality as compared to some of the more technical examples explored earlier, Cardiff and Miller's work nevertheless provides a clear example of the way in which technologically mediated forms of encounter can raise questions concerning the role of technology and its influence on both our perception of the world, and our latent awareness of the space that surrounds us. Indeed, Cardiff and Miller have noticed a profound change in the way in which their works are now consumed in comparison to the pre-smartphone era. As Cardiff explains:

> GM: When we first started doing video walks, we thought that we wouldn't need so many instructions because you could see where you were going. But there were a lot of people who couldn't visualize where a shot was going, so we had to put the instructions back in. Now that everyone has a phone with a video or camera in it, people are more able to follow the movement on the screen.
>
> JC: It's interesting how it has changed since 2000 when we did our first video walk at the Carnegie International. Now people just do it unconsciously. They can adjust much faster. It's interesting how our brains have changed, and we haven't even thought about it. (Cochran, 2018)

If we further consider this work from the context of lived time, Cardiff and Miller's video-walks enable a perpetually reforming encounter both with the physical space inhabited by the participant viewing the work, and the subjective variability provided by the device and its pre-recorded content, all of which takes place in the same geographic space. This encounter between the real and the virtual space collapses and expands our experience of time in very interesting ways. Whilst we might share the same space with other participants in the walk and with the people and actors that feature within the video, these spaces are physically separated by time and yet simultaneously taking place in the experience of the moment. Likewise, the calm, slow durational experience of a tranquil gallery setting might be subjected to a kind of affective interference by a more sinister presence on screen. In a sense this presents itself as a kind of mediated time travel.

There is a sense here of the temporal enfolding discussed earlier, as Cardiff draws attention to another representation enabled by the technologised capture of space and time "All these people from all over the planet – their paths are like virtual strings weaving the world together…" (Marks, 2014). This is the remnant that the previous inhabitants of the journey leave behind, a series of interweaving pathways that criss-cross our own, their physical journey is digitally captured in the past in order to become part of our encounter within the virtual space of the present.

Figure 9.
Forest Walk. Cardiff, J. (1991).



Note. Photo of participant experiencing audio artwork. Retrieved May 12, 2018, from https://www.cardiffmiller.com/artworks/walks/forest.html

Cardiff and Millers work serves to highlight where modes of experience can be calibrated and influenced through the use of technology. By using lived time as a conduit through which to alter the audience's perception of the anchored real space, the paradox of designing for and inhabiting or co-habiting within a mixed reality is made more apparent. Here we see that time allows for the layering of spaces, in an ever-enfolding amalgamation, where echoes of the past, along with staged and fictitious events, can significantly alter a person's sense of place and time.

This exploration of modes of technologically mediated experience has been a part of Cardiff and Millers work throughout their time working together. Cardiff's initial series of 'Audio Walk' artworks first captured the sense of duality within a space that might be achieved via the interweaving of technically captured pre-recorded audio, into a participant's lived experience of a physical space. This originated with the work *Forest Walk* (Figure 9):

> I was doing a residency at the Banff Centre in Alberta, Canada, experimenting with some various technologies, and I created what became my first audio walk…. Probably only 10 people heard it at the time, but it was the prototype for all the walks that followed. (Cardiff, 1991)

The use of audio to question sensory experience operates as the hinge between actuality and virtuality. This in-between space becomes important to and is explored in all of their subsequent audio and video walks. In documenting, recording, and ultimately replaying a particular time and place into another individual's experiential context, we see Cardiff and Miller question sensory experience through the exploitation of time, and the utilisation of a device's audio/visual capabilities, which serve to augment the space of encounter produced by each walk. Binaural auditory stimulation is particularly important to these works, serving to augment the real as we move through it. Cardiff and Miller's audio influences our contextual awareness of the space beyond the visually perceived or phenomenologically real, ultimately constructing a phenomenologically virtual encounter.

Video serves to further extend this augmentation, evoking a stronger sense of physical encounter. The encounter with temporally dislocated on-screen 'apparitions' within the physical space causes us to connect more with their motivations, which in some sense augment our own.

Cardiff and Miller continue to explore new technologies in and through their work, including the possibility of creating something that utilises virtual reality technology. However, as they state "For us, reality offers so much to investigate that we don't have to go to virtual reality yet (addressing here the technologically virtual). I think we've been doing augmented reality for years. Using a low-tech version of it seems powerful enough."

In the context of the practice-led work associated with this thesis, the auditory component serves as an additional supplementary layer of durational virtual engagement with the space, rather than a purely representational or informational commentary as is

traditionally provided by an audio tour. The use of spoken-audio provides a sense of socio-relational context to both the work and its audience that serves to supplement an experience that would otherwise remain relatively solitary for the user/inhabitant of the sculpture park.

The audio element also serves to construct a place of layered co-habitation in which individual inhabitants of the park are drawn into a hybrid socio-virtual place. In its layering of situational contexts, through the continuous construction of a responsive audio archive, there is a further augmentation of the inhabitant's experience which is both social and non-linearly temporal in character.

03: The Irrational Fear of Nothing (2016) by Paul Trillo

Figure 10.
The Irrational Fear of Nothing. Trillo, P. (2016).



Note. Still frames from film. Retrieved May 4th, 2017, from http://paultrillo.com/

If the trend of Matsuda's work concerns a sense of domesticity, augmented via the virtual-technological; and if the work of Cardiff and Miller operates in a more psycho-dramatic fashion; the work of Paul Trillo might be considered in fabulo-ethnographic terms, offering a virtual-actual journey through the 'lifeworld' (after Husserl (1970) and Jonas (2014)) of a fictional character.

Trillo's short film *The Irrational Fear of Nothing* (2016)(Figure 10) follows a day in the life of one man and his journey through a city. The film's gentle musical score is overlaid with audio commentary by the main character, Terry, who recounts, in the form of a stream of consciousness inner monologue, the thoughts of his character, as their day progresses. We hear Terry variously interpreting and navigating the world, dealing with

rational objective tasks and subjectively questioning the intentions and motives of the other inhabitants he encounters.

In its early scenes the film introduces Terry as a lone individual who is constantly over analysing his own place in the world. His days are predominantly made up of similar journeys to and from his place of work (as an actor for commercials). We see Terry venturing out of his apartment and proceeding to make his way through the city streets of New York, via the subway. Throughout this journey Terry is sensitive to the attention of passers-by, the inner monologue providing a commentary around how Terry is interpreting the thoughts and feelings of the people he meets, whether directly or indirectly. Terry's interpretation of these moments fuels his own self-reflection, constantly serving to either reinforce or fragment his understanding of place and time.

In its technical conception of time, the editing moves, via a series of jump cuts, between one part of the day and the next, sometimes moving back to earlier events. This reflects Terry's mixed perception of past memory and his present situation. The changing of time, which occurs variously via visual cues, by spoken references to the time of day, and through the edited intercutting of each place, alters the pace at which we the audience interpret and recombine our reading of the film. Our viewpoint is thus subject to an interchange which is based on the auditory internal monologue of Terry concerning his thoughts and feelings, and the filmed real physical events that occur around him throughout the day.

To achieve this, we see Trillo, as the Director/Writer/Editor, use various technologies to create a unique way of seeing the world from the character perspective of Terry. The films visual direction is captured utilising a wearable 'snorricam rig' this fixes the shot film entirely from a fixed third person perspective. As a result, we the audience perceive the world entirely from behind Terry's back. As he turns, so the environment moves around us, with the audience's view of Terry remaining fixed in the centre of the frame. This is at the same time overlaid with the pre-recorded audio track, which is a

combination of edited narration, voiced by the main character in the film, and is itself interspersed with a gentle piano-based musical backing track.

These combined methods of video capture and edited audio commentary, singularly focussed on a single character/inhabitant, can be seen as a filmic exploration that blurs the first and third person perspectives of a personally inhabited space. These elements of which we have seen in the philosophical debates covered earlier. The role of the individual, perception, and interpretation are all manifest here in the physical/virtual dialogue. It could also be viewed in a sense as a creative depiction of Bergson's view of the world as a matter flow of images, illustrating Bergson's view on how we are able to grasp this particular image from both without and within (both objectively and subjectively) (Bergson, 1911, 1988, 2001). In this sense it is the mixing of two perspectives on reality that is of particular value to this study and the practice that follows.

Within the confines of this worldview, we see the role of designer (in this case the film director/creator) as the architect or controller of interaction, information and encounter. In this sense, it might be useful to analogise this approach with that of a 3rd person videogame, in that such an example might be controlled by the player and at the same time have audible narration applied from the point of view of the game character as they are moved through the world[13]. This auditory augmentation of interaction provided to the audience seeks to provide both feedback and context of the surrounding world to the player and thus provide objective and/or subjective guidance. In the context of mixed reality interaction, the design of this audible component might also be designed to mediate experience.

[13] Videogames that use this approach in a narrative context include titles such as *Uncharted* (Naughty Dog, 2007) and the *The Stanley Parable* (Galactic Cafe, 2011)

The Irrational Fear of Nothing uses elements of this mediation of experience within a cinematic context of design. We are in a sense audibly and visually reliving someone else's construct of journeys through and memories of encounters in the world, without having any direct control of the actions taking place. Without direct control (of the characters movement) the use of design is applied here as a device through which to constrain, edit and control our experience of lived time. Here the audience's own contextualisation of experience is designed to be intertwined with Terrys. Both experiences are in sense *haunted* (in the Derridean sense) or subject to the *causal efficacy* (in the Whiteheadean sense) of the inhabited world. As such the film appears to be an introspective exposition of thought and experience.

If we instead read this film in the context of the modes of the virtual previously discussed, we can interpret the editing of this film as attempting to record and recombine scripted modes of the embodied virtual-actual. In this sense the film also relates to the practice-based element of this thesis in that we assume a point of view within the world of the sculpture park which contains recordings that are recombined as we move through the mixed reality audio and visual experience.

A mixed reality view of the world can be considered to offer similar modes of enquiry to this film, but, with its technical overlay entirely synchronising with the personal world view in real-time, there is a potential to influence not only contextual information but introduce alternate perceptions of space and identity. These might be based off of the encounters from previous co-habitants of this space, or perhaps generated from the recorded memory of the individuals own previous encounters. This variability of experience relates back to Bergsonian and Derridean perspectives on time and memory and the arguments around the impurity of the lived present. The research-led practice element of this thesis then looks to emerge and inform this approach. Ultimately it is suggested here that mixed reality perspectives on time / memory can emphasise and explore the impurity of the lived present.

As we have seen, a lived time presented within this film is one that appears fragmented and disjointed, but this is perhaps only the view afforded to the audience watching, if we empathetically take the place of the main character viewed as the first-person inhabitant/observer we better understand the context being unique to the individual, with duration being dependant on interpretation of memory in combination with present thought and focus. Events that happen in and around the person at any one moment affect the breadth of the specious present if they are directly perceived and then questioned, both in the moment of encounter and when reflecting back on the moment. This is what directs the mode and context of further encounter throughout the disjointed journey.

This is not the first time that Trillo has used this mode of audio commentary to investigate modes of lived time, we see this in an earlier film that has a narrative focussed more exclusively on the concept of re-treading the same journey. In *A Truncated Story of Infinity* (2014) we see Trillo investigate modes of perception and ways of being. Trillo explores this via similar notions of introspection and lived time but in an even more fabulatory fashion. This film articulates the concept of one person's (Subject X aka Vincent) experience across what have been variously termed 'multiple parallel realities' or 'parallel universes' (among others) that are each explored in turn via the arbitrary choices 'Subject X' makes, particularly in relation to a potential connection to Subject Y. In re-treading the same journey over and over, we see Vincent make small changes in choice that significantly affect the resulting outcomes.

Again, we see that it is the accompanying auditory monologue that serves to connect these parallel internal and external universes, as the narrator explores and explains the nature of infinite possibility. In this sense the modes that describe a multitude of universes (a multiverse) are not so different from the internal subjectivities explored by Heim (Heim, 1993) and Leibniz (Garber, 2018; Leibniz, 1714, 1952)[14].

[14] Further analysis of Trillo's work is covered in Appendix 2. A Truncated Story of Infinity

Example Works Summary

Observed via the intertwining contexts of study that serve to orient this thesis, each of these works can be seen to concern themselves with mediating and exploring the boundaries of the relationship between user and observer/designer.

The works of Cardiff and Miller perform in an artistic mode, revealing affective and temporal aspects of reality via the use of sound and video technologies. In a sense they seek to expand the potentials of devices that have existed for some time, in order to produce a novel form of perceptual augmentation. In comparison to the works of Matsuda and Trillo, the use of technology within Cardiff and Miller's works is relatively rudimentary. Audio and video recorders are used in playback mode as a trigger for breaking or interfering with the affordances of embodied experience, experimenting with existing technologies, in a bid to disrupt conventions of usage in order to reveal the 'apparitions'/'hauntings' that such technologies can accommodate.

Each work in itself challenges the common measurement of mechanised time, preferring to explore a more experiential aspect of lived time, and to illustrate diverse aspects of the differential durational realities being experienced. This apparent closeness to the individual experience, and their navigation in and through co-habited space, highlights where and how a perpetually inhabited mixed reality might deliver expanded senses of both clarity and confusion.

Whilst each of these works might be in some sense positioned as art, it is clear that the role for design within this amalgamation of spaces is crucial. By observing and reconstructing aspects of this mixed reality, designers are concerned not with the technical problem solving that is so important in the initial engineering of mixed reality devices, but rather with the anchor points and affordances that might allow human inhabitants to filter and comprehend such spaces, and in some cases distinguish one layer of reality from another.

In addition, the collapsing of space and time that occurs within hybrid realities brings with it a newer contemporary notion of co-habitation. Whilst a myriad of different avenues of exploration present themselves within this context, the idea of layering elements of shared experience within an inhabited mixed reality space provides the opportunity to further explore dimensions of this mode of existence. Despite the potential for environmental intervention and the temporal shifts that are offered by a mixed reality, the need to co-habit such a space brings with it a concretion of the real that currently is obscured in social network environments.

Each of the pieces covered in this chapter attempts to present virtual co-habitation in quite different ways. Matsuda's work *Hyper-Reality* presents digital co-habitants in the form of the alerts and prompts which appear on the digital overlay that accompanies the inhabitant's life, with real persons serving only as obstacles. In the case of Cardiff and Miller, we encounter the vestige of real persons, existing contemporaneously, both in and out of time. That is to say audience and apparition, each alone in time, are curated together into the space of the predetermined route. Trillo's work on the other hand sees its main character project delusion and paranoia, stemmed from self-doubt, onto the strangers that he meets. This internal battle of social inclusion and exclusion plays out as a peripheral constant, occasionally emerging as a central concern when social contact is inevitably made.

Each of these works might be considered a practice-based enquiry into the themes of technological potential, the influence of lived time, and the role of the artist/designer, all of which are brought to bear on a co-located space. Each creator specifies modes of development (composited visual effects, audio/video recording, a snorricam rig) that have in some sense directed their works and enabled them to address their overlapping themes of enquiry.

Impressed by the way in which such works explored the themes in question and intrigued by their various registers of operation, I wondered if an approach to their production might by systematised at a methodological level. Accordingly, this thesis

seeks to amalgamate the methods of Speculative Design and Research AS Design, in an attempt to enable an iterative/reflective approach to design and development within a framework of abductive inference. It derives a practical workflow out of the thesis' themes of enquiry, which enables the resulting artefacts to progressively inform a better understanding of lived time and co-presence in a mixed reality context, whilst incorporating this with an understanding of the role of the designer and the implementation of a suitable design enquiry system, which will be discussed in the following chapter.

Chapter 3 Methodology

Typically, a design methodology follows certain well tested principles. From the application of the 'Double Diamond' method advanced by the Design Council (2005, 2015), to the 'Design-thinking' approach promoted by IDEO (2015; 2016), each has a formula designed to explore and solve design related problems. In stark contrast to this, Rittel (1973) introduced the notion of a 'Wicked Problem' in design. Rittel drew attention to design contexts which were complex, not straightforwardly resolvable, and tended to perpetually generate further problems, as opposed to reaching any kind of a determined solution. The approach taken within these pages attempts to bridge the apparent gulf that exists between these rival approaches to design.

Whilst extant modes of research may offer specific benefits in terms of testing modes of interaction and immersion[15], none appear to offer a suitably integrated approach that considers the designers perspective, an openness to future potentials, and most significantly the influence of lived time. Investigating the contexts of study and their point of intersection, the designer can begin to develop a perspective and a direction. This thesis attempts to embody a viewpoint emerging out of mixed reality technology, temporality and co-presence, whilst constructing a practice-based methodology to creatively investigate and reorient such themes. Thus, it combines a methodological approach, more typically found in the expressive arts with a more specifically design research-based methodology.

Both *Speculative Design* (Dunne & Raby, 2013) and *Research AS Design* (Jonas, 2014) can be considered emerging research methodologies, and whilst Dunne & Raby's approach has been highly influential, neither has been expounded in a particularly

[15] In particular a method connected to Glanville's work surrounding wicked problems and relational design offers some measure of parity in approaching a complex problem scenario via a living systems (Glanville, 2013; Yolles, 2020). However, this does not appear to offer the same kind cyclical creative iteration presented here.

systematic fashion. They would each seem, however, to be particularly useful from the perspective of this research project. In a theoretical sense they enable designers to both address and actualise future potentials in the form of the incorporation of a less metricised/ Cartesian, more temporal dimension to MR and AR scenarios (Dunne & Raby, 2013, p. 3, 2018; Jonas, 2014, p. 24). However, in a more grounded sense they frequently make use of technological frames of reference, alongside the importance of the notion of 'framing' and 're-framing' problems. One of the challenges of this study is to make use of these techniques whilst also presenting such methodologies – particularly those of speculative design - in a more sober and accessible fashion.

In the context of the practical dimension of the work presented below (the construction of a mixed reality journey through a sculpture park), speculative design offered a means of approaching the future potentials of a situation, which in this instance was enabled by the technologically guided and intermixed spatial capture of an environment interlinked with a form of temporal (re-)framing that was provided by visitors spoken word descriptions of their encounters with the artworks in the park. Auditory capture offered the opportunity to deliver first person, subjective, experiential comments, observations, and testimonials, which could then be layered and incorporated into an ever-growing soundscape, in order to accompany subsequent audience experiences of the environment itself.

These approaches both emphasise the importance of what was termed by Charles Sanders Pierce as a notion of abductive inference (Peirce et al., 2018), over and above inductive or deductive strategies of reasoning. Conventionally induction and deduction form the foundation of scientific thinking. Deductive reasoning is focussed on certain conclusions following from a set of premises. This is commonly illustrated via the example –

- All men are mortal. (First premise)
- Socrates is a man. (Second premise)
- Therefore, Socrates is mortal. (Conclusion)

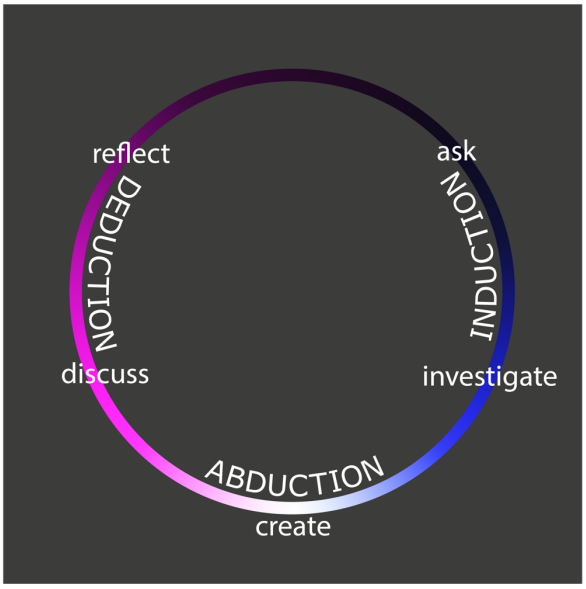
On the other hand, inductive thinking is concerned with observing regularity. For example, dropping a pencil a hundred times and establishing a rule that it is going to fall to the ground. Inductive inference establishes laws through the observation of regularities, and the assumption that those regularities will continue to apply.

Pierce's abductive reasoning connects to a broadly creative practice that is nevertheless linked to reasoning and intimately connected with hypothesis formation in the face of anomaly. As such it is the combination of creative and selective abductive reasoning (Minnameier, 2017) that is important to this study both at the methodological level and at the level of experience design. As Schurz has observed in *Patterns of abduction* (2008), abductions serve as: "special patterns of inference to the best explanation whose structure determines a particularly promising abductive conjecture and thus serves as an abductive search strategy".

Illustrating a cybernetic model of research

As we shall see shortly the inclusion of abductive reasoning, although originally defined by C.S Peirce, has already been adapted in a practice-based design context by Kees Dorst (2011). Before discussing Dorst further, it makes sense to first establish how abductive reasoning fits into a system of enquiry. For the enquiry system underpinning this thesis, a mode of abductive reasoning has been integrated into the system of cybernetic design research that was originally defined by design theorist Wolfgang Jonas (2014). Jonas' work is largely concerned within the fields of theoretical and practical design research and design science. In particular, Jonas has continued to develop research that is concerned with the social consequence of science and technology and the role that design plays within this. Jonas' design model featured a sub-component which he termed *research AS design* [sic], which was associated with the formation of new hypotheses in the face of experiential anomalies. This formed part of a larger conceptual taxonomy of design research that was based on a cybernetic ontology. However, as Jonas (2014) states in his paper *A cybernetic model of design research* each sub-concept has its own purpose of activity:

Figure 11.
Illustration of Learning cycle based on sources: Jonas (2015), Dewey (1910)



> "Many of these models (of design research) have a deficit, which obscures their potential: they do not account for the essential step of creating the new. They neglect abduction, which is the central mechanism of knowledge generation in everyday life, design and science." (2014, p. 26)

Therefore, whilst there is a fundamental openness to Peirce's abductive method, which has famously been implicated in processes of radical and unbridled, perpetual semiosis (as developed in the work of post-structuralists such as Eco, Derrida, Barthes), this is slightly tempered in the context of the Jonas work, and developed in a more formal and functional direction. Jonas proposes the use of abductive thinking within a learning cycle, as was first evidenced in the work of John Dewey (1910). Jonas integrates Dewey's notion of a cycle of learning into a model of design research that situates a designer actively[16] within an enquiry system, producing facts or artefacts based on values. Figure 11 positions the abductive step that lies in-between the

[16] Note that the diagram shown in Fig 11 makes a distinction between reflective and active practice – this denotes the division between the analytic realm of theory and the synthetic realm of practice (after (Owen, 1998)).

processes of induction and deduction. It is worth noting here that the diagram describes a process that is bi-directional, enabling an open transitioning between inductive and deductive processes. However, it is important to recognise that in either direction it is the abductive step that provides an opportunity to 'create the new'.

It must also be pointed out that whilst Jonas is more specifically concerned with the concept of research THROUGH design [sic] (RTD), he aligns research AS design within a similar mode of enquiry, albeit one with a more practice-based focus.

For the purposes of clarity then, it is worth considering this cycle in a more detailed fashion, within the wider cybernetic model that Jonas proposes, before clarifying the qualities specific to a concept of research AS design. This will then contribute to a determination as to where such a mode of research might be considered appropriate to this research-led practice-oriented thesis.

The four concepts of Design Research

Methodologically, the second phase of practice-based work presents the opportunity to practically apply and test an abductive method of enquiry. In applying this within the specific cybernetic model of design research termed 'research AS design', there appears to be an opportunity to determine the position of the researcher/ designer/ observer within an abductively led design-enquiry system. This specific concept implements a system to record the cyclic iteration of designed artefacts based on assumptions and axioms that arise through abductive reasoning, which can then be further defined or refined via frames of enquiry.

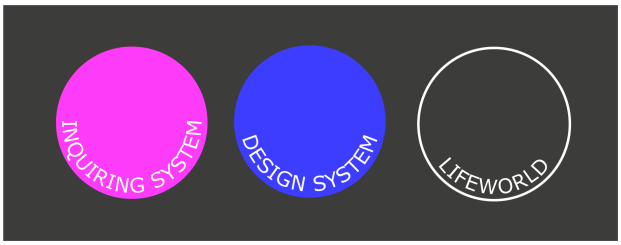
To further clarify this method of enquiry and determine its viability in a mixed reality setting, it is worth spending a short time discussing each of the components that make up the overall system – both the contextual indicators that determine the areas of reference and the position and perspective of the designer/observer within. Then, as the model employed here differentiates research AS design from three other conjoined

conceptual approaches to design research, it is worth illustrating each in turn to offer a comparative distinction.

Each approach corresponds to one of four generic situations of enquiry – these situations relate to the observer/researcher's position, purpose, intentionality and attitude toward subject matters (Jonas, 2014, p. 30) within what is referred to by Jonas and Glanville as the 'lifeworld' (after Husserl (1970)).

First, the space in which each approach is situated is made up of three overlapping areas of reference (Figure 12):

Figure 12.
The areas of reference in the Jonas cybernetic model for design research



The inquiring system sits within a system of design. The inquiring system is processual and temporal in the sense that it allows for changes in position and perspective throughout the different stages and aspects of the project, but always remains within the broader system of design.

Both of these interconnected systems sit within the lifeworld. This definition of lifeworld can assume a number of alternate but related meanings. Here it borrows from the Husserlian concept which emphasises a state of affairs in which the world is experienced, and the world is lived (Husserl, 1970), and it goes on to combine this with aspects of Jacob von Uexküll's Umwelt – the phenomenological surroundings from the self-centred point of view (Uexküll & Mackinnon, 1926).

Second, the key distinction between each cybernetic approach concerns the observer position, direction and perspective (Figure 13). Therefore, located within the overall lifeworld are a set of indicative symbols that together constitute the designer/observer

and the relative perspective. To be clear, these symbols consist of three interconnected components:

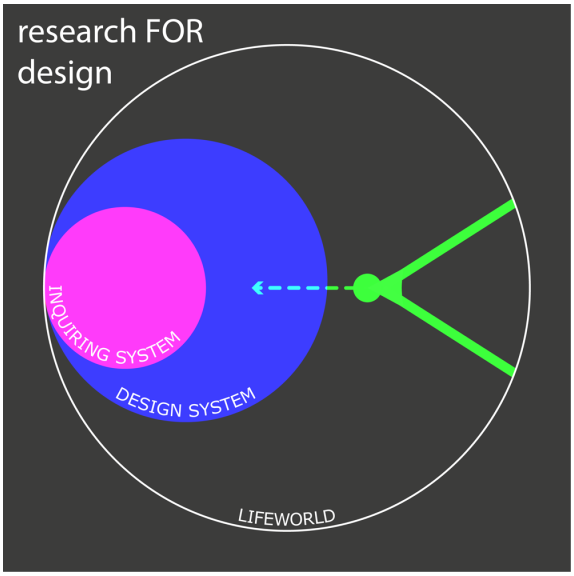
Figure 13.
The components that make up the observer position, perspective and outcomes



1. The Observer Position (& Direction) – This indicates the observer position relative to the design/inquiring system and the space outside of this system.
2. Perspective – This is a clarifying marker that has been added to the Jonas/ Glanville model by this author, employed here to better illustrate the breadth of perspective taken by the designer/observer. This is particularly useful when combined with the cone of futures used in speculative design, as we will see later in this chapter.
3. (Arte)facts – This is dependent on whether a process of 1st or 2nd order cybernetic observation is employed. 1st order cybernetics produce facts, 2nd order cybernetics produce/design artefacts. Further explanation is provided below.

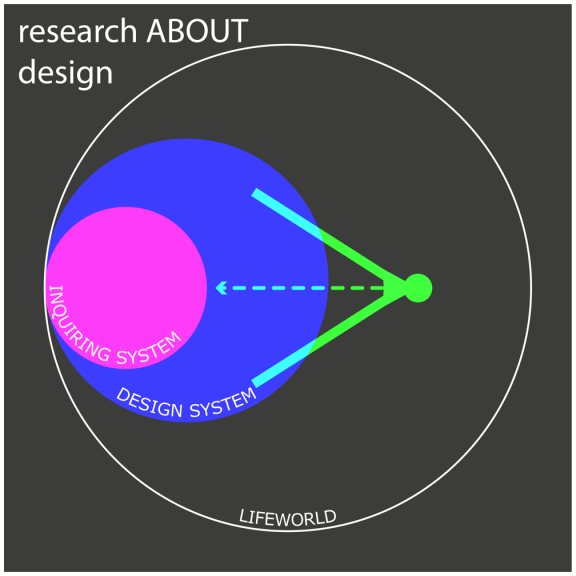
When combined, each of these components is arranged such that we see four different concepts that can be split into two groups.

Figure 14.
Research FOR design situates the observer outside the inquiring system



Note. Looking outward toward external phenomenon, informing a design system.

Figure 15.
Research ABOUT design situates the observer outside the inquiring system,



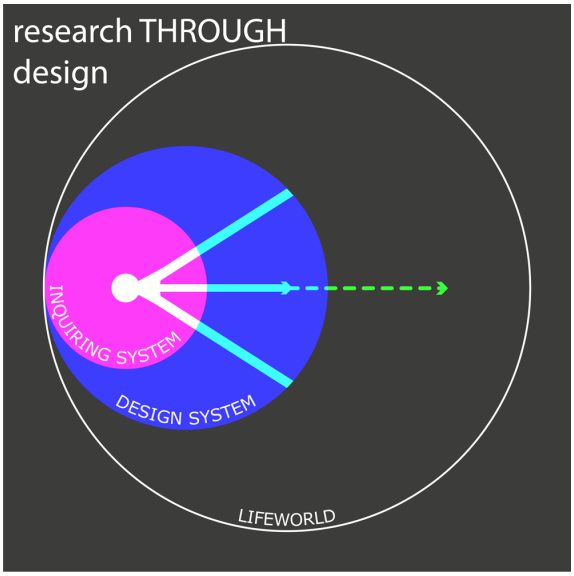
Note. Producing facts ABOUT the design system.

The first set of concepts are based in 1st order cybernetics, "situated outside of the design/inquiring system producing facts" (Jonas, 2014) :

research FOR design (Figure 14) is located outside a design/enquiry system. It looks outwards, generating knowledge FOR design using scientific methods. This area is informed by an objective mode of external input with elements that lie outside of the design system. For example, this could be an externally quantified dataset that informs/determines aspects of a designed solution to a problem.

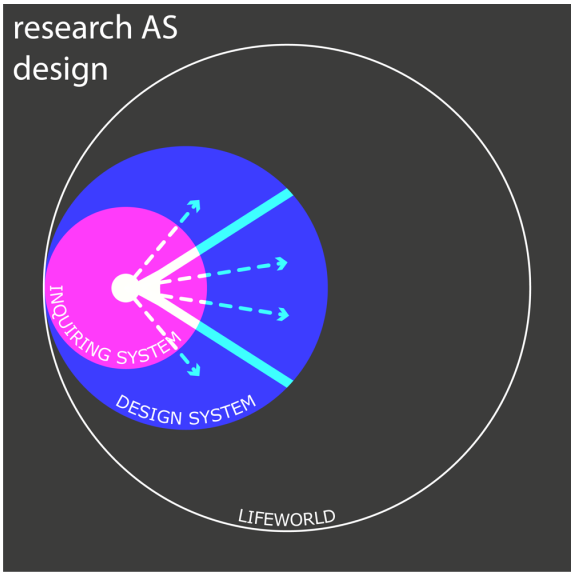
research ABOUT design (Figure 15) is also located outside design/enquiry system but looking towards the nature of design as a subject of disciplinary research. This might for example be empirical research that uses interviews in order to evaluate design processes in order to better understand how a skilled practitioner might approach the production of artefacts. We could include fact based publications such as Josef Müller Brockmann's seminal *Grid Systems in Graphic Design* (2008) in this model.

Figure 16.
Research THROUGH design situates the observer inside the inquiring system



Note. artefacts are guided by design process and purpose.

Figure 17.
Research AS design situates the observer inside the inquiring system



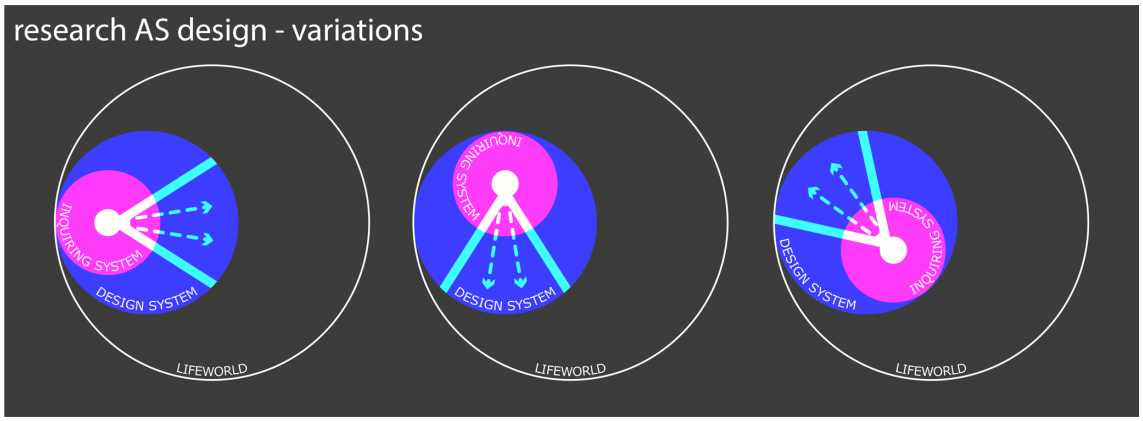
Note. producing new artefacts based on variations in abductive values.

The second set of concepts, based in 2nd order cybernetics, are located inside the design/enquiry system producing artefacts:

research THROUGH design (Figure 16) (aka RTD) is located inside a design/enquiry system. It looks outwards at the purpose of design and generating transferable knowledge. We can see examples of this in HCI projects such as Rob Tieben's *Gallery of Playful Moments* (2015), and Bill Gaver's *The drift table: designing for ludic engagement* (2004). Keiichi Matsuda's various works (2010b, 2010a, 2016, 2018) that together investigate various facets of a mixed reality mode of habitation could also be included in this approach.

research AS design (Figure 17) is also located inside the design/enquiry system but is differentiated from RTD in its focus on the abductive production of 'variations' (or 'artefacts') that in turn serve as material to guide the observers position and perspective. Whilst published research on this area is very limited (classed as 'emerging' by Jonas), we see potential early examples of this concept in the practice based speculative design work such as Gaver, Dunne & Pacenti's *Design Probes* (1999). In essence the concept of research AS design has the capability to offer multiple different

Figure 18.
research AS design allows for multiple variations to be created.



outcomes within the inquiring system, which may then be used to establish, enhance or re-frame a hypothesis, as illustrated in Figure 18. Therefore, when applied here, an initial disruptive moment is supplemented by design-oriented guidance (in the context of my own work, this is further examined through the practice-led, phased approach in Chapter 4).

Jonas tentatively proposes such a 'managed disruption', partially defining an 'emerging' cybernetic model of 'research AS design' as:

> An embodied/situated/intentional observer inside a design/inquiring system, concentrating on the production of 'variations' AS raw material for the design/inquiring process. Research in action, performed in the medium of design. →Design [sic] as the inaccessible medium of knowledge production: a learning process. Probably the essential mental and social 'mechanism' of generating new ideas, the location of abductive reasoning. Research AS design may denote 'Design Thinking' as a cognitive and social process, which, in turn, can be the subject of enquiry ABOUT or THROUGH design. (Jonas, 2014, p. 31)

Perhaps the most notable distinction between Jonas's research AS design and the approaches of research FOR and ABOUT design, concerns that lack of separation between the designer and their object of enquiry. For Jonas, the designer him/herself is positioned as a part of a cyclic meaning making process with less distinction between subject and object. Whilst this is arguably likewise the case with research THROUGH design, there is

nevertheless a stronger emphasis upon stability and regularity of communication which is less present in the case of research AS design.

As a short summary then, research AS design provides a position and perspective within a creatively led, but carefully phased, practice-based system of enquiry. It also acknowledges and provides space for an abductively led cycle of development, without explicitly defining an objective outcome. This may, in some areas of design practice, then transition into a process more aligned with research THROUGH design.

Importantly, research AS design amplifies the need for an abductive starting point and therefore might provide certain useful qualities for the research led practice explored later in this thesis, especially when coupled with a speculative design-based agenda.

An abductive starting point for research-led design practice

Initially this study might be seen as a combination of research AS design, alongside a kind of 'critical-making' which involves a cyclical practice-based process of reasoning, alongside an emphasis upon temporality arising out of speculative design. Indeed, the concept of critical making is described by one of its foremost advocates as "a cycle of focussed critical enquiry or sustained exploration aimed at discovery" (RISD & Maeda, 2013, p. 104) and exists as a counterpoint to traditional methods of design practice. This cycle of enquiry is further discussed in interviews on models of critique when Sutton, writing in the Rhode Island School of Design's *The Art of Critical Making,* asks faculty members to 'draw' the critique process (Sutton, 2013). Educator Leslie Hirst at RISD has described critical making as "transforming the ordinary into something meaningful – (critical making) involves absolute focus and an enormous amount of doing that is often hard to qualify while it is being done". (Hirst, 2013, p. 32). In a more formal setting this could be seen to resonate with the learning cycle described earlier in this chapter as well as with aspects of research THROUGH, and research AS, design. That is to say, for each of these design concepts it is through the performative *doing* of research and making that new anomalies and insights might be created and discovered. Jonas defines and

explores this *doing* in the context of what he terms 'projective abduction' via reflective play:

> Research on complex problems is presented as a reflexive play with observer positions, guided by the logic of the design process. This playful dance of perspectives is – in our view – the most important conversational medium for the generation of new knowledge. (Jonas, 2014, p. 34)

Therefore, whilst this merged approach of research THROUGH design and *critical* making might be seen as a straightforward method to more directly adopt, it is claimed here that such a method might be too limiting in the design of combined modes of representation and embodiment in a mixed reality related context that is more speculative in its manifestation. This is because the RTD concept remains more focussed on the inductive and deductive stages of process (at least in the research cited here). However, a focus on research AS design, applied more specifically via a perspective that allows a *speculative* approach to reflexive play/making, as popularised by Anthony Dunne and Fiona Raby (2013) (discussed in more detail further below) provides the potential to expand the research AS design approach toward a methodology that incorporates a stronger temporal emphasis.

The abductive anomaly. Before examining the role of speculative design within this methodology it is worth reminding about the importance of temporality. From the perspective of this study, it is important to recognise again that both induction (generalisation from encountered experiential regularities) and deduction (logically reasoning from premises to conclusions), can serve as responses to moments of abduction - the process of creative hypothesis formation in the face of anomaly.

Figure 19.
Scans contained anomalous fragments of geometry.



In the case of the research led practice element covered here, an anomaly appears at two different levels of temporal exploration:

- At one scale there is an anomalous aspect of allure generated by the absence of artworks, and the presence of audio fragments, all within the generated MR landscape of the sculpture park via the practice work proposed later in this thesis.
- At another scale we can see the operation of abductive reasoning within the context of the 'two virtuals' as a conceptual hinge between the two spaces of the virtual-technological and virtual-actual. Abductive reasoning offers us the chance to generate speculative artefacts with the purpose of exploring/researching *between* the two spaces, without fully defining a *probable* fixed outcome, only an aspired outcome (an aim to orient the movement of the project).

For example, the initial notion that the 'absence' of an artwork in the computer-generated rendering of the landscape of the sculpture park could be used with purpose, arose out of initial anomalous voids and glitches that could be observed in actual scans (attempts to veridically scan and archive the works) (Figure 19).

These voids within the scans were initially a limitation imposed by the depth scan devices used and their corresponding data set. When attempting to reconcile these spatial datasets onto real-world photo and video captured locations, rogue layers of artefactual geometry appeared, which seemed to have been generated by the capturing process in and around areas of the site of enquiry that could not be seamlessly resolved.

This mode of partial spatial capture is not unusual in the processing and display of the geo-spatial information provided by depth sensing devices. As discussed in an earlier section of this thesis (Chapter 1), much effort has been expended particularly within

fields of robotics and photogrammetry in order to better resolve complex computation problems such as spatial anchoring, integrated object recognition and occlusion, and various rendering strategies that attempt to approximately resolve issues with 3D data reconstruction[17]. The large volumes of technical research attest to a variety of potential solutions, but again as this tends to fall under areas of computing and engineering, the resulting outcomes veering toward a deductive need to perfect the metrification of a space, without consideration for understanding how these voids might be appropriated as they are presented.

In the context of the methodology presented here, whilst in some sense concerned with virtual-technological modes of representation, the design does not specify that a 'perfect' spatial capture is necessarily a pre-requisite for habitable co-presence. In the pursuit of abductively defined aspired value then, to productively explore the merging of virtual-actual and virtual-technological, the lack of emphasis on a perfect replication of space might allow for other aspects of mixed reality, anomalous or otherwise, to be further explored and brought into the foreground of design investigation.

Given this alternate focus, the design methodology applied here offers an openness that might suggest or allow for alternate avenues of enquiry. In practice this was suggestive of the notion that a literal void in the data could serve experientially as both an abductive and alluring moment for the audience (this is further explained in Phase two of Chapter 4).

This additional use of audience as a framing stage of enquiry determines a temporal mode of analysis of the inhabitants (addressed later in this thesis as audience / stakeholders) for whom such an artefact is being designed. In this instance, the process of practice-based enquiry would utilise the frames of subjective temporal change to

[17] A broad selection work can be found that covers this area of research covering mobile mapping, surface reconstruction and SLAM (simultaneous localization and mapping)

explore and refine the design parameters of the inhabitant's experience through cyclical processes of induction, deduction, and abductive critical making.

We have already seen the connection between processes of abduction and the notion of allure, and the importance of them to this study when discussing the work on temporality by Francisco Varela and others. As a reminder, basic coverage of Varela's model of embodied cognition discusses the role of affect, memory, and prediction (also read as impression, retention and protention)(Varela, 1999) in determining the qualities of perceived image and its subsequent subjective interpretation by the individual.

In utilising the anomaly of temporal variability, we are applying a mode of abductive reasoning as a foundation for the examination and altering of the allure of immediate objects within a co-habited, digitally mediated, physically embodied environment.

Within the context of the practical work being developed in this research project, these combined elements of temporality, affordance and affect are constituent factors, or frames, that help to productively develop and modulate a situation enabled by a mixed reality experience.

Modulating frames

In discussing the role of abductive reasoning as a starting point for modulating the design of artefacts, the concept of framing and re-framing offers a more practice focussed proposal that runs parallel to the work of Jonas. Kees Dorsts' work looks to connect a philosophical understanding of the logic of design with hands-on practice. In 'The core of design thinking and its application' (2011) Dorst elaborates on the concept of framing from earlier work by Pierce (by way of Roozenberg (1995)), deriving a productive form of design based on a set of formal logic based equations that are centred upon the definition and use of abductive design reasoning (2011, 2017). This is realised by working backwards through the logic equation, from the aspired value the designer wishes to create, toward a working principle, and finally the created artefact

Table 1.
Abductive Logic equation - Source: Dorst

reasoning				
WHAT	+	HOW	leads to	OUTCOME
(elements)		(pattern of relationships)		(observed phenomenon)

normal abduction				
???	+	HOW	leads to	VALUE
(artefact)		(working principle)		(aspired)

design abduction				
???	+	???	leads to	VALUE
(artefact)		(working principle)		(aspired)

itself (Table 1). This artefact can then be used to re-frame the working principle and produce more artefacts, or further iterated upon toward the aspired value.

As Dorst (2011) states:

> framing is a term commonly used within design research literature (since Schön (1983)) for the creation of a (novel) standpoint from which a problematic situation can be tackled.

The process of framing allows a designer to reposition the contextual viewpoint through which they envisage a design problem. In so doing the designer may deduce a new approach to a situation, which may further reveal answers to the field of enquiry and subsequently may enable them to better recognise the desired value that is central to the enquiry.

As Dorst states in Table 1, 'normal abduction' (also referred to as 'Abduction-1') is often what designers and engineers do in problem solving – create a new design based on a known working principle and test suitability toward a pre-defined value.

Of more interest to the hybrid methodology discussed here is Dorsts second definition, which he terms 'design abduction' (also referred to as 'Abduction-2'). This sits comfortably within the context of speculative and conceptual design, in that the designer

Figure 20.
Geoffrey Mann - Cross-fire (2010)



Note. Retrieved 13th March 2018, from http://geoffreymann.com/crossfire/

is faced with both an unknown working principle and an unknown artefact. The challenge in this instance is to work on both elements in parallel and this is carried out through the appropriation of frames. Each frame presents the designer with a hypothetical working principle with which to explore the peripheral territory (or problem space) within which the aspired value exists. The creation of artefacts in exploring phenomenological themes within this peripheral territory develops insights, that lead to the aspired value.

Clearly this shares many similarities with the earlier cybernetic model – the artefact and working principle as defined by Dorst are fashioned and refined in tandem, just as the design and enquiry system sit together in Jonas's research AS design. Each embeds the designer with a view to using an abductive process within which artefacts form the principal element for production followed by reflection and/or investigation.

We might contextualise this method of production by once again considering this approach through the analysis of an artwork. As part of the MoMA exhibition 'Talk to Me: Design and The Communication Between People and Objects' (G. Mann, 2011) artist/designer Geoffrey Mann's 'Cross-fire' project (Figure 20)(G. Mann, 2010) considered the idea of a 'charged space' created by a domestic argument. In a more conventional setting this might be achieved by filming the two participants and cutting or moving the camera between them. However, Mann presents this as a theme through

which he proposes a non-material to material convergence. The artefact (the resulting film) instead visualises the surrounding sound waves created by this conversation. However, this is done not through the visualisation of sound waves, but by using stop-motion animation to present a deformation of the inanimate objects presented within a physical space.

In this case the author proposes that both the artefact - a time-based media - and working principle - a series of deformed sculptural objects - have been mutually co-developed toward an aspired value (the audience seeing the formerly intangible characteristic of the spoken word).

The remaining unresolved component within this logic equation is that of the means of defining the aspired value. In the context of this thesis the aspired value concerns a need to reconcile both sides of the virtual – the technological and the actual – within the context of a mixed reality environment, which will condition the design of artefacts and products.

The cone of futures

The process of speculative design advocates design as an activity projecting what *could be* (Dunne & Raby, 2013, p. 2), as opposed to a scientific endeavour of analysing what is (Jonas, 2014). The proposition of a 'proximate future' (Bell & Dourish, 2006) if applied in the context of MR, provokes a variety of complex questions, addressing the ways in which we might, or should, productively inhabit such an environment.

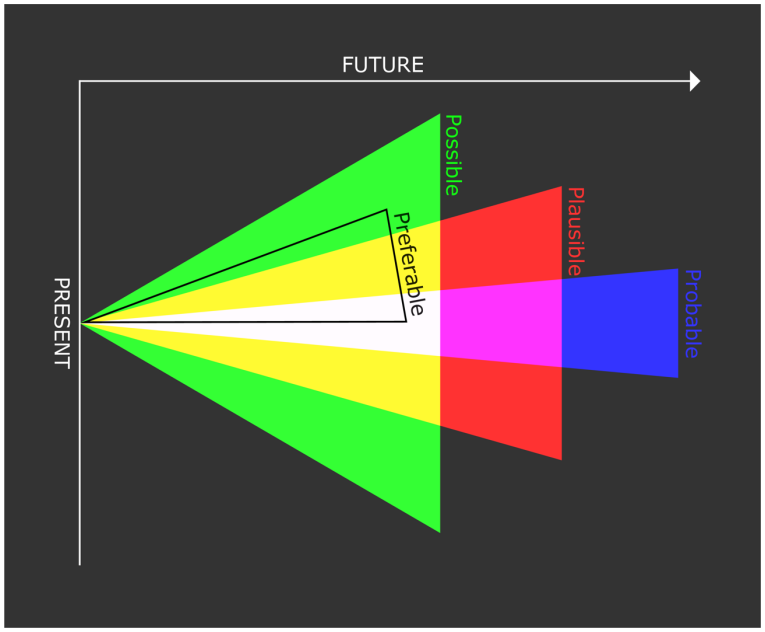
When considering mixed reality and technology, it is important to separate the perspective of speculative design from perspective of design fiction. Whilst each shares some similarities, design fiction is concerned more with analysis and exploration of ontologically 'finished' or finalised future worlds and the elements that populate them. With speculative design however, the purpose is to explore more an uncertain space of future potentiality via ambiguity and provocation. As Dunne and Racy state in

Speculative Everything its purpose is "to take a more poetic and subtle approach to interrelationships between the real and the unreal" (Dunne & Raby, 2013, p. 102).

The subject of a future 'inhabited' mixed reality is itself faced with the task of managing the interrelationship between the real and the unreal. It is here that we find speculative design providing a useful set of aspired value characteristics (the mode of encounter, the useful application of voids and absences, the variability of lived time) that lie beyond the bounds of critical design and making discussed earlier.

As we have seen above, the 'framing' of a design proposition is key to the adoption of a cyclical process of design. The process of modulating the frame of a problem context can lead to a series of designed artefacts, in both material and conceptual terms. The values inherent to this process are guided by the use of a cone of futures (Figure 21, P.106). Originally illustrated by Hancock and Bezold, this diagram presents a conceptual viewpoint situated in the present looking to provide a series of future perspectives. These perspectives concern 'levels of likelihood', with each gradually wider than the last, fanning outward from the probable (most likely/predictable) to the possible (not likely - but still not impossible / fantasy). In approaching a process of production with these perspectives in mind there is the possibility of generating speculative artefacts that "act as a catalyst for collectively redefining our relationship to reality" (Dunne & Raby, 2013).

Figure 21.
The cone of futures adapted from a combination of Hancock and Bezold (1994), Voros (2003) and Dunne & Raby (2013)



Building on Dunne's earlier research that utilised a concept of thought probes (B. Gaver and Dunne et al., 1999), the project *United Micro-Kingdoms* (2012) found Dunne and Raby defining an aspired value in the form of a thought experiment, – namely the question "can a nation state be designed?"

Using an abductive logic equation allowed them to design a system of enquiry in tandem with system of speculative product design. The resulting artefacts that emerged from this enquiry were informed by constraints / frames imposed by the design system, referred to in their project as 'kingdoms'. Each micro-kingdom's design system was modulated by a different set of (distinctly opposing) political, social, and economic ideologies. Dunne and Raby operationalised this influence by envisaging different modes of mass transportation (e.g., car, train, etc) for each kingdom that arose out of and resonated with these ideologies.

These outcomes present the audience with provocations which serve to question our present-day perspectives and societal ideologies. They also draw attention to the way in which new technologies can be seen to influence us.

Dunne and Raby's project provides a useful example of how a frame of reference can impact a design, and how a projects artefacts and outcomes can be extrapolated toward an unseen (and often unwelcome) future. In creating this project, the designers looked to build in a series of rule-based conditions that would modulate the frame through which each construct would be designed. Dunne and Raby's ruleset led to a juxtaposition of economic and personal freedoms, to be further considered by the audience of the work. Each artefact manifested itself through distinctive systems of belief, value, priority, and ideology; by adopting fundamentally different stances a set of "social, ideological, technological, and economic models" (Dunne & Raby, 2012) were able to be discussed that considered how these models might inform approaches to the design of future transportation systems.

> The projects (resultant) value is not what it achieves or does but what it is and how it makes people feel, especially if it encourages people to question, in an imaginative, troubling, and thoughtful way, everydayness and how things could be different." (Dunne & Raby, 2013, p. 189)

Figure 22.
Perspective change



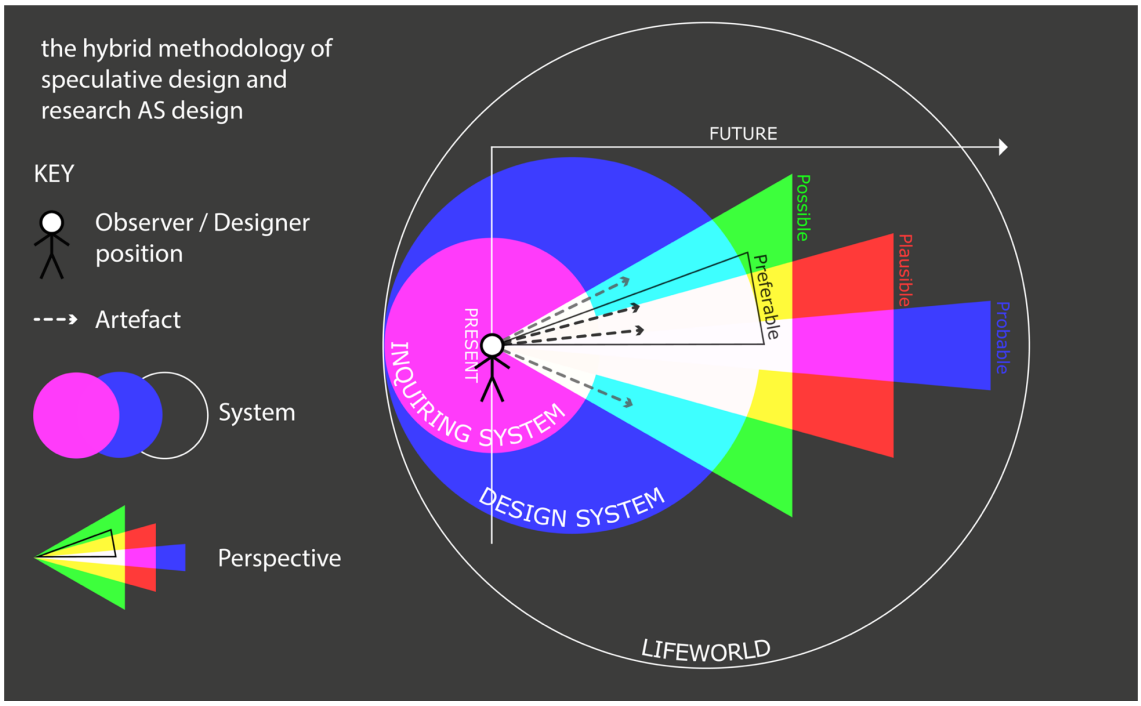
Note. The indicator for the designer's perspective is changed (from the left symbol to the right symbol) to reflect the speculative approach to making.

The research AS design approach to perspective and position, coupled with this 'modulation of frames' broadens the space for creative exploration and alternate aesthetic approaches, whilst maintaining a guiding purpose. This is illustrated in Figure 22 with the former perspective indicator used in the cybernetic diagrams (Figure 14, P.94 - Figure 18, P. 96) altered and enhanced to indicate the probable, potential, possible, and preferable perspectives.

This method provides a designer with a practice-based approach through which they might examine the intangible/unreal/speculative and then present resulting artefacts that take into account both aesthetic and psycho-analytic contexts.

Combining the methodological components

Figure 23.
A hybrid methodology for practice-research



Note. The authors novel combination of the cybernetic enquiry system *research AS design* (Source: Jonas, 2014)and the *Cone of Futures* (Source: Hancock & Bezold, 1994)

In the case of this thesis, we might consider the desired value to be the productive reconciliation between two environments, one virtual-actual, one virtual-technological. This might be achieved by investigating and developing a richer sense of temporality and the importance of allure in relation to mixed reality or digital/virtual worlds.

Figure 23 maps the cone of futures addressed here onto the earlier cybernetic system of research AS design. The observer/designer is still engaged within the design enquiry system producing artefacts. This enquiry system is informed via an abductively led learning cycle that considers an aspired value. It is however then enhanced through its widened perspective and in its broader measure of context. This arises out of speculative design's widening probable-to-potential cone which operates as a form of frame modulation.

Returning to the application scenario of a design practice-based approach to a problem context, we have developed an applied method for modulating frames that

inform the "production of 'variations' AS raw material"(Jonas, 2014). This denotes a process of iterative practice-based research that interfaces with the cognitive and social processes of abductive reasoning as defined by Dorst (2011). In so doing, the process of critical making inherent to Speculative Design is documented (the WHAT), presented for analysis (the HOW) toward its suitability (the VALUE) within the conceptual problem context, as was reflected in Dorst's diagram which was reproduced on P.102.

Conclusion for methodology and statement of research questions

In the context of the practice-based element of this thesis then, the WHAT becomes the iterative generation of artefacts, based upon a number of initial parameters regarding the potential for audio descriptions of subjective encounters with the works to affect the spatio-temporal perception of audiences of the works.

The HOW refers to the experience that is created through the combination of audio, video, and spatial volume which defines the created artefacts and the inhabitant's exposure to an ever-accumulating soundscape. These artefacts are created via the generation of a series of small-scale motion-based captures. The subsequent reframing of these artefacts then becomes instrumental in adapting or recontextualising the application scenario.

The VALUE addresses the richer sense of the importance of temporality that subsequently arises in the context of this project, and which conditions the design of a mixed reality scenario.

To reiterate the aims and hypothesis, in the context of this research, the methodology enables us to ask questions of mixed reality and then develop practice-based artefacts of investigation. This process raises several practical-theoretical points which also serve as catalysts for the research questions of the thesis itself, namely:

i. How might we explore the creative potential of absence in a Mixed Reality environment? (see artefacts produced as part of Practice Phase Three: Practically applying the intertwining contexts of study, P.142)

ii. Can virtual-technological platforms express a richer philosophical sense of virtuality? (see artefacts produced as part of Practice Phase Four: The different levels of spoken audio – from the perspective of curator, maker, visitor. P.164); and Chapter 5: Future exploration and analysis, P.178)

iii. How might the spoken word be used to incorporate a richer sense of lived time into computer mediated virtual environments? (see artefacts constructed as part of Practice Phase Four: The Layering of Spoken Audio', P.161)

In practice these points are evidenced via intertwining contexts of investigation and their influence on the production of artefacts that respond to a temporally sensitive mixed reality scenario. Alongside this practice, the commentary surrounding each artefact responds to the points above both in a review of their construction and also in discussing the effect of their consumption.

Chapter 4 Practical Dimension of the work

A documentary summarising Practice-Research can be viewed at:

http://www.stephenhibbert.com/

The PhD project uses a specific form of iteration within a series of practice-based phases of production and analysis in order to explore mixed reality using a form of effects driven film making. This offers a form of making that can be interpreted as both an artistic experience, but also has value in enabling a rich kind of navigation through a space such as shown in the context of the sculpture park. The purpose of this work is to enable a kind a prototypical visualisation that with the appropriate resources and time might be further developed into an interactive installation.

By using technologies inherent to mixed reality as a reference, a suitable taxonomy is developed. This taxonomy considers both technologies of representation i.e., the device capabilities; and the so called 'technologies' of embodiment as explored in earlier chapters surrounding lived time.

The practical dimension of this work ultimately seeks to present temporality and allure as a mixed reality scenario, using these qualities/properties as a basis for the presentation of a practice based speculative design artefact. Subsequent iterative phases of development continue to reshape the MR scenario in line with the aspired values of the project, by employing an abductive strategy/context, that can be viewed through the modulating frames of, interpretation, analysis, feedback, and social and cognitive enquiry.

This is intended to be achieved via the adoption of the methodology based on a synthesis of speculative design and research AS design, that was described in the previous chapter. The artefacts produced in this phase of the project stand as proofs of the working principles that are formulated in the pursuit of conceptual design production. The (abductive) artefacts themselves derive from, and in some sense inform the values

that shape the process of enquiry, as the work is developed in a reflexive and iterative cyclical fashion.

After some initial groundwork to establish both a process and working taxonomy of mixed reality-oriented design in phase one, phase two of the practice developed a focus for investigating this field along with the qualities of temporality and allure that are characteristic of the environment of an outdoor sculpture park. One of the core priorities of practice phase three of visualisation concerned the incorporation of aspects of the inhabitant's movement through a digitally scanned environment, which was overlaid on top of its real-world counterpart.

The digitally scanned environment played a distinctive role in so far as it introduced areas of 'absence' and/or 'distortion', where the artworks would ordinarily be found (see Figure 24).

Within this same space, in phase four an attempt was made to capture a more subjective sense of lived time via the collection of in-situ audio recordings from the site of enquiry, beginning with the capture of atmospheric sounds and later incorporating spoken testimony. Initially the captured atmospheric audio provided a sonic canvas/soundscape that served to supplement the absences and distortions in the digital rendering of the park, and this was later amplified by the auditory spoken-word component, which further explored the dimension of temporality in the capturing of the space.

In cyclically producing such artefacts, the changing frames of investigation allowed the designer to illustrate the mixed reality from a series of different viewpoints. The emerging system might be considered an aspect of co-design, having arisen out of the video and audio participation from a series of inhabitants/visitors.

The role of abduction that is so central to the novel positioning of both project and thesis comes to the fore at the level of both design methodology and the resulting

Figure 24.
Absence or distortion introduced through the scanned artworks



audience experience. In this sense the thesis and the practical work can be seen to become intimately combined.

Understanding the technical considerations

Practical and technical considerations relating to production of artefacts include the use of more advanced scanning technology, the use of digital point clouds to reconstruct a digital environment, and the subsequent processes of integration/compositing between captured video and the data of a series of 3D scans.

There are also issues concerning the capture of voice/audio. This component could have been enabled via mobile phones or microphones or, alternatively, listening posts might be more naturally integrated and embedded around the site, with audiences being directed to participate via a series of prompts or cues. In this particular practice work however, a solution is found via the use of mobile binaural microphones. These are carried by visitors to the park, recording conversations in and around a select number of sites. In practice this would produce spatialised audio in a manner reminiscent of the works of Cardiff and Miller that were discussed earlier.

The audio, video, and 3D Scanned elements are then edited together in order to creatively interconnect the diverse modes of capture. By mediating between the different sources, the designer is then able to abductively 'interfere' with the layered assets and consequently manipulate the temporal modes of habitation and experience, both for the inhabitant/participant, and any wider spectatorial audience.

Developing phases of practice-research

Whilst this chapter of the thesis concerns the evolution of practice-based outcomes, and their relationship to a set of methodological concerns, it's important to recognise that the early phases of the investigation were exploratory and experimental and that the insights gathered from this early work went on to determine the parameters of the study's emergent methodology which itself went on to condition the second phase of study. Thus, the work carried out at the sculpture park is only one outcome of the project as a whole, and the methodology which conditioned this is also intended as one of the projects contributions to knowledge. This methodology is embedded generically throughout the project in terms of the development of the intertwining contexts of study, and the cyclical method of abduction, investigation, and reflection, which enabled a phase of making along with a peripheral avenue of project specific technical enquiry, which in this case concerned the production of mixed reality focussed media artefacts. These elements have each continued to develop in a project specific fashion throughout the duration of the thesis, alongside the practice, all the way through to the later stages of practice-research that fully realises the aspired values of the thesis.

To be clear, throughout this evolution of work there have been four phases of research. Phase one constructs a taxonomy, phase two considers the abductive cycle, phase three fully converges the methodology and context of study, and it is only in phase four that processes of making occur that constitute the practical outcome of the project. In getting to this point, neither the practice nor research aspect entirely dominate this process. Instead, both were worked on in tandem, to inform one another and to develop a balanced method of exploration.

To elaborate a little, the first phase of research investigated a speculative visualisation based on then current developments in wearable technology, with a view to identifying a methodological approach that could be both speculative and rigorous (see Chapter 3). In a sense this phase has now come to be usefully described as a pilot

investigation that led to a 'creative taxonomy' of terms surrounding a mixed reality-based experience.

Phase Two of the practice-research sought to apply the abductive methodology in order to hypothesise a sketch for the making phase, that could be developed and tested in a small scale, rudimentary fashion – in this case utilising a fairly crude portable 3D scanner. At this stage there was a related concern with establishing proofs of practical technique and technological feasibility. Particular attention was paid to the moment of capture and to the digital reconstruction of layers developed out of the depth-sensed environmental data.

Phase Three went on to look more closely at refining the implementation via the intertwining contexts of temporality, technology and the role of the designer. This was carried out via the capture and visualisation of space, and these were juxtaposed with aspects of lived time - in this case utilising the movement of inhabitant's journeys through the park. This resulted in an emphasis being placed on the shape and dynamics of repeat journeys through the space and then ascertaining what might constitute moments of encounter.

Phase four builds upon elements of phase three, but supplements and amplifies the affective dimension of lived time by layering passages of spoken audio upon the motion-based mixed reality visualisation of a number of journeys through a section of a sculpture park.

In summary, over the course of the thesis, the practice has developed from a first phase that was initially concerned with a more formal HCI focussed exploration of the component parts that might be used within a hypothetical mixed reality system. Phase two departs from this more scientific, HCI-led approach, beginning to lean more towards the speculative and fabulative forms of enquiry that are associated primarily with arts-oriented modes of research. This was then re-grounded in phases three and four through its application to a more situated context, combining the notion of designing for plurality

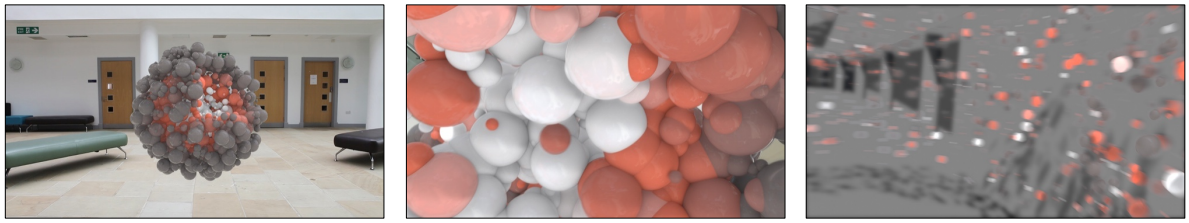
through the frame of a mixed reality, with the context of a culturally consumptive environment in a sculpture park.

However, just before embarking on the central practice-research it is also worth considering the original practice-based work that informed the thesis as a whole, in order that both the original process of making, and context of visualising a mixed reality enquiry can be more suitably understood.

‘Another Reality’ and the potential for technology

Practice phase video: http://www.stephenhibbert.com/pre-phase-one.html

Figure 25.
Another Reality short film. (2014)



As briefly covered earlier in this research work, prior to undertaking this thesis, I had produced a short film, entitled *Another Reality* (Figure 25), that sought to investigate a measure of mixed reality. The film, which explored dynamic immersion and interaction, served as a significant foundational element to the enquiry conducted in these pages. It attempted in part to speculatively visualise a future mixed realty system, utilising characteristics of the then current hardware design. The main purpose was to demonstrate how a three-dimensional user interface might be virtually anchored within a real environment and then to illustrate how such an interface might work from the point of view of the user.

As the project progressed the numerous issues surrounding the ‘user’, or what we’ve now come to address as the *inhabitant’s*, need for feedback and affordance within this immersive context arose. The choice of the term inhabitant does not simply reflect a whimsical choice of label, rather it positions a person in radically different terms. The design oriented ‘user’ is typically considered in a very immediate and purely pragmatic fashion, as an entity confronted in the moment by a specific problem or scenario that needs to be navigated towards a solution. Contra this, the ‘inhabitant’ that is framed in this thesis has a richer and more fragmented kind of interiority, being positioned as an entity with memories, imagination, feelings, and rich sense of socio-relationality. Whilst the earlier project highlighted the need for certain kinds of user feedback and affordances in the context of practical MR scenarios in order to form a connection with

Figure 26.
Varjo. (2019). XR-1 Mixed Reality Device.



Note. A mixed reality view of virtual car is placed on a live video feed of the environment. As the camera (attached to the headset) moves, the lighting applied to the car is continually adjusted via the use of image-based lighting from surrounding real environment. This is expected make the combination of real and virtual more seamless.
Retrieved July 2, 2019, from https://varjo.com/xr-1/

the environment, and an awareness of their location and orientation within it, this feedback was concerned primarily with a grounding of the user. Typically, this form of feedback might be provided via sensory cues such as graphic effects (e.g., physically based lighting) or auditory stimulation (e.g., located environmental audio).

Real-time devices that appear to implement some forms of environmental feedback have been seen in recent years in the form of industrial devices such as the Varjo *XR* (Figure 26). This device operates as a 'video see-through' head mounted display meaning that the participant views the world through a live video-feed, with pre-built graphic objects integrated into the viewport in real-time. One of the Varjo *XR* device's principal marketing points is its attempt to 'seamlessly' integrate the digitally rendered versions of real objects such as a newly designed vehicle cockpit or car model into a real environment through the use of dynamic lighting, which is achieved via the real-time filtering and processing of the real/actual physical lighting conditions that surround the user.

> "With XR-1 we are able to explore digital objects as natural extensions of the real world. Varjo's vision is to create a mixed reality where you cannot tell apart anymore what is real and what is virtual"
>
> Uhro Konttori (2019)

Whilst these industrial use cases continue to be developed in various settings, and clearly offer avenues of technical advancement, they tend to be focussed on highly pragmatic and known contexts of use. There was a significant shift in the project associated with the current body of research, however, where affordances were now sought, not to more precisely orient the user, but to instead encourage imaginative lines of inhabitant *escape*. Such affordances were typically provided by absences and voids in the modelled landscape, which were then supplemented with layers of descriptive and associative audio.

Exploring the limitations of digital capture

The setting for *Another Reality* also highlighted the reliance on a distinctly Cartesian formation of the environment, that was highly subject to measure. The film's location within a covered atrium space allowed for the area of capture and subsequent interaction to be contained. This resulted in the potential for a fairly precise form of capture within a

Figure 27.
The two contexts of measurement.



Note. (Left to right) The atrium space provides a measure of control with its manufactured lines and uniform decoration. Whereas the later phases of the project proved to be a more significant challenge in terms of metrification.

Figure 28.
Generating marker less depth-based data



Note. Each of these environments use different software solutions to generate motion tracked points but in any case demonstrate how much more complex a natural setting is to track accurately. The image on the left can rely on many fewer points to generate a stable motion track. Nevertheless, these constraints served another purpose later in the practice-research phase.

'controlled' environment - one that constitutes a highly geometric artificial space - clean/white/carefully designed.

In contrast, the challenge of the current project was to implement a mixed reality in a more naturalistic setting, that was open to many contingencies which cultivated a range of distortions (Figure 27, Figure 28) in the spatial data. These flaws and anomalies were creatively exploited in the context of the new project, by foregrounding their resonance with the more creative cultural concerns that are associated with perspectives arising out of the arts (e.g., duration as a mode of warped, distorted, sculptural time), along with the embrace of more experimental, less pragmatic, approaches to the world.

In a sense this adjustment to the process became a key factor in the later stages of practice. Rather than being seen as a constraint, anomalous errors in the scans and 'spaces between' each reality became core points of expression of the real/digital marriage, with voids and absences serving to point toward the fragmentary nature of the experience of the moment.

Practice Phase One: A speculative system investigation

Practice phase video: http://www.stephenhibbert.com/phase-one.html

Generating a space

The purpose within this first practice phase is to investigate two key areas connected to mixed reality capability by developing an understanding of depth-based data processing, and its resultant compilation and manipulation within a wearable head mounted display-based system[18]. More specifically this means:

1. Investigating the likelihood of generating real-time environment data to be used within a speculative interface utilising a depth sensor, potentially alleviating the need to use the vision-based 3D tracking that can be found in many earlier AR implementations (Haller et al., 2007) .
2. Investigating the potential to rapidly integrate the real-time data alongside designed bespoke content into a head mounted display

Both of the concerns listed above require the data output from the head mounted display and depth sensor, along with a suitable software environment that can serve as an integrative bridge. In this speculative scenario, this integration is expected to be realised within a versatile software development environment such as the Unity Engine, developed by Unity Technologies. Using this software, a spatially captured three-dimensional environment can be generated and subsequently used to test each device as necessary. In speculating upon the way in which a series of compatible third-party plug-ins or application protocol interface (API) programs could be used, each connected device's data, input and output through this system, could theoretically be integrated in order to realise a 'unified' and interactive virtual/real environment.

[18] The two-step approach adopted here would later prove to be important because of the implied separation of processes needed when considering the capture of spatial data and the ability to reconcile both fixed points of capture and motion (time) based capture.

Understanding depth-sensing capability. The first key area of enquiry for this phase concerned the depth sensing capabilities of certain technologies, which can be considered core in so far as they ultimately influenced the shaping of all subsequent phases of the project. The understanding that was developed in how and where depth capable data is generated, formatted and interpreted spans the entire practical phase of development, but it was here that this understanding was first investigated in detail.

Initial depth sensor investigation uses the Microsoft Kinect for Windows (Version 1.0) depth sensor hardware. A depth sensor has a wide range of possible application fields, with Microsoft Research in particular having published an extensive collection of materials dealing with environment capture and individual object recognition as seen through the implementation of early *Kinect Fusion* software (Izadi et al., 2011; Newcombe & Davison, 2011). Although this version of the Kinect sensor is not a mobile device (without custom modification) its capability and set of components, specifically designed for depth calculation, are a good indicator of the potential types of data outputs that might be used.[19]

Test One – capturing movement

The Unity software plugin 'Zigfu ZDK' (Motion Arcade Inc, 2012) enables direct display access to the Kinect sensor data via Unity Engine. This Zigfu software is primarily concerned with bipedal 3D spatial skeletal tracking. Therefore, whilst this would clearly be of benefit if looking to extrapolate its potential use out toward motion tracking and co-present representation of virtual avatars, its functionality and implementation here with regard to environment scanning and tracking was found to be limited. The test did,

[19] This continued to be applicable when using other depth sensing devices such as the Occipital Structure sensor (Occipital Inc, 2014) in Phase 2). Indeed in the time since this phase of practice was completed much of the technology developed for the original Kinect Sensor has since continued to evolve into aspects of the Microsoft Hololens Head Mounted Display and the Azure Kinect device and connected cloud computing platform (Microsoft, 2019b).

Figure 29.
Skanect software calculates high-density scan data.

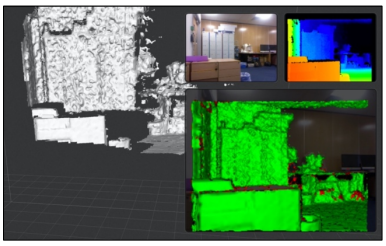


Figure 30.
A Low-density mesh is generated.

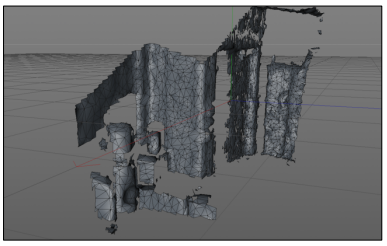
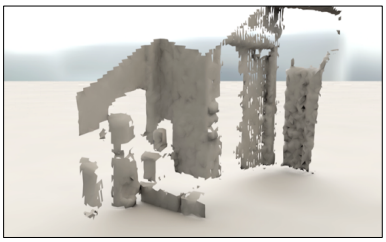


Figure 31.
Mesh lit and rendered using image-based lighting.



Note. This shows a number of windows showing the separate Kinect camera sensors.

however, demonstrate the potential complexity of capture, especially when applied to moving objects. The ability to only partially capture this aspect of a real-world, even in fairly standardised or controlled settings highlighted the potential issues that such a capture might present in a more complex outdoor scenario. Certain similar aspects to this test might be more clearly evidenced in more recent commercial implementations such as Facebook social VR experiments (Facebook, 2019).

Test Two – capturing space

To capture a fixed space, a Microsoft Kinect sensor, in conjunction with a software plugin called *Skanect* (Occipital Inc, 2014), was used to create a three dimensional mesh of the physical environment immediately surrounding device test space. This setup allows depth and colour information to be fed through to a screen in real-time. Snapshots of this data can then be captured and processed into a high-density mesh. A low-density version of this mesh is then output to a separate 3D program. This mesh can then be further edited and adjusted to determine the final look of the mesh object when rendered. Figure 30 demonstrates a Kinect output from Figure 29, with the resulting output being fed into a 3D program (Figure 31). It is important to note these initial fragments in the data being captured. Because the sensor remains in a fixed position, only details that can be seen from this position are captured and connected, with multiple holes in the data becoming more visible as a virtual camera is used to alter the perspective. Whilst at the time of capture the intention was to determine ways to solve

these ‘errors’ it later became more apparent that these fragments were an inherent quality of the depth captured space and could be utilised in a productive manner.

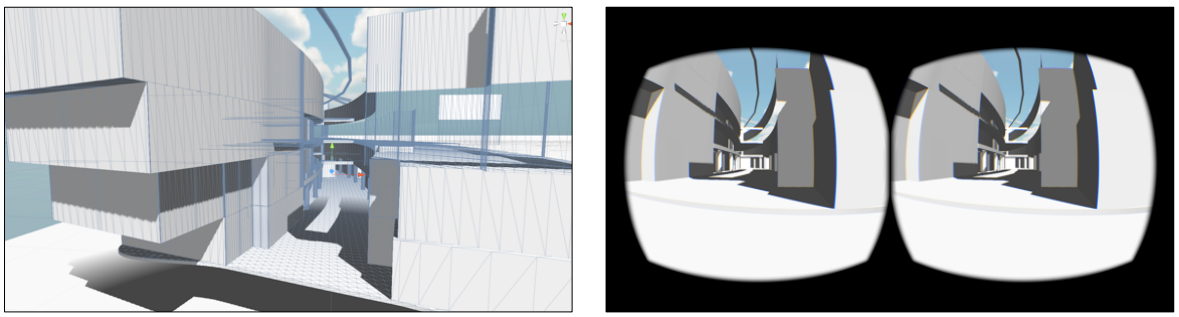
Although relatively basic in both technical and geometric complexity, this process proved the viability of quickly generating a 3D mesh from depth sensor data. As such an enhanced capture method of this kind was planned for the practice phase 2 using a portable version of similar technology (see Practice Phase Two: Iterative testing of the methodology).

From a contemporary perspective a number of implementations of depth capable sensing cameras have been integrated into industrial tools, robotics and other mobile smart devices for various purposes including device security, facial recognition, and machine vision (Google Inc, 2014; Izadi et al., 2011; Lin et al., 2013). Whilst these technologies have some overlap with mixed reality devices in regard to scenarios for resolving various near field scanning requirements, the question of establishing a continuously inhabited mixed reality environment presents distinctly different challenges.

Ultimately, the impact of the depth scanning tests on the later project scenario can be seen in the evolving nature of the captured space. Whilst each test was quite limited in its scope and outcome, together they provided a further understanding of the spatial data underpinning a mixed reality mediated experience. In addition, the success or failure of each test/experiment served to lead the nature of enquiry toward what ultimately became the research AS design process, which was developed in Chapter 3.

Immersive environment testing

Figure 32.
Scaled Creative Arts Building (CAB) interactive test.



Note. This interactive test environment is rendered in the Unity software

Note. Stereoscopic image view of Oculus Rift display. Environment from Point of View of Oculus user

Whilst the previous section considered the role of depth sensing technology within this project, the current section will consider the role of the user within a virtual environment. Once more, the constraints of the hardware tested (the head mounted display) serves to better focus the nature of enquiry. Whilst a mixed reality device might have been most usefully employed, a virtual reality device could still act as an interesting proxy in a productive fashion, as the emphasis and scope of enquiry meant that the principal requirement here was to determine some initial parameters that might serve to inform understanding around spatial orientation and virtually augmented habitation.

This VR implementation allowed for design within and through a stereoscopic head mounted display device (HMD). Internally this device integrates numerous sensors that might be seen as compatible with a MR device's ability to detect position and orientation. All of this technology is focussed on providing a continuous motion-based feedback loop between the device and its user. In this way the system can potentially provide a measure of real-time feedback to the user and enable a sense of 'presence' when moving around and interacting within a virtual space.

To investigate this sense of immersion, two volunteers were immersed within a specially constructed virtual environment for just a few minutes in order to simply gauge their reaction to a virtual reality experience, the feeling of presence, and an impression of its potential to rapidly alter a user's surrounding visual perception.

A replica environment of the Richard Steinitz Building, University of Huddersfield (Figure 32) was integrated into an interactive VR scene within the Unity Engine. Users were then able to navigate a virtual space familiar to them from the physical world. Whilst movement through the real space was very limited (by the HMD being tethered to a host computer) virtual movement was by contrast untethered, allowing movement throughout the digital 3D structure.

This simple constructed space was deliberately used in order to limit the complexity of design and construction. This again highlights the differences between the control afforded in using a designed interior space and the more naturalistic space of the sculpture park. It was the subsequent recognition and exploitation of these limitations, that provided the opportunity to create more poetic benefits that re-oriented the potential application of a mixed reality in the context of the current project.

Conclusions from a speculative system investigation

In considering the actual use of the devices to both read, create and operate a digital space this phase helped to determine some of the boundaries and limitations that might condition or befall a mixed reality experience when it is taken outside of 'laboratory' conditions and applied to a less predictable, naturalistic setting.

The main significance of this phase, however, was the opportunity to develop creative solutions in order to overcome or bypass the increasingly apparent technical limitations of MR systems that would apply and become accentuated in the more contingent, rural, real-world setting of the sculpture park.

This progression toward a less stringent, more 'poetic' mixed reality scenario also allowed the overall project to investigate the wider, culturally consumptive context that might be faced by an inhabitant of a MR version of the sculpture park environment. In order to explore the context of this scenario in the round, a key insight was the notion that a Cartesian approach to precision may not in fact be helpful in developing a viable mixed reality experience.

At this point, there still remained a need for a constructive method of design that would reconcile the embodied aspects of time that informed the virtual-actual with the representational space provided by the virtual-technological. Phase Two considers these aspects in more detail in tandem with the development and application of the methodology discussed in Chapter 3.

Practice Phase Two: Iterative testing of the methodology

Practice Phase video: http://www.stephenhibbert.com/phase-two.html

Practice Phase Two progressively considers the methodology a designer might utilise in designing for a mixed reality system. To reiterate from the introduction, in so doing there is a requirement for a practice-research approach that is speculative, in the sense that it has the requirement to remain open and responsive to the continually changing context presented by mixed reality. However, in contrast to Phase One this phase actively starts to adopt and test elements of the research methodology defined in Chapter 3. This is evidenced through the adoption of an approach to designing that might incorporate cyclical modes of enquiry. As a reminder, the methodology discussed and defined earlier offers a productive process that potentially leads to a divergent series of probable, potential or possible avenues (Dunne & Raby, 2013; Slaughter, 1989), this is dependent on the resulting artefacts being produced throughout each cycle. This begins with an aspired value which is connected to the context of the design problem.

In terms of application, whilst Phase One was concerned with a more deductive mode of investigation into the more pragmatic technological concerns of immersion and representation of a mixed reality experience, Phase Two takes the taxonomy of representation and embodiment from the previous phase and uses it within a speculative aesthetic framework. Here the practice develops more fully into more specific qualities of mixed reality focussed design and production that may be developed through the context of technological 'capture'. As sections of the physical environment inhabited by the observer/designer were captured and analysed, questions arose around how virtual/digital fragments of an environment might be creatively stitched together and intermixed with a view of the real. In essence, the abductively led purpose within this phase of enquiry was to explore the limitations of spatial capture and how these might be more productively used, interpreted, and displayed.

Figure 33.
Site 1 - Whitley Wood



Figure 34.
Site 2 – Eddy (2014) at the Yorkshire Sculpture Park



Of particular note here is the transition from a 'controlled' test environment to a natural 'uncontrolled' setting. This phase primarily involves the use of two small external sites of enquiry in order to evaluate both:

- the capability of capture within a complex natural environment
- the application of a creative design enquiry system

Site 1 (Figure 33) - a natural gulley at Whitley Wood in Mirfield, was chosen for its narrow aspect in order to better illustrate the boundaries of capture in some way.

Site 2 (Figure 34) - a remote part of the Yorkshire Sculpture Park offered a more expansive setting with the JocJonJosch artwork *Eddy* (2014) providing a focal point in amongst a wooded area.

Phase 2 makes use of a mode of capture that requires the compilation of overlapping sections of an external space. This was achieved through the use of a portable 'Structure' depth sensor that was attached to a tablet device. Given the inherent complexity of a spatial capture, the Structure sensor is primarily geared to scan outward toward internal, constructed spaces; or inward toward relatively small, designed objects (Figure 35). This again recalls a Cartesian mode of capture that struggles to promote itself outside of a measured set of boundaries. Therefore, the constraints around the range and area of capture were in the first instance imposed by the limitations of the device hardware and its software. Whilst this initially appeared to present an issue in terms of only having a small area within which to explore the location of a specific

Figure 35.
The structure sensor is designed for designed objects and environments.

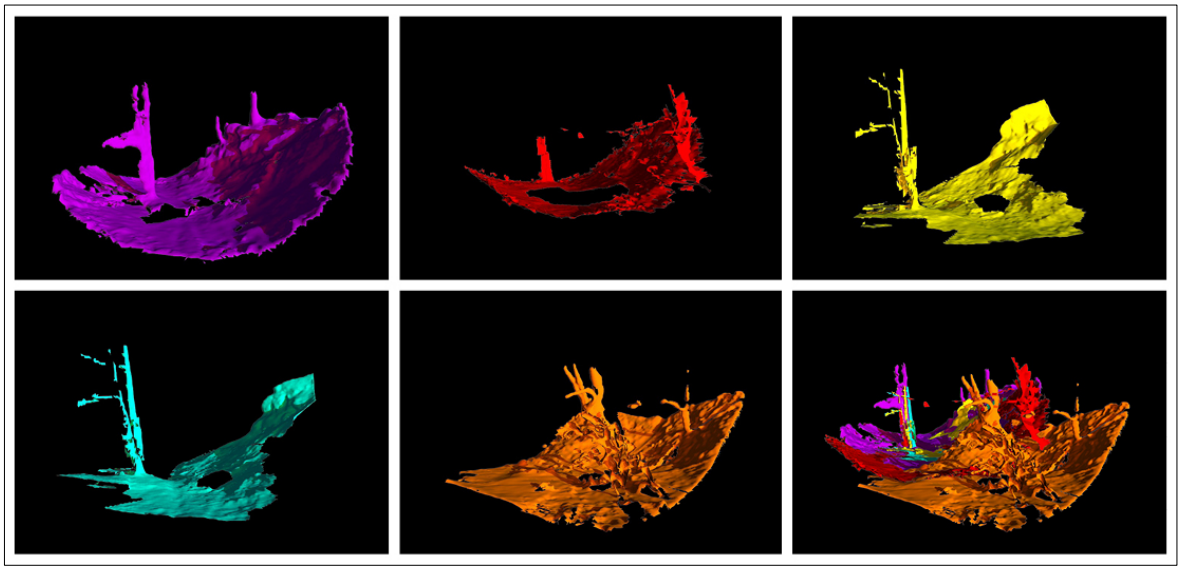


Note. Promotional images created by Occipital Inc. (2013)

artwork in a mixed reality scenario, it is at this point that these constraints, started to be challenged and creatively exploited.

The Structure sensor, when taken into a natural environment, is confronted by a greater degree of contingency and randomness. This occurs in the interface between the sensor and the natural world and arises out of an object's makeup and distribution within the environment. Imprecision relating to the sensing and measurement of a wide distribution of depths, surfaces, and objects, serves to interfere with captures that are suited to a more 'fixed' and 'indoor' scenario. However, in applying the spirit of abductive enquiry and the ever-emerging temporal variability of the inhabitant's movement through the environment, we might re-evaluate the supposed ideal of a fixed scenario. This returns us in part to discussion in Chapter 1 on Bergson's definition of image, and subsequently Janet Cardiff's interpretation of the experience in Chapter 2. If we consider the primary mode or objective of capture to be the representation of a space and its interpretation, as a qualitative multiplicity constituted by innumerate temporal enfoldings, we can see how this might be enabled by the technologised and repeated capture of space and time. Accordingly, in so far as these partial captures can be seen to imply/embody the necessary complexity and plurality of the situation, they can be reframed as productively useful. In other words, an approach that suggests the capture of layered fragments that can be in some way be brought together or amalgamated,

Figure 36.
Five independently captured spaces are merged together in the bottom right image.



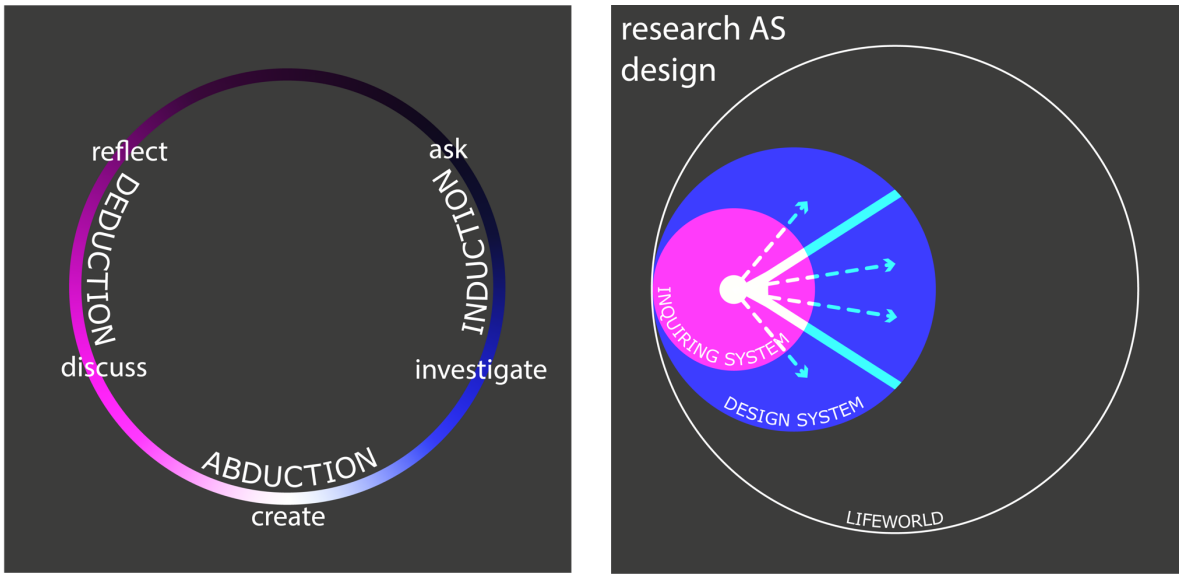
presents an opportunity to investigate and examine a more temporally transient mode of capture.

Site 1 - Capture of Whitley Wood

Figure 36 highlights the spatial capture of a series of adjacent areas at Whitley Wood. These independently captured 3D meshes, coloured here for clarity, are spatially aligned and merged to create one slightly larger 3D model. This stepped process of capture, followed by their collective stitching or layering, serves to demonstrate in a crude way how a technologically automated system of capture might work.

It is here we start to see the application of the research methodology in practice. Figure 37 reminds us of the two elements; firstly, the abductive step – to utilise a fragmented capture of an environment – and secondly, a consequent cycle of enquiry. This inquiring system exists within a surrounding design system which is itself defined by a basic implementation of the intertwining contexts of study. All of this is encompassed within a lifeworld (Husserl, 1970; Uexküll & Mackinnon, 1926) that co-exists both digitally and physically within a mixed reality scenario.

Figure 37.
An abductive cycle used with a research AS design inquiring system model as discussed in Chapter 3.



Applying this method through a process of creative enquiry enables the designer to form a series of outcomes or artefacts. In this case these artefacts are simply the fragmented meshes of a small space, however their apparent simplicity enables a measure of closer interrogation. Through these captured fragments of virtual spaces, the designer is presented with an apparent limitation of the system. Yet these fragments serve as a kind of digital memory or trace of the space itself. In repeatedly coming back to frames of enquiry, in this case an analysis of the technological capture and designing a response toward a sense of user interpretation, the designer is positioned at a viewpoint. This perspective/viewpoint enables reflection, investigation, and then a cyclical re-framing toward a better understanding of how and where a mixed reality is generated and experienced.

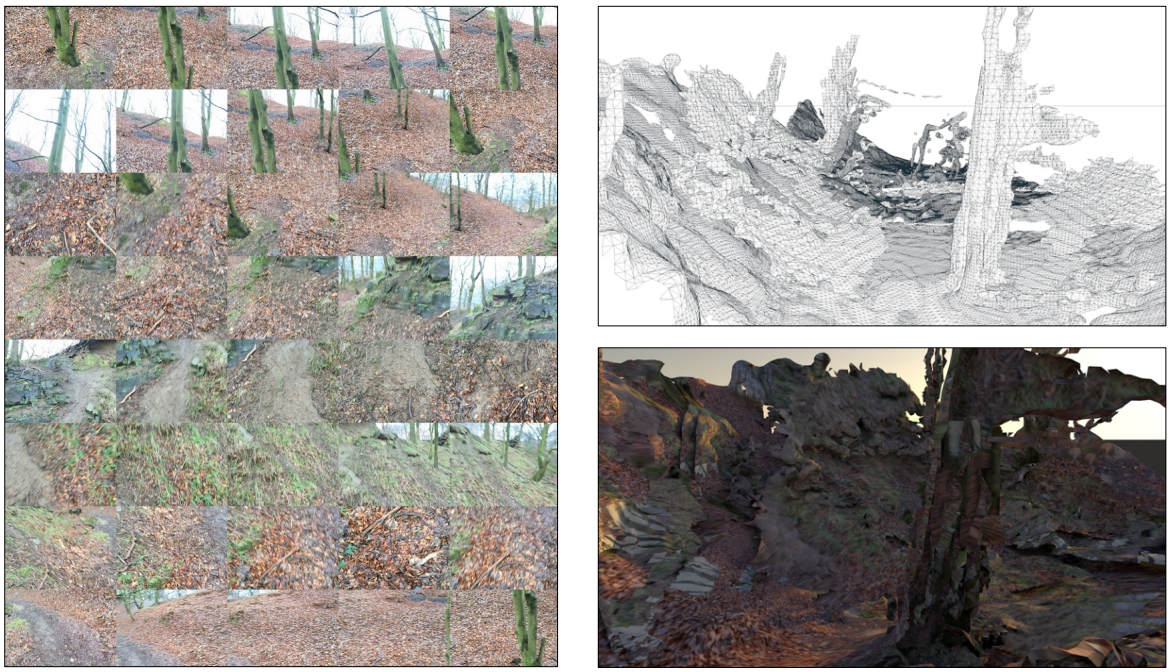
This temporal re-framing returns us to the cybernetic model of research discussed earlier. In applying a form of abductive reasoning, the uncertainty afforded by the fragmented capture of the environment can be logically navigated with purpose toward a possible solution. This solution does not reject the 'errors' or voids of capture but rather integrates them into a potential new scenario of enquiry and thus enables a potential new form of mixed reality experience.

In the case of how each cycle of iteration might be usefully applied, the designer/observer must in turn reflect on the objective purpose of the environment and determine its intended use. Whilst this may sound rather narrow in its remit, this can be seen as a (re)grounding for the design enquiry system in order to facilitate divergent new situations of enquiry. What might be created or generated as a result of this method of enquiry remains open to additional speculative investigation and interpretation as the further determinations around the context of enquiry are made.

Moving back to the practicalities of this process, once captured the virtual environment's data is then imported into a 3D software program, where some additional element of manipulation or data wrangling is required before the model / environment / landscape is processed for output render. Alongside this process of creative exploration, it is worth noting that the device itself has been designed so that the mobile sensor array mimics some basic elements of human vision. As the manufacturer states: "optical elements, separated the same distance as human eyes, [allow] *Structure Sensor* to bring human-scale depth perception" (2016). With the sensor array allowing for simultaneous capture of both depth related data and photographs using an integrated RGBA camera, the combined arrays of data are passed through the Structure mobile application, allowing the low-density meshes to be digitally textured with the photographs, as shown in Figure 38. Considering the ocular marriage of the left and right eyes in the context of human scale perception, even without a wearable head mounted device, it seems reasonable to suggest that all conscious experience can be considered to be in some sense virtual.

As with Practice Phase one, this pipeline mimics many of the traits of a low-cost depth sensing capable MR system in a more stepwise fashion, and as a consequence this allows for closer analysis of the incoming scan data and the subsequent steps of technical mediation that take place prior to final display. Through this mediation the designer can apply elements of variation in order to better explore potential outcomes.

Figure 38.
The multiple Structure sensor captures are layered together with photographic texture maps applied.



Site 2 - Capture of Eddy

From this first site of enquiry the methods and tools used were then employed in a more complex scenario at Site 2, which constituted the first of the captures at the outdoor sculpture park. From the insights gathered at Site 1, this second cycle of mobile capture introduced a number of extra features pertinent to the practice-research.

- Layered capture of a wider space
- A specific focal point situated within the space
- The introduction of duration and influence of time via the mapping of a journey / movement through the space.
- The notion of both intentional and random voids and absences

In addition, further elements of variability were implemented, and the notion of voids and absences were in some way amplified. This element of variability began to explore the intertwining contexts of study more directly, with the variability of time, memory, and duration of the specious present all serving to influence how a mixed reality environment might be viewed and manipulated.

Figure 39.
A hemispheric photo and captured mesh wireframe of Site 2.



Site 2 is situated at a remote junction within the Yorkshire Sculpture Park landscape. Its position lies away from many of the other artworks, requiring a visitor to move away from the main routes through the park to a woodland area hidden somewhere near its outer boundary. The position of the site in a sense allows for a more hidden or private encounter, particularly in the summer months where surrounding foliage is most dense.

It is perhaps somewhat fitting that the artwork entitled *Eddy* (and its sibling *Worstwood Ho,* 2013) by artist collective JocJonJosch itself exists as a focal point for commentary on speculative process. As Rye Holmboe discusses in the essay *Thinking in Circles:*

> "The collective addresses the fraught relation between the individual and the group… JocJonJosch seems less concerned with beginnings and ends than with duration and process, and the works the collective produces – whether they take the form of video, photography, sculpture or performance – are perhaps best understood as experiments or 'test-pieces', to borrow Sol LeWitt's expression. Whichever path the collective takes, it is not in order to reach a clearly defined endpoint but to become the path itself." (Holmboe, 2013)

Here the practice-research develops a mode of movement without terminus, through a layered spatial capture. Further respect is paid to the integration between the real space and its peripheral qualities. Figure 39 illustrates the resulting spatial capture which utilises both a hemispherical photo of the front of the site and a wireframe view of the

Figure 40.
A series of coloured digital meshes are superimposed onto a real backdrop.

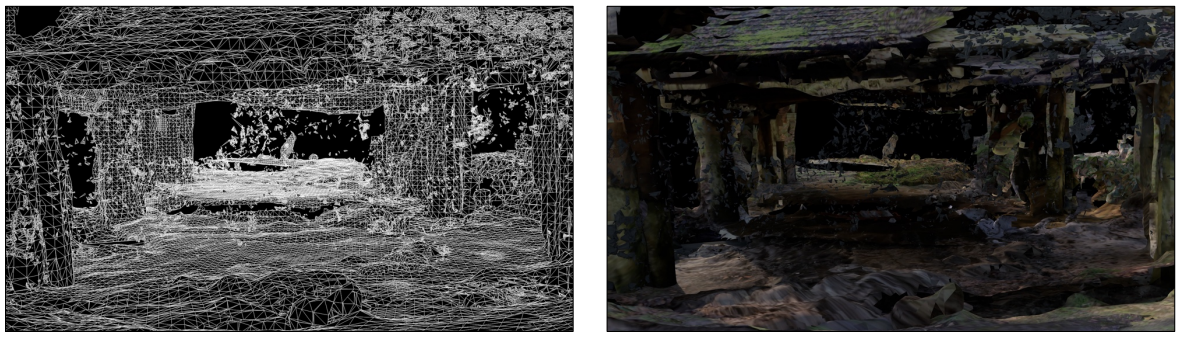


depth captured space. From the wireframe we see the significant gaps in the capture of the space with many of the smaller details have been removed through the tessellation process employed by the Structure system itself. In a sense it disregards the minutia whilst foregrounded what it takes to be the more essential structural components of the scene - in this case the ground and protective structure sheltering the *Eddy* artwork.

There is a comparison here with the hyper-real UI elements that we have seen in examples such as Keiichi Matsuda's works, where the MR presented by his film *Hyper-Reality* (Figure 7, P.66) seeks to amplify elements of a mobile interface and map these onto the physical environment. In contrast to this, the examples shown here in various ways seek to identify where the digital and physical manifestations meet, and where the voids of data might be subtly revealed. In designing a reconstruction of the space, Figure 40 illustrates how the integration of supplementary contextual information (e.g., the remaining partial representation of trees, foliage etc) creates a 'soft' connection between the real and virtual spaces.

Parameters such as date and time of capture, along with geographic position are all recorded and integrated into the virtual scene information. This additional layer of information allows for the digital space to be physically rendered with an approximation of the physical light position present at the real environment's moment of capture and ensures that the resulting digital space can to some extent account for its adjacent physical real-world characteristics. In so doing the illusion of the combined virtual/actual space starts to come together in a more cohesive visual integration.

Figure 41.
Close-up view of the removed Eddy artwork



These elements of data analysis and visual representation challenge the mechanised and industrial application scenarios for MR, where data captured is matched to data held within the system in order to produce a connected result. In doing so the similarities of this method of integration, which might ordinarily be rejected as 'inaccurate' and therefore productively meaningless in scenarios such as the Varjo example shown earlier (Figure 26, P.119), are in fact altering the potential reading of the environment and inhabitant experience. Again, this highlights the differences in approach taken here from the more conventional application scenarios for mixed reality related technology. Where a problem scenario is developed via measurement toward a preferable outcome, there is a limit to the basis by which a problem scenario is approached.

Therefore, whilst the base objective (in this case the experience of viewing the environment/space/artwork) remains the same, the abductive approach that accommodates a subjective experience can be interpreted in an altogether warped fashion, open to aspects of temporality and allure that lie beyond the practical application scenario often seen in data driven settings. This is something that will be explored more extensively in Phase 3 of the Practice-based research.

Notion of designed voids and absences

Alongside the subtle elements which contribute to the overall representation of space there is the opportunity to make further adjustments to particular parts of the spatial capture. Figure 41 illustrates this, with the removal of the Eddy artwork from underneath

Figure 42.
Lazzarini Skulls (2001).

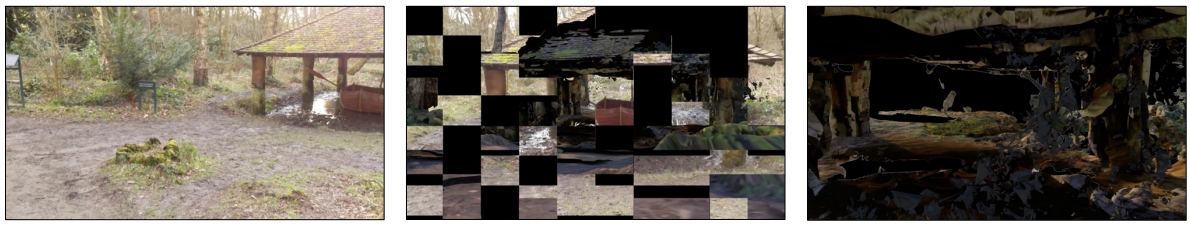


Note. Retrieved August 18, 2020, from http://www.robertlazzarini.com/skulls

the surrounding shelter. This mediation, afforded by the designer, catalyses the imminently occurring moment of encounter, demonstrating in some way what is depicted in the writing of Dan Torre (see 'The moment', p.49), where mixed reality might be employed to actively disrupt and in some way digitally mediate actuality. This altered scenario presents the viewer/inhabitant with an aspect of uncertainty, as the real world still contains the work in question, and consequently, the viewer is faced with a 'unified duality' of real and virtual. A related, similarly tensile experience is described by Hansen when he describes Robert Lazzarini artwork *Skulls* (Figure 42): "Lazzarini's work functions by catalysing a perspectival crisis, confronting us as it does with 'the disorienting ambiguities of digital space'" (Hansen, 2004b). This happens because *Skulls* distorts our view of reality, appearing as an illusion of form. On witnessing the sculpture, the viewer is forced to question and reconcile their own interpretation of what appears to be a virtual 2D image of a human skull, when in fact it emerges that this is actually a 3D sculptural object that has been subjected to 2D mode of a distortion.

This mediation of actuality is further explored with the introduction of tracked first-person movement through the space (see Figure 43), which visualises the journey taken by the mixed reality inhabitant. As the inhabitant approaches the sheltered artwork their view of the space is disrupted, with the digital interrupting their view of the real and effectively removing the artwork entirely. Here we are left with the only visible construct

Figure 43.
Still frames from an *YSP Eddy* test sequence.



being the depth scanned mesh, as the physical/real world is visually masked. The viewers own bearing on the real/virtual merging is partially removed with only the non-visual senses being able to comprehend the actual space. Here, the temporal disparity between the originary moment of spatial capture and the immediate time of the inhabitant is open to any amount of interruption, as designated by the system and its design(er), which may disrupt a conventional lived time experience. Accordingly, in a limited way, we are introduced to a perturbation of experienced time, that is derived from an enfolded multiplicity of recorded duration.

This cycle of design enquiry has been employed to investigate and reflect further on the mode of capture and begin to incorporate aspects of embodiment, primarily in mixed reality. The designer/observer within the design enquiry system can make a distinction between motive and consequence and then deduce or induce a means of expanding various modes of seeing. This warped encounter – of the artwork / artefact /object / focal point of interest - and the world surrounding the work – highlights the principal elements of a manifest mixed reality as enabling a wider spectrum of engagement. In so doing we begin to see a broader mode of application for mixed reality.

In increasing the breadth of this mode of application, we might also pause to consider the way in which this approach to the creative augmentation of the encounter is located at the point of intersection between *things*, or perhaps 'units'. Bogost is clear in his opposition to certain humanistic theories of being, in order to build upon concepts of phenomenological interpretation through an object-oriented ontology. As Bogost states:

> The experiences of things can be characterized only by tracing the exhaust of their effects on the surrounding world and speculating about the coupling between that black noise and the experiences internal to an object. (2012, p. 100)

In considering this approach Bogost names this practice of constructing artifacts as *carpentry* using 'philosophical lab equipment'. In this sense, the replication of fragments of previous inhabitants' journeys (or the exhaust of their effects) through the park by utilising mixed reality 'equipment' appears to offer an interesting way for the operator (after Bogost) "to gain some insight into an alien things experience in the form of previous audience bodily encounters with the artefact. However, a wearable mixed reality device is itself an object, actor and mediator, sitting in-between the current and previous inhabitants. In accordance with Graham Harman's similarly object-oriented view, we might describe the MR device's subjectivity both as connector between units and as an aesthetic surface on which some rudimentary communication can take place.

Such a position that does not inherently favour the human user, but rather looks to appropriate values and characteristics inherent to both virtual-technological and virtual-real units. As such when it comes to generating an artefact, the division between human action and device interpretation may be foregrounded, with the inherent human bias resulting from a humanist realm of thought becoming replaced with a more balanced mode of production and analysis that takes into account a broader spectrum of human and technological subjectivity.

Summarising Phase Two

This phase of practice developed out of a hypothesis posited in phase one that intended to scope the extent to which a mixed reality might be continuously inhabited in a context of interaction, toward an applied method of speculative design which might allow for the progressive investigation of a mixed reality space.

In the process of applying this new (or rather, underexplored) abductive method of practice-based enquiry, we are presented, in its second phase, with a series of insights into the capture and interpretation of physical and co-located virtual space, which serve to better inform the overall project and to illustrate how it benefited from this speculative, cyclical process of practice-research.

Towards the end of this phase of study, a number of questions concerning the effect of interrupting the visual aspects of experience (through the substitution of voids) were beginning to emerge. It is at this point that the notion of how a further cycle of enquiry might bring this notion of exploring the creative potential of absence to the fore, one that might utilise aspects of temporality and of lived time. Up until this point, development within the practice phases had primarily been focussed on a measured duration of specific fixed time and space using speculatively designed mixed reality as a basis and the 'research AS design' methodological approach. However, in order for the practice to move beyond a fixed illustrative concept, to become something which can instantiate an extended experiential visualisation, there needed to be some allowance within the design for an immersive experience occurring over time and perhaps over a larger space. The aim was to bring into focus the experience of lived time, specifically when inhabiting a mixed reality space. The replication and investigation of such a space utilising mixed reality in the culturally consumptive setting of the Sculpture Park.

It is at this point that a more developed basis for the intertwining contexts of study emerged and was thus expanded more fully into Chapter 1 – with the role of design, the potential of technology, and the influence of lived time becoming more defined than they had been previously. In practically applying these intertwining contexts a third phase of practice-based work was planned and undertaken.

Practice Phase Three: Practically applying the intertwining contexts of study

Practice Phase video: http://www.stephenhibbert.com/phase-three.html

Practice Phase Three looks to build upon the elements of technical application and modes of enquiry that were completed in the earlier phases. In particular this comes in the form of seeing the process of spatial capture alongside an aspect of lived time as a potential influence on the inhabitant of a mixed reality experience. With an emphasis on the moment, both of capture and encounter, the speculative research 'as' design methodology can be further applied.

In practice this begins with the capture of a physical/digital space at a higher visual resolution than Phase 2. There is then a process of cyclical making that attempts to repeatedly map and visualise a mixed reality user's journey through this space. Together the resulting artefacts, illustrated in the form of first-person video journeys, investigate a multiplicity of durations of capture, derived from the multiple versions of a single route through the space, that are then combined with the depth captured virtual environment, and which serve to augment an inhabitant's experience. From the perspective of lived time, no two individuals' journey through a space will be the same, and this also applies to repeated journeys through the same space by the same individual. The goal here is to provoke further enquiry into how a standardised view of metricised time, might be problematised within the lived time of a mixed reality mediated experience.

This phase also looks to further develop the combined aspects of temporality and of absence accentuated via the use of technology, as introduced in Phase 2. Here we might refer back to the paper *The Image is a Moment – the art of the visual encounter* where the authors propose an approach that aims to "disrupt conventional readings of time, [and to discuss] how time is experienced in relation to 'the artistic encounter'… [querying how] … encounters with artworks might affect – or be affected by subjective

perceptions of time" (Hibbert & Powell, 2018). It is perhaps here that a mixed reality setting might help to interrelate these interfering subjective perceptions.

These combined modes of encounter and moments of capture can be productively explored in the context of the design methodology described earlier in this text. As a reminder - we first consider an inquiring process that repeatedly looks to generate encounters as artefacts, this lives within an exploratory design enquiry system that seeks to provide parameters of variation for the encounter. These variations together serve as a pattern of possibilities that provide a landscape within which a suitable outcome can be selected and repurposed for future experiences.

From the view of the designer this multi-layered, cyclic system involves a consideration of both internal and external factors governing the experience at each point of repetition. This is followed by an investigation and reflection upon the resulting virtual-actual life-world from the point of view of the inhabitant/observer experiencing the mixed reality. In this fashion, each cycle of enquiry selectively produces an artefact that alters the technologically generated digital environment and obscures elements of its physical world counterpart.

The resulting mode of audience encounter might be considered both in terms of an emergent and pre-defined experience. It is predefined in the sense that certain decisions around the virtual manifestation may have been made by the designer / architect or other stakeholder in advance of the systems use, but it is also emergent in so far as the inhabitant retains some form of control over their own movement and interaction choices. As is discussed in Chapter 2, this recalls certain similarities with Matsuda's *Hyper-reality* film that visualises interaction elements embedded with the augmented world, and proceeds to play on the unplanned nature of emergent user experience as the AR system is hacked and reset.

This combination of the pre-defined and emergent appears to offer an interesting avenue through which the designer could productively apply the methodology defined earlier. If a designer is faced with a temporal mode of interaction such as a mixed reality

environment, they might well consider the pre, immediate, and post latent opportunities for engagement and analysis. In using the methodology described here, the designer continually creates and reviews their series of "variations AS artefacts" (after Jonas (2014)). The 'pre' opportunities consist in the mode of abductive inference to be explored by the designer; whilst the 'post' opportunities exist in documenting certain aspects of a completed journey for future re-use.

Interestingly, designing for the immediate aspects of temporality could be seen to align with certain aspects of Husserl's cycle of impression, retention, and protention and later Varela's 'horizon of integration'. Both appear to offer a supporting framework through which the designer might influence the encounter and thus augment individual modes of experience.

If we consider the methodology alongside Husserl's cycle, it begins the cycle of artefact making with an abductive viewpoint aligned to an aspect of protention, followed by the induced impression (of the perceived immediate moment), and concluding the cycle with deduced retention (observing both the users embodied and calculated technological). To state this in simpler terms, we see the designer is utilising foundational aspects of temporality to cyclically create, investigate and reflect on the outcomes generated.

To summarise, this third phase looks to further explore augmented and expanded modes of spatial perception in comparison to narrower more immediate framing of perception in phase two. In applying the parameters of temporality, the manifestations generated when journeying through a mixed reality mediated space might serve to capture and reveal a wider mode of interaction and encounter than was seen in phase two of the study. All of this is enabled via a layered mode of display that is concerned with revealing how a mixed reality mode of seeing is problematised by the merging of the pre-existing asynchronous and the immediate synchronous perceived world(s).

Widening the cone of possible capture

Figure 44.
Manufacturer's illustration of the Faro Focus 3D Laser scanner operation.

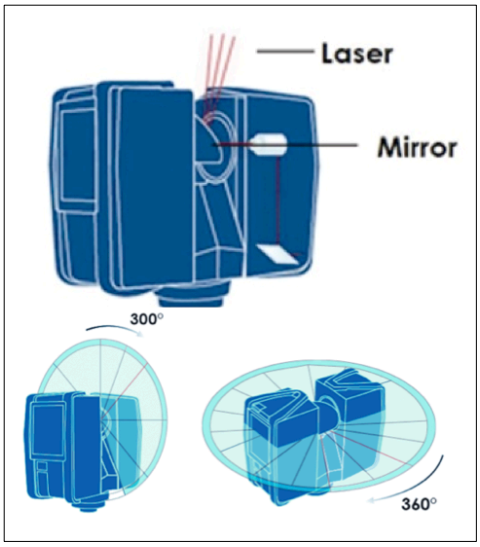


Figure 45.
Author setting up Faro Laser scanner for low resolution scan at University of Huddersfield.

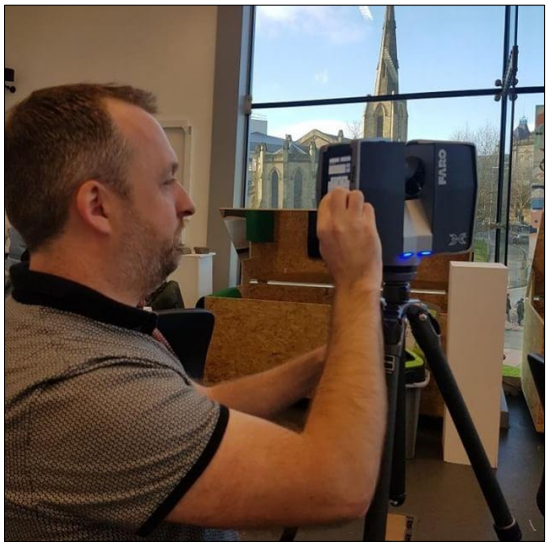


Figure 46.
Resulting example low resolution 360-degree laser scan taken within a design studio at the University of Huddersfield.



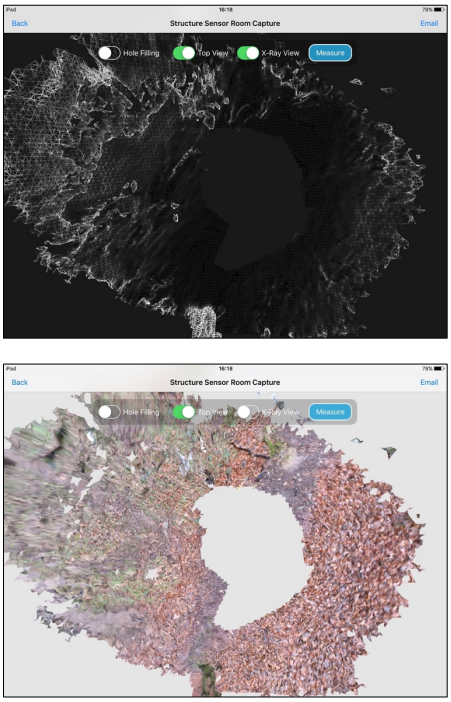
Building on the principle of capturing a spatial volume, phase three introduces a more elaborate mode of capture. Whilst the captured elements in Phase Two had relied on portable image-based depth sensors in order to reconstruct a virtual mesh of the physical environment, this technique came with a significant limitation in its maximum volume of capture. With each individual scan that used the Structure sensor only able to reach across a 10-metre space, a larger spatial capture using this device would only be achieved via a forced interruption followed by a procedural layering of multiple adjacently located surface meshes or 'patches' being brought together at a later stage,

in a manner similar to that seen in Figure 36. Whilst this enabled an element of designed interruption of the capture which might for instance unpick the seams between the 'patches' of various spaces, an alternative that might offer the capacity to increase capture volume might help facilitate a longer journey/trip through a space, particularly when traversing through an external setting such as the sculpture park.

In order to explore a larger space, this next phase looked to implement an alternative mode of capture that could work across a more expansive area. The use of a structural laser scanner appeared to enable a much larger volume of space to be captured at a much higher density, perhaps at the cost, in terms of processing-time, of using a more complex approach to processing the resulting data. As with the Structure sensor and other devices discussed earlier in this thesis, structural laser scanners are normally used in an industrial setting in order to measure distances in and around a built environment. As a consequence, the software and tools built to be employed in such a context have a very specific focus that would typically fall outside of the criteria explored here. The device in question – a Faro Focus 3D laser scanner – works by mechanically generating millions of laser light pulses as it rotates on 360-degree gimble (Figure 44, Figure 45, and Figure 46). This not only measures the distance of any reflected pulses of light from a single point in space but can also capture the reflected RGB colour value at each point. This process generates a geometric and colour accurate hemispheric point-cloud. The extended reach of this scan increases the diameter of a captured space from 10 metres up to 100 metres. Figure 47 and Figure 48 show the two different diameters of capture from an overhead viewpoint.

Whilst the volume of capture increases ten-fold, this current implementation of laser scanning requires longer to calculate, with the Faro scanner taking anywhere from approximately four to twenty minutes to scan an area (dependant on scan resolution parameters set by the operator).

Figure 47.
Overhead views of a Structure Sensor mesh.



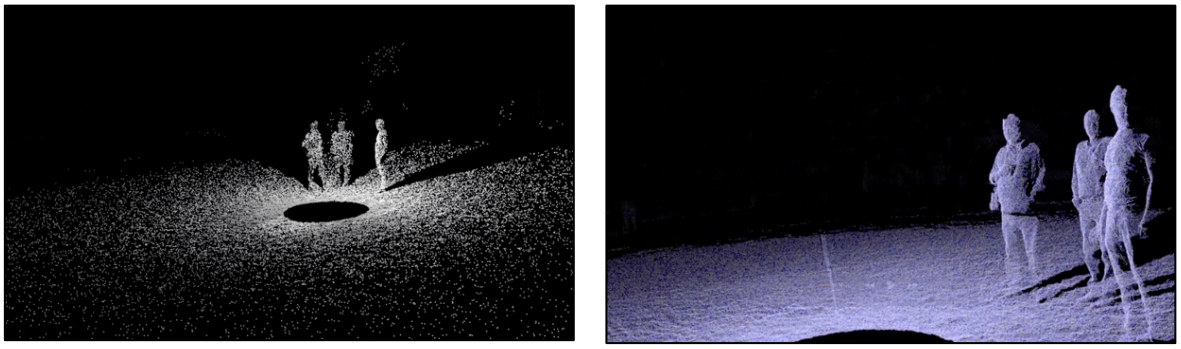
Note. Each structure sensor scan is limited to a ~10 metre diameter.

Figure 48.
A Faro Focus laser scanner captures points across a ~100-metre diameter.



Therefore, whilst real-time point cloud solutions are beginning to emerge (see Appendix 3), as with the Phase Two use of the Structure sensor, the data here has to then be subjected to a process of offline calculation. With this in mind a number of initial scans using the Faro device were run in order determine a suitable 'minimum' density that might be productively incorporated into the field of enquiry (Figure 49). Higher densities, whilst perhaps preferable in their level of visual fidelity, became more and more unusable as the magnitude of the data sets moved beyond the processing capabilities of the computers used. As with the missing data in Phase Two, what at first appears to generate a limiting factor, with respect to the requirement of real-time fidelity within a Cartesian context of formal measurement, can be reframed in terms of the project's aspired aims and values using an abductive cycle of enquiry. That is to say, a solution that met the abductive value – that is in some sense premised on the notion of anomaly - could be creatively worked towards. Looking at this from the point of view of the user/inhabitant, the increasing density/complexity of the area captured might

Figure 49.
Initial density testing of the laser scanned data.



seem to be something that is only of peripheral relevance. Here the central concern is the motivating factor of a journey using mixed reality, rather than a digital facsimile of the real. The *augmentation* of perception in its multifaceted complexity might therefore not need a point cloud with such density, surrounding the user at all times. Instead, it might be reasonably assumed that an inhabitant's experience exists in hybrid space that blends *between* the virtual and the real. In this scenario, the project seeks to elucidate how the moment being experienced, with all of its potential and possibility can be adjusted toward a lower density of capture that nevertheless serves this purpose.

In this sense the cycle of enquiry, speculatively designing and producing artefacts that inherit variability in aspects such as visual scale of each point, allows for a suitable level of possible outcomes to be investigated and reflected upon (Figure 50).

The boundaries that limit the area of spatial capture surrounding the user/observer potentially also serve as variable controls between the virtual technological space and the surrounding landscape (in this case shown using a video recording of the real).

Figure 50.
Investigating increasing scale of each point of scan data



Figure 51.
A measured scan allows for multiple scanned instances to be accurately overlapped.



Note. This image shows a high-density colour scan of the Site 3 space overlaid with a low-density scan at the same location.

Therefore, whilst some element of density is required as a reference, this density can be scaled both in terms of resolution and distance to fit the bounds of usability. The question of the bounds of usability impacts both at the design stage and ultimately in the stage experienced by the mixed reality inhabitant.

In conjunction with the above issue surrounding levels of density, this mode of capture also allows for certain 'enhancements' over the Phase Two method of capture. The distinct layers of surface geometry that were captured in Phase Two idealistically served as approximations of the physical environment. In contrast to this the laser scanned environment offers the potential to physically map more accurate dimensions of space that in some way serve to anchor the scale of the virtual environment more thoroughly (Figure 51). Whilst this does inherently contain some semblance of Cartesian capture, here its measured accuracy serves more as a 'staging post' - a point of departure for the physical and digital, as opposed to a de facto purpose.

As a reminder, the abductive cycle of enquiry allows for the incorporation of the anomalous into its cycle of development, but it is this anomalous quality that is tempered and grounded via the connection to a normal (unedited/'unaugmented') 'base layer' environment. There is a need for a thread or overlap to establish a context for being able to experience the unusual, otherwise the experience risks spilling over into realms of fantasy or discombobulation. This need for a normative context/set of anchor points is not unique to this project, indeed it could be viewed as a founding condition for all contexts of speculative design.

Therefore, here we also see the cycle of enquiry within the design system being used to establish parameters or boundaries through which to explore, without losing sight of the context for exploration. Whilst the location displayed via the mixed reality headset might technically be drawn from anywhere, its super imposition within this sculpture park location means it does have a constraint applied in terms of location. Thus, it is here we see that the intertwining context of study enables the audience to reconcile what is happening, in this case the establishment of the spatial and temporal parameters of real and virtual habitation.

Here the transformation of encounter from the 'purely' physical to one that is mediated via technology mimics some of the commentary discussed in Tacita Dean's work from Chapter 1. Dean's work is consistently intertwined with the chosen medium of delivery. From the celluloid films such as *JG* to the audio taped exploration of *Trying to find the Spiral Jetty* there is a continuing evolution of experiential mediation. In essence we see that a determined focal point allows the audience to connect with the work and at the same time interpret the encounter in their own subjective fashion.

Figure 52.
Sitting by Sophie Ryder (2007)



Site 3 – Sitting by Sophie Ryder

Site 3 contains one such focal point of determination and interpretation that is documented via a series of video captured 'journeys' through the site. These journeys provide the base layer for temporal capture (location, route, auditory) from the observer/designer perspective with an artwork providing a point of focus.

As with many other works by Sophie Ryder, the sculpture *Sitting* (Figure 52) in all its enhanced and exaggerated mythical form stands both within and outside of the real. At over four metres tall, this artwork would appear to dominate a space if it were placed in a more contained setting. Here, alongside similarly large manmade and natural structures and objects, it appears integrated in some way into the landscape. Only in approaching the sculpture at ground level, or seeing it pictured alongside a visitor to the park do we get a truer sense of its size and scale.

As a point of interest within a mixed reality setting, that fuses a view of the real and virtual, this sculpture serves as an interesting point of encounter. In addition, its exaggeration of form provides a navigational point of interest for the visitor journeying through the park. In this way it might also be seen and used as a kind of anchor point.

Figure 53.
Site 3 - located around the Sophie Ryder artwork *Sitting* (2007)



Figure 54.
A 100m^3 laser scan of the Site 3 area.



From this fixed point the challenge here is to offer some measure of a mixed-reality-inhabitant synchronicity between the scanned digital space with its physical counterpart as visitors' approach and journey through the site.

Figure 53 and Figure 54 show the point of capture for Site 3, which presents a far more open aspect than Sites 1 and 2 in the second phase of practice. Located in a central part of the sculpture park this site encompasses the area alongside the sculptural form of *Sitting*. This aspect accentuates the use of the laser scanner as we see a wider area of capture, containing an array of natural and man-made objects spaced apart from each other.

All of this is captured in one pass from a single location in the centre of the space. A fixed point of capture means that we see only points that can be reflected directly back to the device. As such any elements lying beyond the scanning device's direct field of view are occluded and do not appear. This creates what might be described as a detailed map of the area immediately surrounding the device, but this map is only ever really one point deep. From this central point then, we see a gradual decline in fidelity, due to both maximum scan distance and occluding objects, toward a virtual void in space beyond the 50m maximum radius of capture. Again, if we consider this within the context of technologies of seeing discussed earlier, we observe that the mediation provided by technology presents a component of a husk of identity that is abstract and inconclusive

in its presentation. Nevertheless, this provides a measure of detail that surrounds the inhabitant as they move through the space from one part of the park to the next.

The emerging encounter

In considering the emerging qualities of any physical encounter - when moving toward, alongside, and away from a point of interest or focal point (in this case an artwork) - a unique visual experience is partially constructed out of a myriad of different environmental variables, and of particular importance is the direction and speed of travel. A mixed reality view of this space offers the potential to change or adjust some of the properties being experienced by the inhabitant/visitor.

This phase of practice-research looks at the changes and adjustments that might be made to the journey taken by a visitor through an area within the sculpture park. In its resulting presentation a series of video artefacts can be viewed as recorded 'memories' of the encounter. Each recorded journey exists as a unique manifestation of the physical reality being explored. Adjusting the visual properties of a mixed reality viewpoint can be achieved in many ways. This phase attempts to achieve this method of adjustment by way of a layering of the different modes of capture above a recorded video journey. These artefacts can be interpreted in such a way that the real-time version of encounter could be seen to be a realisation of the innumerate temporal enfoldings that ultimately manifest as a fragmented or distorted view of the real. This fragmentation occurs both temporally and spatially when a normally linear experience is interrupted via a series of pre-occurring experiences which are presented in the current time and space. In so doing mixed reality is understood more as a way of both problematising and enhancing our ways of experiencing through technology.

As discussed at the end of phase two, we might employ the use of Bogost's alien phenomenology in order to more clearly see the way in which the human and technical modes of perception become intertwined. This occurs when "tracing the exhaust of their effects on the surrounding world" (Bogost, 2012, p. 100) or as Mullins rephrases – "tracing the edges of things" (Mullins, 2015), as human and technical objects leave their

marks and traces upon the hybrid technologically virtual-actual environment. The human presence is reflected through the establishment of desire lines which mark both the physical and virtual environment, and subject it to auditory hauntings. The desire lines of technical objects are manifested in different ways with a disinterested and evenly distributed mode of attention resulting in partial and fragmented renderings of environmental surfaces. These radically different modes of subjectivity become knotted together on the aesthetic surface of the head mounted display. A trace of the effects of the 'human exhaust' appears in the videoed journey - a fragmentary physical sense of the human inhabitant's views of the world (itself based on attention); a trace of effects of the technical object's exhaust is found in the millions of data points being saved to the memory banks of the integrated computer used to operate the many instruments within the laser scanner. This technical object is also fragmentary, depending on environmental factors that affect capture resolution and quality. In mixing together the two traced effects we begin to see how mixed reality might be useful in visualising the coupling between objects. This in turn then appears open to some kind of interference from one another. Thus, the objects and their representation within this shared space appear to offer an avenue of enquiry that will be further explored in Practice Phase Four: The Layering of Spoken Audio.

Here this phase of practice-research utilises the intertwining contexts of study to speculatively alter or layer the *visual* aspect of an encounter and evidence this via a recorded journey. This context, in combination with cycles of interrogation, explore where the optical 'hinge' is located between the two spaces of the real and the virtual, a central avenue of exploration for this thesis. The next section details how each layer of recording can further interrogate the visual component of a mixed reality.

Tracking movement through the space

To better try and demonstrate the visual element of overlapping experiences being merged via a mixed reality system, the practice-research moves into the aforementioned process of layered composition. This journey is presented from the point of view of the

Figure 55.
The layers of a journey through the sculpture park.



Note. Shown in unedited video form, a digital mask layer, and as a digital point cloud counterpart.

user (using a video camera) overlaid with the spatial data captured by the various technologies of seeing. The final series of films therefore should be seen as a recorded simulation of mixed reality, that presents an emergent encounter that co-exists in both physical and technological space.

The composition of real and technological is here presented via a series of digital layers as initially shown in Figure 55. At the base of this stack of layers sits the video camera recorded walk around the site of enquiry. This video layer acts as a proxy for the user/inhabitants unedited view of the real. To maintain this continuous view of the outdoor space, the video is purposely kept as a one-shot sequence with no intercutting. The intention here is to mimic the real view of the walk as experienced by the user of a mixed reality system. All of the digital information is then mapped to this base and serves as an overlay that distorts or alters it in some way, using processed digital effects to interrupt the view of the real.

Above this sits the point cloud laser-scan layer, which exists as a wide aspect virtual surface that offers the user inhabitant a fixed virtual space / anchor point. As we can see the voids and absences generated here are as a result of the point cloud data being transposed in their processed amalgamation with the real. Spatial data is projected out into the real environment providing a virtual backdrop to a user's journey. Its large spatial volume means that it can also operate at two levels of attention – both in its immediate central view showing the direction of travel around a focal point, and a wider peripheral view of the surrounding space.

Finally, within this stack of visual layers there is the opportunity to introduce another technological mode of seeing – an RGB camera tracked view of the Site 3 space (Figure 56). Here we see another method of spatial reconstruction quite different to the methods and devices used to capture depth until now, but nonetheless a likely standard component in a system/device capable of mixed reality. In essence 3D camera tracking relies on analysing differential patterns within the sequential RGB frames to determine the direction and speed of movement, and then proceeds to construct a three-dimensional representation of the pathway taken by the camera/user/inhabitant in virtual space. This pathway can then be used to match the motion and orientation of the real view with digitally constructed assets that are composited into the mixed reality view of the world.

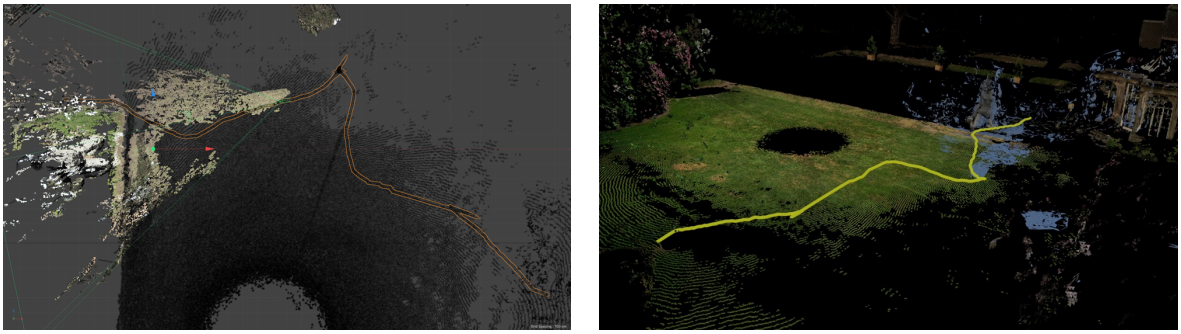
Whilst the fixed location of capture enabled by the laser scan offers a measured perspective of the surrounding environment, and in simple terms works by way of a laser reflecting off of a spinning mirror - it is reliant on a lack of movement in the form of a fixed location for the scanning device. Motion tracking in a sense relies on the opposite of this, in the form of inhabitant movement through space. It is here we start to see the temporal aspect of a mixed reality manifest. The duration and speed of movement through the space not only influence and affect the inhabitant's duration of experience but also function as a significant factor in the technological interpretation of the space. The motion tracking system's reconstruction of a space, in terms of its accuracy and volume, relies on the amount of time, quantified in terms of a number of frames, that it has to read and analyse the view.

Figure 56.
A sequence showing marker less motion tracking being used to map the space.



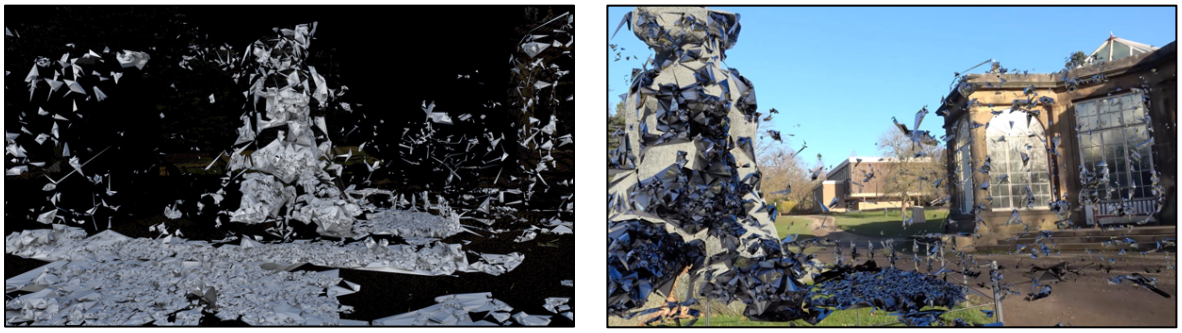
In constructing a three-dimensional pathway of the user's journey (Figure 57), the motion tracked system is attempting to determine (via algorithmic differential analysis of pixel clusters) visual information that can be usefully applied within a merged/layered visual display. However, where the dimensions captured using the laser scanner could be seen to be uniformly accurate in their measurement, the process here relies upon a repeated series of algorithms to generate many reference points that pop in and out of existence. This means that the quantity and quality of the tracked data can vary significantly from frame to frame, particularly in the less controlled/designed external setting shown here. As the mode of capture has only the pixels that are in the frame of the camera's lens as its area with which to calculate a set of reference points, the positional accuracy and duration are often extremely variable. As the user (with camera)

Figure 57.
A motion tracked pathway through a digital capture of Site 3.



Note. The left image shows the view from overhead, on the right is an aerial 3D viewpoint.

Figure 58.
The motion tracked data is further used to calculate a version of the space.



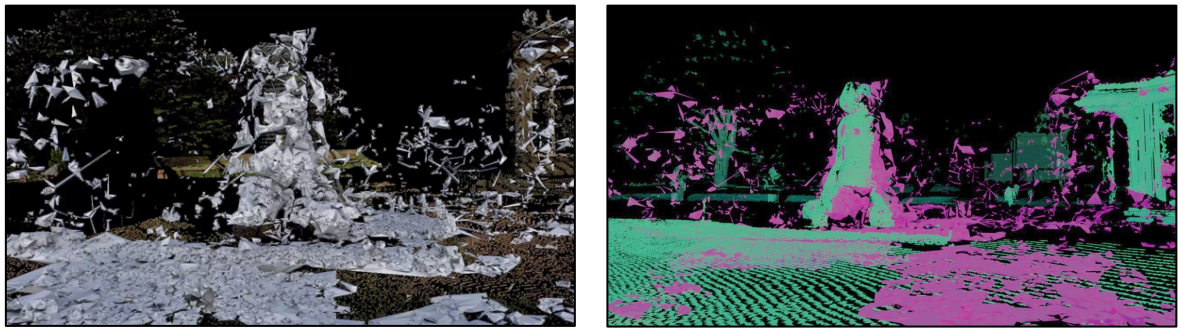
moves through the space, so this visible area constantly changes across the entire frame. Whilst this is a necessary component for this method, it means that continual gaps in information appear dependant on how long each visual element remains in view.

We see here the evolving nature of a time and space is in part mediated by the technologies of viewing afforded by mixed reality. It is also here that the control by the artist/designer can further catalyse the imminently occurring moments or phases. This control is investigated via a process of creating, reflecting and adjusting the various layers of capture and its presentation, which radically influences the aesthetic dimension of the work (colour, tonality, vibrancy).

As a motion tracked pathway is generated, three-dimensional objects can be displayed in amongst the view of the real. Figure 58 shows a motion tracked reconstruction of a scene. Using the same process as the camera tracked layer, this technique analyses differences in a sequence of 2D RGB video frames and attempts to reconcile and connect together points within a scene to generate a series of 3D meshes.

This combination of layers – the video of the real, the laser depth scan, and the motion tracked mesh - are held together over time by the physically and virtually matched pathway (Figure 59, P.159). Each layered component fragments the view of the real, with the resulting merged encounter dependent on a set of parameters that can be selectively altered by the system or directly by the designer. The voids and absences that occur here serve as catalysts for demonstrating the interstitial edges separating the embodied form of phenomenological perception and its technological manifestation.

Figure 59.
The laser scan and motion tracked 3d scene layers combined.



Note. The image on the right is recoloured to highlight the different modes of capture. The point cloud is green, the motion track mesh is pink.

In essence then, the practice-research within this phase of enquiry furthers the abductive notion that voids, and absences might be usefully employed as a part of the spatial component of the mixed reality encounter. This potentially offers a space within which the virtual actual is employed in order to infer new meaning to spatial forms of encounter, outside the bounds that are represented by the virtual-technological representation. In doing so the research reveals the creative potential of absence in a Mixed Reality environment.

Summarising Phase Three

In summarising phase three, this series of layered journeys through the site explores the designed combination of spatial and temporal capture to alter the observer experience within a mixed reality. These video-captured journeys could also appertain to the experiences documented in the example works reviewed earlier. Both Matsuda's central characters (2010b, 2016) and the participants in Cardiff and Millers video walks (2014) inhabit a space or site of enquiry within the context of a journey through a mediated environment that intermixes both the actual and the technological. Each set of works offers the suggestion of a freedom to explore the environment, whilst being both expanded and constrained by the technologised modes of viewing.

The linear measure afforded by the unedited video sequence (serving as a proxy for the experiences of each inhabitant within a mixed reality scenario) provides a stable

basis for the mechanised representation of time that is then translated into a potentially cohabited synchronous/asynchronous mixed reality environment. As we have discussed, this overlapping of spatial/temporal experience within a continuously relived virtual/actual moment is then further susceptible to influence via the notion of subjective time perception that we expect within a technologically mediated space. Therefore, whilst each inhabitant of this mixed reality does not experience the physical journey in a uniformly directed manner, there is the notion of subjective influence within each encounter that forms part of a journey. All of this mediation can be influenced, though not totally controlled, by the designer cyclically iterating the virtual technological representation of space and the digitised disruption of the physical environment.

This aspect of mediating the subjective influence on lived time is co-dependant on a series of other sensorial cues. Further examination of this aspect required another phase of practice. In essence the mode of encounter, particularly with regard to a site a of enquiry open to the public, would be more realistically affected with both image and sound. It is here that the practice-based work moved on to further investigate the idea of co-habitation and the influence of multiple spoken-audio recorded conversations.

Practice Phase Four: The Layering of Spoken Audio

Practice Phase video: http://www.stephenhibbert.com/phase-four.html

Practice phase four discusses the addition of an auditory component to the visual layers of encounter discussed in phase three. Throughout this earlier phase the temporal and spatial capture of a user/inhabitant journey provided a series of data-performative outcomes. Each of these, and any number of other spatio-temporal artefacts, are assumed to have the potential to be overlaid as a supplement to the current occupant's experience of this mixed reality capable space. This layered mediation of each individual's personal encounter has the capability to collapse the singular experiences of visitors and other stakeholders into a kind of co-habited temporal, poetic and syncretic experience for each inhabitant. Given the speculative nature of the system in question, these layered conditions, in combination with the inferred subtleties of auditory interpretation, can be subjected to further examination.

Auditory capture offers the opportunity to deliver first person, subjective, experiential comments, observations, and testimonials which can then be incorporated into a soundscape that amplifies the layered mixed reality experience. This additive process of creative production follows on from the abductive search strategy defined earlier, in that it allows the designer/observer to follow a line of creative interrogation within a cyclical system of enquiry. Given the context of exploring the interoperation of a mixed reality experience, the combined effect of audio and visual artefacts on embodied cognition offers a particularly promising mode of conjecture that might further enhance the practice-research goals in line with the earlier research question 'i. how spoken word might be used to incorporate a richer sense of lived time'. This further establishes the Derridean notion of complication of the specious present by the involuntary interference of memory in the inhabitants first person construction of the moment being experienced. As a reminder it is argued that the basic patterns of embodied cognition can be influenced via affect, memory, and prediction (also read as the force of impression, retention and protention, after Varela (1999)). Within the formation of this pattern the

various components that are used to deliver the digital audio element of a mixed reality can each offer a degree of influence on the inhabitants' experience of lived time.

In its most straightforward manifestation this auditory element might involve two primary sources – sounds received naturally in real-time at the point of capture in the physical world, and those generated (typically spoken audio) and placed as a facet of the virtual counterpart environment. To explore this asynchronous marriage of audio environments, a number of sources were captured, with each recording integrated into the visual capture generated in phase three.

A connection to the journey

In order for the auditory element to retain some form of connection to the visual, each recording takes place within the same 50 metre radius of the laser capture, alongside the Sophie Ryder *Sitting* artwork (Figure 53, P.152).

As with the visual element, the base audio layer consists of an unedited environmental soundscape, captured at the same point as the video base layer discussed in phase three. This offers a matched 'anchor point' in the visualisation that might serve as a foundation or point of departure. In addition to this base layer a series of audio tracks are then captured and added.

Whilst this could easily be populated with any number of audio artefacts, for example alternate natural soundscapes from other places or musical scores, the context here focusses on a combination of co-habitation, memory, and shared asynchronous experiences, that need to be contained within the environmental and cultural context of the sculpture park. With this in mind there is a focus here on recordings of spoken word and 'live' environmental audio that relates to the place of capture. As with the visual manipulation of the MR environment, the sonic canvas / soundscape of the spatial encounter can also be subjected to designed manipulation and iterative adjustment, and in turn this can be seen to alter the spatio-temporal characteristics of the inhabitant's environment. Additionally, however, the audio component has a more intimate

relationship to our faculties of association and memory. As organisms, we process vision and speech separately, and this enables a highly dense field of audio or voice to accompany a visual stimulus. The most densely layered spoken audio can serve as a semantic cloud that inflects our reading or interpretation of an object or moment, without at the same time incapacitating us or obscuring the more practical contours of our immediate environment.

Indeed, as previously discussed with regard to Tacita Dean's audio artwork *Trying to Find the Spiral Jetty* (Figure 60), sound itself can be a powerful influencing factor, provoking pre, during, and post variability of the physical encounter. Within this piece Dean explores the nature of the journey itself within an auditory format that suitably "connects the audience with the landscape" (Papapavlou, 2015) in a provocative and alluring fashion, allowing the audience an insight into the journey itself. In so doing each individual experience of the work is in some way dependant on an amount of pre-knowledge of the intended site of enquiry – in Dean's case this being the general area of the land-formation, but not the exact location of Smithson's *Spiral Jetty* artwork. Where Dean would likely have used a more traditional media to explore these aspects, in the case of the project associated with this thesis, the designer/artist is able to influence these audio and visual aspects of encounter in real-time via the immersive capability of the mixed reality medium.

Figure 60.
Trying to Find the Spiral Jetty. Tacita Dean (1997).



Note. The audio cassette tape includes a series of printed instructions that provide directions toward Smithson's *Spiral Jetty* artwork.

The live environmental audio anchors the mixed reality inhabitant in the real world, surrounding the visitor on their journey through the landscape. Overlaying this the recordings of spoken word serve to generate allure, the resulting artefacts connecting the present inhabitant with moments from past visitors, not unlike, but still more open than the Cardiff and Miller audio walk artworks discussed in Chapter 2. This act of 'temporal intermixing' amplifies the connection of colocation and signifies the potential for mixed reality to reshape multiple qualities of the encounter, whilst serving to further influence the pre-knowledge of the artworks and their environment.

The different levels of spoken audio – from the perspective of curator, maker, visitor.

This pluralistic approach, implementing multiple audio recordings that have been captured on a journey toward or around a place of interest, appears to offer a suitable avenue of investigation within the context of a typical visit to a cultural heritage site. To further investigate and reflect on how this might be applied, two audio interviews were conducted – the first with a Curator, the second with an active independent artist/maker visiting the park. Each interviewee discusses aspects of visiting and working in the park

from both pragmatic and social standpoints. As such these conversations, whilst informed to differing degrees, are able to offer a personal insight into their view on consumption within a cultural heritage context.

As Deputy Curator at the YSP, Damon Jackson-Waldock is part of the team responsible for organising and placing work in the park. In the interview, Jackson-Waldock discusses the process of trying to balance the distribution of works throughout the natural and manmade areas of the park in order that novel experiences emerge for both new and seasoned visitors. As Jackson-Waldock states:

> …we quite like the term 'to get comfortably lost' because from that you kind of have this freedom. You go and explore, and you've learned, and you find new things. But at the same time, you can have the conversations and journeys, all of these words, are quite important, I think, to us.

As with many cultural attractions the park displays works for varying amounts of time, with long-term installations being interspersed with the temporary. The Park is in a perpetual state of considered re-arrangement, from the shorter exhibitions that might only last a few months, to the medium- and long-term loans that occupy many of the larger spaces. On one level this process of rearrangement encourages new readings of the space and collection of works, as well as presenting the opportunity for something novel to be discovered/experienced. It is this that drives the return appeal (and seasonal marketing) of the park. On another level this re-arrangement has the potential to alter the routes of traffic moving through the parkland. Whilst an encounter with an artwork might provoke new readings from new positions, here the more permanent artworks serve a more pragmatic purpose as navigational reference points to orientate and guide the general visitor through and around the various sub sections of exhibits. Jackson Waldock continues:

> I think journey is a quite a nice word to use when we think about visitors taking your[sic] own personal journeys around the park, we get a lot of people

> revisiting. And so, they'll tend to do maybe similar journeys, or they might want to try something new.

The combination of the fixed and the temporary placement allows the park to be 're-mapped' and explored in alternate ways.

Here we see how the inclusion of a mixed reality viewpoint might also offer a duality of both familiarity and uniqueness to works that appear more fixed in their physical form. In this captured virtual overlay, the seemingly fixed nature of a physical journey can be warped or distorted, generating a more transient experience, not only of the *new* artworks/installations, but also the previously 'fixed' long term works and their surroundings.

Each perspective offers an alternative way of interpreting both the journey to and encounter with the artwork. The technological mediation of this experience is able to intercut and overlay each of these 'seeing and listening points of reference' and in so doing have the capability to illuminate/interrupt/augment the experience. It is again here we see the capability of a mixed reality to suggest to the inhabitant the emerging image, constructed both by the artist/designer and that of their own (pragmatic or philosophical) reading of the work. Mixed reality enables both the designer and user to explore how the encountered fragments affect an experience.

The second interview also took place at the Site 3 location alongside the *Sitting* sculpture. Alice Morris is a graphic designer with a particular interest in the role of artwork and the potential for unexpected interpretation.

> I'd like to say that (knowledge of) the artist really informs how I look at the artwork, but there used to be an Anthony Gormley here, and I thought that I'd really like it because I have seen his 'Angels of the North'. But when I got here, I thought it was a bit underwhelming, and it's actually the (unexpected) stuff, there's one by, Joan Plenza - 'Wilted face' - and I'd never heard of that sculpture before and that was like quite breath-taking.

Morris' reading of the meaning of the Sophie Ryder *Sitting* artwork is taken from a largely uninformed perspective, perceiving the position and orientation of the work "it initially sort of strikes me as something quite domineering and it looks like it's looking over the landscape saying, 'I own you'". As a maker herself, Morris then becomes interested in the formation of the piece and the choice of materials. As a designer she welcomes the idea that the wire material used to create the sculpture is purposely chosen. Here there is an inference that the gaps in the wire mesh allow natural debris such as leaves to be embedded in the structure, the sculpture therefore further embedding itself into the landscape around it. There is also an aspect here of cyclical change, as the seasons come and go, so the artwork is besieged by falling leaves and debris before being renewed as the natural elements follow a process of decomposition.

This interpretation of the work again unfolds into an informal view of the relationship between the natural and the man made. Morris describes her interpretation of the encounter as she sees it, but the audio capture of this description, overlaid onto a mixed reality journey through the space, again serves to inform and in some way modulate the qualities of perceived encounters by other visitors.

As a mixed reality inhabitant our pre-knowledge of the space and work is in a continual state of re-calculation, which is then further affected by the changing state imposed by the mediated layers of display and sound. As with the early audio walk artworks by Janet Cardiff, auditory stimulation augments our perception of an encounter-oriented journey. This augmentation might be from auditory cues intended to draw attention to a specific aspect or narrative element using fragments of memory from other visitors, or in order to provide a measure of context that matches or influences our reading of the environment.

In implementing a design that either guides or adjusts attention, so it can be reasonably assumed that the inhabitants lived cycle of retention and protention is adjusted in some way, and therefore their durational perception is open to potential alteration.

Figure 61.
The Intermixed Journey



This again recalls the potential multiplicity of durations that could be enabled via the auditory component of a mixed reality system as discussed in the introduction to this thesis, when considering the issue of reconciling virtual actual and the virtual technological constructs. As further layers of auditory adjustment are added or invoked via mediation, so each inhabitant is presented with a series of possible influencing factors that invisibly affect the journey and any encounter. In so doing, we see that a mixed reality system can be creatively employed to examine the interrelationship between the physical and the digital forms of virtuality.

The short film entitled *The Intermixed Journey* (https://vimeo.com/552437857) (Figure 61) that accompanies this phase of practice research offers a suggested outcome that combines these aspects of auditory layering. The film is directed from the first-person perspective of the mixed reality inhabitant walking through the Sculpture Park, past the Sophie Ryder *Sitting* artwork. Along the way this journey is interrupted and influenced by both the depth scanned view of the space captured and the combination of 'live' in situ environmental sounds. This is then further enriched via the audio spoken word elements that bring forward the idea of a co-present lived time via captured traces and memories from other previous inhabitants.

As the journey progresses, we see the inhabitants perceived transition between the digital representation of the space into the real, each step revealing the interaction taking place. In its computer-generated form the space introduces voids and absences in amongst the partial capture of the environment, with only the background noise of the countryside remaining relatively consistent.

Summary of Practical Dimension of the work

As we have seen, the layered model of cyclic iteration allows the designer to gradually improve and move toward a series of potential outcomes that explore the speculative. A mixed reality mode of design and consumption requires a series of steps to understand the parameters that might inform its use.

First, the reading of an environment can be captured in a number of ways, each must in some way reconcile the physical and digital to generate a sense of continuity that allows the inhabitant to orient themself. Each of the earlier phases of this practice-research built upon the last to gradually determine modes of creative enquiry that might suitably inform the spatio-temporal mixed reality scenario.

By first understanding how technology is able to 'see' the space being viewed, utilising a number of different digital sensors, the role of the system and its limitations is better understood. From this point of technological seeing, a deeper understanding of how differing types of data sets can be usefully employed was then explored, first in a smaller controlled environment and then toward a more complex natural scenario more befitting a real world/domestic/general setting.

In amongst the investigative early phases of practice-research we see a number of limitations, inherent to the technologies employed, start to affect and distort the reading of the space. However, these issues can be viewed as aspects of a system that, given the framing of the project, no longer requires absolute replication of the real. Rather, the fragmentary gaps and voids in the data can be usefully and creatively exploited as an intriguing spatio-temporal quality of data capture and mixed reality. Phases two and three looked to expand on this aspect, moving away from the broadly technical, utilitarian mapping of a space, toward a reading that might, through the incorporation of anomalies, influence the embodied experience of a hybrid space. Phase three in particular opens out into the potential for mixed reality experiences to be much more layered in their construction. It is here that the creative designer might explore modes of

engagement and interpretation, that in this case are driven by the encounter with an artwork.

Introducing the auditory element offers a complimentary mode of enquiry that might enhance the aspects of lived time beyond the private, sequential representation of the journey as recorded by the unedited first-person video sequence. As the inhabitant or user of such a system journeys through the space, so they are potentially open to influence by both visual and auditory fragments, as borrowed aspects of another person's experience potentially affect their reading of space and duration.

Chapter 5 Outcomes and Conclusions

As a reminder, the development of this thesis has led to a unique contribution to knowledge that consists of three main components –

A. defining a generic method that could be applied in artistic research contexts
B. producing a specific creative mode of project generation, with respect to technological interfacing, which makes use of the Yorkshire Sculpture Park as a situation
C. establishing an approach that allows for portable applications across contexts within the cultural and heritage industries

As a result of the above, it is very difficult to clearly separate outcomes and conclusions in the context of this practice-oriented study. This is due to the fact that there is a sense in which the outcomes, seen from another perspective, could also be said to be the conclusions. Therefore, this final section looks to examine the outcome-conclusions in turn, from the perspective of their portable, and translatable aspects, alongside their more located and situated status as artefacts 'within' the sculpture park.

Contribution A: Defining a generic method for artistic research contexts

In one sense there is the 'portable' outcome of a practice-led methodology that enables a number of modes of applied speculative design to manifest through enquiry led by abduction. This was initially developed as a way of practically investigating the problem context as presented by a mixed reality mode of consumption. The complexities of this emerging and still speculative platform led to an approach that synthesised a range of methodological precedents toward the generation of artefacts. These precedents included:

- A cybernetic method of design research termed 'research *as* design', which inherently requires a practice-led mode of enquiry
- An abductively led cycle of creation, reflection, and analysis

- A speculative 'cone of futures' approach that encourages a process of modulation seeking to actively re-frame the problem context.

The outcomes from this synthesised approach resist some of the conventions that might occur in the more risk averse strategies adopted in design related disciplines (e.g., 'standard' or more conventional mixed reality environments). Whilst it may be seen to be inherently difficult to establish a strong sense of grounded meaning in some of the solutions outlined in this thesis, the suggestion here is that the value of this synthesised method can be derived from the way in which it offers a way toward an abductive and interpretative incorporation of many disparate elements.

One of the conclusions of the study then is that this methodological framework is valuable and portable across a diverse array of projects/studies arising in a practice-oriented research context – providing a discipline specific methodology that could be utilised by future researchers looking to examine a design scenario that might benefit from an expanded, less-predictable, and more creative outcome.

Whilst the first phase of practice-led research set some of the conditions for this approach when testing the values of a speculative system, it was only when these conditions were better defined and applied from Practice Phase Two onward, using this productive methodological process, that it could be seen to be of value for other researchers.

Here we saw the use of a cycle of making that was led by abductive inference, in order that modes of intuition could be suitably interrogated. This was a defining quality of the project methodology. The abductive approach allowed for diverse outcomes to expand beyond the limited or more restrictive predictable outcomes that fall into an 'objectively' led mode of enquiry and that might be confounded by complexity. Instead, there was the potential for possible alternate solutions to emerge which had a capability to invert certain restrictions found in modes of interrogation that lean strongly towards deductive or inductive enquiry. In the practice covered here, we see these diverse outcomes manifested in the interrogation of voids and anomalies captured by the

technology being creatively interrogated and interpreted. These artefacts open up the prospect of examining the relationship between the inhabitant of a mixed reality, the technological system, and the resulting mediated view of the world. As such the capability and potential of a mixed reality is reframed from a purely informational, objectively led implementation, into a richer more subjective mode of perception.

Further defining this process of practice within a phased approach to development also proved particularly useful. This allowed the researcher-practitioner to evolve alternate modes of presentation and development offering potential new avenues of insight into how, where and why an application scenario could be further investigated and explored. If we consider for example the practice conducted here, focussed on mixed reality, and the transition from Phase Two to Three - Phase Two revealed the notion of designed voids and its mediation of actuality, and this then became a core frame of context in Phase Three when investigating the emerging (mixed reality mediated) encounter within a cultural heritage setting. In the context of artistic research, this supports and even fosters the idea that creative decision making in the face of anomaly via a reframing of enquiry can lead to flexible modes of interpretation and perhaps help to overcome problematic design scenarios.

Contribution B: A specific mode of generating speculative outcomes

In considering the portable outcomes that emerged as a result of the practical work (I.e., the mixed reality sculpture park project visualisation) there appear to be a number of qualities and capacities that could be fine-tuned to different culturally consumptive scenarios. Thus, a similar framework could be applied to museums, galleries, or other cultural heritage situations.

Given the right expertise, a real-time based technological approach that intertwines the various modes of interaction between the various stakeholders offers a potential to deliver a series of novel outcomes. These would be dependent on the definition and

adjustment of parametric factors that contribute to an encounter – in this case the technological mediation of capture, generation or consumption - by one or more stakeholders – the user, the designer, or site curators.

In a more film-based, visualisation specific sense, there is the analysis of the 'fixed' outcomes that manifest in an evolving series of practice-research artefacts, each exploring a culturally consumptive mixed reality scenario in the form of audio-visual journeys (as evidenced in the documentary film that accompanies this thesis).

These sculpture park project visualisations, produced over Practice Phases Three and Four, were designed with the concerns of the cultural industries in mind, which merge considerations of aesthetics with participation, entertainment, and the delivery of information. In the context of these concerns the resulting conclusions taken from the visualisation present a form of art-oriented, cultural consumption and investigation which intertwines factors such as:

- The spatio-temporal relationship between self and objects, particularly within a durational frame of lived time.
- The role of aesthetics in presenting novel experiences that the application of technology can then be used to enable from different points of view - from the designer developer of hi-tech experiential services; to the experiential artist; to the public audience experience whose participation might enable a kind of wonder in and around a site of enquiry.
- A strange mode of both passive and active participation. This mode is passive in the sense that an augmented encounter enables the intermixed presentation of real and digital materials; and active in its mode of capturing a rich syncretic temporal archive of encounter that resonates with the concerns of cultural history.
- Enabling immersive entertainment via the potential for play based interaction or academic investigation. The environments of the cultural and heritage industries mean different things to different people and therefore might appeal to a wide spectrum of audiences in a variety of ways.
- The potential to capture and present a range of information - from the everyday to the profound. This could be taken from the vernacular of the local environment or introduced in curated or scripted forms.

The generation of outcomes in this way underlines the importance of visualisation in this context, allowing both designer and audience/recipient to examine, understand, and interpret the approaches taken.

Contribution C: An approach for the cultural industries that is portable

In understanding the values of the resulting platform/exhibition, we also need to appreciate that the complexity of the problem exists across two different kinds of virtuality (digital/computational and the more temporal, philosophical conception of the virtual-actual). Practically exploring the intertwining contexts of study as covered in Chapter 1 helped to elucidate a mixed reality scenario that could be utilised in a diverse range of culturally consumptive contexts.

Approaching the qualities and capacities of the project which have value in culturally consumptive settings, we can see how its theoretical concerns have been translated into a technological platform. We have explored the characteristics of a speculative mixed reality system, practically examined the use of spatial capture technology; explored the visualisation of memory and the specious present in the context of both audio and video display; and considered the role of design in adjusting these layers. This enabled the researcher-practitioner to interrogate how a mixed reality technology could both influence and be influenced by the various actors/objects and stakeholders.

The speculatively envisaged system is particularly useful in context of cultural consumption in so far as it is premised upon the notion of pluralistic experience, the context of interpretation, and the presence of multiple voices.

Within an arts and humanities context there is an inherent resistance to closure of meaning which is somewhat at odds with other sectors. By engaging in a layered system of enquiry that is able to sample certain scenarios and contexts via the phased production of artefacts, each potential stakeholder would be able to investigate and reflect on the outcome(s) from a number of viewpoints. This provides a measure of

progression that might otherwise become blocked or confused if conventional approaches had been adopted. If more traditional methods had been adopted a less radical solution may have arisen. Perhaps most importantly, the method utilised in the project associated with this thesis provided a more suitable approach to development in the cultural industries. This was related primarily to its openness to the faculty of interpretation with respect to the consumption of the arts, and a resistance to a dominant single reading or solution.

Each of the above approaches were synthesised to provide a practice-based framework for developing outcomes that lie somewhere between the speculative and the real. If we take the wider cultural sector as our example, the consumption of cultural spaces is of course multifaceted. Within it we see the various stakeholders and audiences attempting to be in some way accommodated. These range from the measurable elements of a business context in terms of returns on investment, engagement and retention; to the qualities of experience received by the visitor; to the opportunity and potential for the artist/designer to express themselves. The prospect of multiple stakeholders' interests, not unique to the cultural sector, is a key aspect that remains difficult to directly or properly address. It is not being suggested here that the above framework provides a single answer to this, rather its value can be seen to lie in the emphasis placed upon creativity and novelty in order to derive a solution that might address such a situation in a creative and diverse way, with plurality as a key aspect of the design.

Co-presence in culturally consumptive mixed reality environments

From the perspective of the more situated outcomes of this thesis, the practice phases covered in Chapter 4 progressively develop a response to the conundrum of a mixed reality mode of consumption within a setting that also involves consumption of cultural capital. Within this context we are faced with a challenging marriage of both passive and active scenarios of both enquiry and engagement. The series of artefacts produced stemmed from a design enquiry system that accepts the capability of a

technologically mediated mode of seeing but is bound with an understanding of how lived time must be incorporated into such a scenario. Through this enquiry we determine that lived time is a key aspect that drives and is driven by emerging temporal and spatial anomaly. In appreciating this aspect of a mixed reality, the practice reveals a way of co-habiting such a space that might be productively utilised in a setting such as this, for both visitor, artist, and curator.

For the visitor, by interrogating the relationship between two modes of virtuality we might better understand how a formerly limited informational mode of seeing can be implemented in a more dramatic and thoughtful way. This mode of augmenting experience is seen via the emerging qualities and layers of the various artefacts produced. As the possibility for technology to augment a journey is further developed, so there is the opportunity to integrate modes of perception into the experience and challenge the inhabitant's notions of how they interact with the artistic environments surrounding them.

For the designer, the outcomes resulting from the practice-research in Chapter 4, built utilising the research methodology covered in Chapter 3, offer a series of insights into a speculative mode of creative exploration. When designing for a complex scenario that has inherently plural qualities, constituted in this case by engagement and immersion, the designer is able to adopt a flexible approach, even without having the certainty of a fixed goal or target. In the process of generating new or novel artefacts, an abductive starting point allows for the anomalous to be suitably introduced and then reflexively produced without being hampered by a more fixed mode of evaluation. The resulting suitability is achieved by retaining enough of the pragmatic elements of a mixed reality to be useful. The mode of making followed here, then, demonstrates that a basis for exploration can then be developed with the opportunity to ultimately generate something more plural and open.

In so doing, particularly in the context of a complex mixed reality scenario, there arises an opportunity to produce a series of potential experiences that present an

inherent uniqueness to each participant. This collective process is the plural outcome that identifies the bridge between the embodied (actual) virtual and technological virtual.

For the artist and curator, a more open mode of practice often takes place in terms of exploring concepts. Arguably this moves beyond the narrower confines of the more directed practice that typically takes place in the context of design. Given the difficulties that a mixed reality interaction scenario might present, this mode of enquiry offers great potential for the exploration of differential modes of being. Utilising an approach that incorporates pragmatic sensorial input and output, whilst actively encouraging variability in both temporal and spatial modes of display, would appear to offer a valuable avenue for developing a wider set of experiential potentialities.

Such an approach might involve a broader spectrum of agency that goes beyond the curator or artist. Systems which incorporate acts of capture, mediation, and response might instead be developed by technologically sensitive designers and would likewise rely on an understanding of the augmentation of affect, memory, and prediction, and how such factors might influence the inhabitants/visitors own mediated journey.

Future exploration and analysis

In summary, this thesis has explored how and where aspects of the creatively led production of the new might be suitably applied within a defined framework. Here the prospect and potential inherent within speculative design is given a mode of operation that values the idea of the emergent and cyclical, but which is aimed towards a problem context beyond the prosaic. Whilst the future application of mixed reality technology remains in a state of continual research and development, its purpose and use has a wider implication than the purely Cartesian and informational. This thesis introduces the notion that modes of technological virtuality can affect the virtual actual in the sense that mediated sequences, via modes of augmentation, can influence, interrupt, and affect our subjective sense of temporality, and this remains an open line of enquiry that might be explored beyond this thesis.

Future work might incorporate the above elements in a number of different ways. For example, the types of spatial capture and their differing representations of an environment appear to offer an interesting avenue for further comparative study. If we consider the way in which the 'objective' fixed intermittent points of precise measurement presented by laser capture have thus far relied on very controlled uses, whereas the 'subjective' motion tracked method of spatial capture continues to evolve the variability of time and space, with its constant renewal and recalculation seemingly in opposition to the former fixed mode, this opens up potential for more durational enquiry.

The practice-research conducted here also highlights the purpose of introducing modes of augmentation/interference. Its purpose in the context of this project was to actively acknowledge and somehow facilitate the embodied modes of experience of the inhabitants within a mixed reality. It foregrounded the diversity inherent in subjective experience, a particularly pertinent aspect that is inherently active, but often occluded or ignored within a technological mixed reality. This approach to realising a variability of experience considers, but in some sense pushes against centralised, hegemonic design centric notions such as 'the user', as a universal category, as is suggested by the universal Kantian subject that was inherited by cognitivist approaches.

Crucially then, the pluralistic approach investigated here allows for the future exploration and analysis of the ways in which a co-habited space and lived time might be shared. The project enables us to envisage how a future mixed reality system or environment might serve to enable modes of continuous co-habitation and facilitate a mode of cultural consumption which has the potential to be dynamically manifested syncretically over time and space.

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Appendices

Appendix 1.

Conceptual visualisations of a Mixed Reality

Figure 62.
The 'Black Mirror' Episode 'Playtest' speculatively explores the idea of a mixed reality game.



Note. Dir. D. Trachtenberg (2016). Black Mirror: Playtest. Endemol Shine UK.

Figure 63.
The 'Captain America: Civil War' film includes the use of a fictional MR device entitled 'Binarily Augmented Retro Framing'



Note. Dir. A. Russo, J.Russo (2016). 'Captain America: Civil War'. Walt Disney Studios Motion Pictures

Conceptual visualisations of a MR have existed for many years often stemming from the fictional representations presented by the likes of 'Snow Crash' (Stephenson, 1992), 'Neuromancer' (W. Gibson, 1984), 'Ready Player One' (Cline, 2011) and more recently 'Black Mirror' (Brooker, 2016)(Figure 62). The ubiquitous (as opposed to task specific) existence of a MR tends to provoke both a sense of utopian wonder and of dystopian alarm in these adaptations. In losing our innate anthropomorphic sense of perceptual rationalisation they appear to argue that there is a distinct possibility of mass sensorial discombobulation, recently dramatized via the visual effects driven Binarily Augmented Retro-Framing device in the films Captain America: Civil War 'MIT Stark Foundation' sequence (2016)(Figure 63), and the Spiderman Far From Home 'Illusion Sequence' (2019). For an illustrative visualisation see Chapter 2 Example works - Keiichi Matsuda's 'Hyper-Reality' short-film (2016)(Figure 7, P. 66).

Appendix 2. A Truncated Story of Infinity

Figure 64.
Trillo explores multiple realities in a *'A Truncated Story of Infinity'.*



Note. Dir. P.Trillo. (2014). A Truncated Story of Infinity. USA.

The design of this film is thoughtfully handled, in particular the editing through which to visually demonstrate the concept of multiple realities (Figure 64). Repeated elements such as the use of recursive reflection to indicate an infinite series of Subject X doppelgangers, or the repeated camera shot sequences that interchange a series of objects to indicate alternate choice provide the anchor through which to tell the story of Vincent's subjective choices.

Throughout all of his work, Trillo attempts to engage in how cinematic technique can serve story, and how story can in turn inform the technique being applied. In a sense this echoes the role of technology in general as discussed earlier in this thesis. Mixed reality exists or has come to manifest what it might be defined as via a dual form of design and development. First in the real application scenarios developed as part of its technical evolution via development, testing, and industrial application. Second via the

visualisations envisioned by the artists and designers that speculate on potential future scenario extrapolated from the present using aspects of speculative design.

Again, this can be further defined in the context of the combination of methodologies defined in Chapter 3. The use of speculative design considers the cone of probability. In the case of Trillos work discussed here, this speculation surrounds the ideas of the unseen and the unknowable. As both of the central characters in each film are used as devices within which to explore potential scenarios of variability. Terrys internal conflict within which we witness internal conflict of one's own memory and interpretation ultimately informs the choices he makes throughout the day, and the way in which he views the world around him. Vincent's story is told via infinite potential variability ultimately guided by the theoretical principle of infinite universes.

These films are successfully widening the cone of probability in terms of the subject and the designers reframing of the scenarios via the use of technologies as modes of seeing and interpreting.

Trillo is using the technologies he has chosen – the snorricam rig and the repeated sequential edit – to tell the story. These films utilise the technological frames of film production within which to produce a series of artefacts from a specific point of view.

Again, we also see the use of abductive reasoning in order to produce these works. Trillos articulate exploration of the unseen and largely unknowable/unprovable is the aspired VALUE with which to begin the creative process of producing each film. This is achieved in the end via the use of a specific filmic device. This filmic device is the frame used to produce the film, 'the HOW'. The 'THAT' is the explanation or exposition of the Theoretical concept or communicates the story resulting in the desired VALUE.

Appendix 3. A wider use of point cloud data

The application of point clouds specifically optimised for use within real-time systems continues to be an area of development for device manufacturers, with many real-time focussed hardware and software stacks being developed to offer some kind of optimised solution. These solutions point towards increasing application of particle systems within many fields of enquiry, but are largely optimised for either for scientific measurement, vehicle wayfinding, or used in the creation of baked in image effects. At a smaller scale handheld mobile variants that utilise this technology have been developed, but have largely only been implemented via the aforementioned facial ID cameras employing the use of laser focussing and active depth sensors which use an infrared illuminator to project points onto a surface in order to accurately determine depth (Qualcomm, 2017).

Appendix 4. Transcript of interview with YSP Curator Damon Jackson-Waldock, 2nd April 2019

[00:00:00.360] - SH

So, interview with Damon Jackson-Waldock on the 2nd of April 2019.

So, Damon, what in terms of your role as a curator, what's what does that entail and what does that involve?

[00:00:17.430] - DJW

Yes, well, I'm a deputy curator at Sculpture Park. And what that involves really, is the word curator is a funny one, I think. It means to care for, a relation to care for an art collection in a traditional museum setting. So, I interpret that now as my job is to care for not only the art, but also care for artists, their ideas, their projects. It's very much project management based, sorting out problems and kind of helping those artists fulfil the kind of creative goals.

[00:00:52.970] - SH

Yeah, great. And obviously, you've got quite a permanent versus temporary collection. How does that work in terms of those more permanent works? What sort of relationship do you have with the artists in those contexts?

[00:01:07.740] - DJW

Yeah, well, I guess most works that you see in the open are long term loans. We don't really have a big permanent collection. We've never felt that we should spend public money on purchasing work. So, everything is long term loans. However, there are things that have been here for a very long time.

One of our longest loans, is about 37 years. You'll see things like the Henry Moore's works in Country Park. They've been with us for years as well, but they are always changing. And so, each kind of relationship - with the artist, or the studio, or the estate -

is very different as we have some loans here for just a year. You know, we average it out to be about three to five years. Just maintaining those relationships with the studios.

And it's really good that on a loan basis that you have works that might change. So, when people visit the park, the experience of a particular area of the park might be very different to the last time they visited, because something's moved or. Yeah, you know, we've got new work there in place. So, it's quite nice for the visitor and also helpful for the artist as well, because sometimes it might be difficult for them to store large works of art. It's really nice working relationship. Get storage for free, and then we care for the work and look after it.

[00:00:02.170] - SH

So, think about the visitor experience and thinking about how important their experience is. What do you think about when you think about their experience? Both thinking about the sculptures and whether (the purpose of) the visit is looking to do what. What do you expect their experience to be when they come to the park?

[00:00:20.410] - DJW

Yeah, well, it's a mixture of things. First, we start off by thinking about we've got to care for this landscape. We've got to protect the landscape. We also need to position sculpture, which looks good for the location. So, it's kind of trying to balance this because we're a unique gallery, I would say, because we've got all this open air. Trying to strike a balance - in what looks great for the artworks, what's best for the artworks, what's best for the landscape, but also what's good for visitors to kind of enjoy and experience. So, we have to balance all three things.

[00:00:48.420] - DJW

So, for example, people think that we've got tons of space here and, you know, we've got 500 acres of land. But actually, we're quite at our capacity now in terms of sculpture. And that's why this idea of changing sculptures important. So, it's trying to balance all of that. But for visitors, I think the main thing really is, is that when they come here, they

are not only here to see new things. We like the idea of you might just come here for a walk and not come for the art and you happen stumble across a great work of art.

[00:01:14.190] - DJW

And you either like it or you dislike it. And so, yes, just about that journey. I think journey is a quite a nice word to use when we think about visitors taking your own personal journeys around the park, we get a lot of people revisiting. And so, they'll tend to do maybe similar journeys, or they might want to try something new. But I guess we just have to balance all of that, all those ideas.

[00:01:36.810] - SH

And one thing you just said came out with and was the fact that you're at capacity and that sounds quite unusual to an outside audience. How do you how do you figure that out in terms of what makes you determine it's at capacity?

[00:01:58.620] - DJW

You've got to (consider density) when you are placing sculpture, this is something we've done now for over 40 years. So, I mean, our director is still the same director. So, he was there at the very start, deciding and looking at locations for these sculptures. We've got this expertise, but it's not easy to place sculpture in the open air.

You know, public artworks just generally are really difficult. You get such a mix of emotions from visitors if (for example) it’s in a town centre. So, you've got to place it carefully. We've got to consider the landscape here because, you know, we are in an historic landscape. You also have to consider the artworks and all of the kind of the work that goes into it. So, you've got to you've got to balance that. So, I think when I say at capacity, we can't just keep putting more and more sculpture in there.

Things have to move and organically change. And, you know, so like, yeah, a lot of people think, oh, they've got tons of room for sculpture. But you need to you look at where they are. And already, you know, there isn't much room in this area in the lower park for any more until one of the loans comes to an end and it's time to move on,

change it up. But I think that's all quite exciting like I said, for the visitors to experience something new and it's great for us to use different parts of the park in different ways.

[00:03:19.290] - SH

We'll start to walk towards this Sitting sculpture (Sophie Ryder). So, this has been here for a number of years now, a few years at least and looking at a work like this and the positioning of it, what were you aware of, why was it positioned in the place where it is, at the time it was placed.

[00:03:42.330] - DJW

I mean, this is this comes from a Sophie Ruder exhibition retrospective we had a few years before I started and I think it was always positioned kind of like looking out over the landscape.

I'm not quite sure why it was chosen for this area. I think it's a mixture of logistical things. So, it needed kind of flat ground area. There aren't many places in the park that are flat but again, this idea of looking out and over the lakes, I guess is quite important.

Thinking about people's experience not only of this work, but of the space and experience of time, how much is that factored into the way that you decide to place the works, all the exhibitions that you put on, what sort of context does time play in what you do, if at all?

I think in time does (play a part). I mean, it's not something that we necessarily always talk about when we're planning a project or an exhibition or placing a sculpture. But it is quite important because we know that visitors come here for different sets (periods) of time. You might come for an hour, and you might want to just walk a dog, for example. Or you might be making a special trip to get here. (We understand) it's not it's not easy to get here on public transport, for example. So, you see a lot of people commit to coming for the full day.

That's why there are levels of car parking in that it kind of reflects those different factors - how long people spend here. So, again, I guess it's not something that we really think about when we are programming, however, is something that's always in the back of our minds. For example, if you're planning to put something down by the lake, near to where we stand now, we actually understand that that journey you take from the main car park is slightly different if you're parking down in this car park.

So, we kind of do think about all the (qualities and durations of experience) in the back of our minds. But at the same time, I think our goal really is "where does this sculpture fit in best?". But then we acknowledge that, you know, some people like to walk up to the Longside gallery. It's not opened all the time, but when we do open it, we kind of have to factor that in and we kind of have to create moments to pause, I guess, in and around the park. So, if you're walking to the centre of the park, you know, the lake for example, we opened the Poppy (WW1 memorial) exhibition there was a few years back with this idea that the lakes would be a place to kind of stop and reflect, and then before you carry on walking up to the gallery.

[00:01:47.980] - SH

Central point, in a sense, at the bottom off the valley obviously

[00:01:51.510] - DJW

It's a central point, but then also kind of the facilities and various other sculptures, I guess. So, I guess it's always in the back of our minds about places where you can stop off and see this before you move on to this or.... It started to happen a little bit more and more recent exhibitions, I think that I'm aware of. For example, the Panoni exhibition that's on in the underground gallery. We've placed a sculpture down by the lakes, with the idea of then once you've seen the main show, you have a kind of a journey through the trees because the exhibition was very much about that - to go and see this work in the landscape.

So, there are elements of that with particular projects and how we spread out for example, the new building that we've just opened at the weekend, the idea from that came from a few years ago when we had the poppies down at the lake. We realized they brought in quite a big audience, an additional kind of four hundred thousand visitors in four months.

[00:02:40.630] - SH

I was down here; it was a busy old time.

[00:02:42.360] - DJW

It was a busy old the time. And from that we realized that we understood a little bit more about how people use the space and how it could be difficult, or you know, landscape - walking through landscape - so, the building very much kind of came from the idea that we need to start to spread footfall and open up new areas of the park, which is something we've always tried to do. A few years ago, where we are stood right now, I'd say about four years ago there wasn't much sculpture around here, just the Caro's which have been here for a long time.

It about trying about opening up new areas of the park for people to experience new sections. By placing more sculpture over there - is trying to get people to use that space.

[00:03:16.710] - SH

Yeah, utilise the space. We'll keep moving because we're getting cold aren't we!

Yes, so thinking about, one of the things I'm interested in is exploring this diversity of experience, and I wonder what's the approach with perhaps people that have alternate sensorial capacity. For example, someone who's blind or some somebody that has an auditory experience rather than a visual experience. That's quite different, obviously. Where does that come in? Does it come in at different points or is it how do you deal with that and cope with that in different ways?

[00:04:03.320] - DJW

Yeah, I mean, it's a challenge for any organization not just an arts organization, to how people engage with what you've got for different abilities. I guess this idea of touch has always being quite important for us, not just for anyone that has visual impairments, but just more general visitors. We've always tried to encourage caressing and touching of the sculpture. That's why the sculptures are there. You know, more and more sculptures at the moment have to be roped off for various reasons. But for example, the Barbara Hepworth piece - the 'Family of Man' - she would always talk about caressing the sculptures and touching it, touching the bronze. And that was kind of where we started. You should be able to touch a bit more in the open. So, touch is much easier, I think, uh, for people for anyone to kind of interpret, I guess in terms of sensory experience. I think just the idea again, this unique idea that we've got a mixture of we're open-air gallery, you're exposed to the elements, but whilst seeing sculpture, I think for anybody, again, it's got a (multi) sensory experience here.

So just listening to the birds at the moment whilst experiencing great art, there's not many places in the UK you can get that. So, again, you've got that experience for everybody. But in terms of the challenges that face the organization, it's really difficult to include everything and try and make everything accessible, although we try and do as much as possible.

[00:05:41.620] - SH

In terms of your own personal experience, not thinking about it as a curator, when you come to encounter an artwork, what are you expecting? Are you expecting, let's say, for instance, some people expect that the artist is creating an experience that you're meant to 'get it'? You're meant to understand what their purpose is, all the meaning behind it. Other people say it should be to be the opposite. It should be open, an open experience for you. What's your take on that?

[00:06:07.880] - DJW

My personal take. I think for me, an artwork has to create some kind of feeling or emotion doesn't necessarily have to be always good or bad. You know, you don't have to

understand what ‘they are trying to say’. But this idea of creating a conversation I think is quite important (whether it’s) a debate or question. But I quite like this idea of artworks will create a conversation. So, if you don't necessarily understand it, you go away, you find out, you talk about it, and then you start to learn. And then that's why learning goes hand-in-hand with the kind of the creation of art, and whatever we place in the park here.

There's always some kind of learning resource. Schools will come, you know, and that's the whole point of it, really to create a bit of a conversation, you get some artworks. I personally quite like an artwork that explores particular issues that you might see out and about in the news. But (I think that’s) because they have more time to develop ideas and sometimes show more honesty than you would say on a news broadcast. So, I quite like to see it artwork that gives me something that I might not necessarily get in the mainstream media.

[00:07:15.610] - SH

That's really interesting. You've got these ideas of a journey and a conversation. You've got this kind of almost linear, organic sort of quality to them, you know, they're all the self-directed, but they're kind of guided at the same time.

[00:07:31.390] - DJW

Yeah, and that's everything that we try and do. We try and balance that, I think we quite like the term “to get comfortably lost” because from that you kind of have this freedom. You go and explore, and you've learned, and you find new things. But at the same time, you can have the conversations and journeys, all of these words, are quite important, I think, to us.

[00:07:50.200] - SH

I think that that's kind of aligns with what I'm trying to understand as a mixed reality experience. In a sense, whilst the informational side is very important and that's the traditional sort of mixed reality, you know, overlay display, whatever, what I'm trying to understand is how it distorts more and more areas of our perception. So, the idea, that

you've got this guided journey, but this is gently getting lost within the space, if it can be enhanced or distorted or changed in some way without it being this this overload.

That's what I'm trying to investigate, and articulate.

Appendix 5. Transcript of interview with Artist/Maker Alice Morris, June 2019

[00:00:31.550] - SH

What I'm trying to capture is more of an experience of somebody, and what experience is, what an encounter is. So, it doesn't have to be profound, you don't have to break down in tears when you start worshipping the sculpture.

[00:00:44.650] - AM

I think my eyes are already streaming from the wind so....

[00:00:46.590] - SH

It's not about performance. It's more about just the way people interact, not just with a park, but with the artwork essentially.

So, we'll start walking and there's a particular route that we're going to take, and I'll show you. It's capturing the birds and everything else as we are going around to the sitting sculpture, the Sophie Ryder artwork.

So, in thinking about your experience of the park, why is it different to somewhere like an art gallery? What makes it different in terms of an experience or an encounter? Do you think, in your own words?

[00:00:17.340] - AM

Well, mainly just because it's all out in the open. So, I think there's a lot of works here that Artists do are bespoke for the park and (they have to) think about the outdoors environment before that to make it, so that it fits into the environment better. I think it’s a lot harder to for like the curators to place where the sculptures are going to go. So that it fits in with the environment and the like, unlike a bland art gallery.

I'd like to say that (knowledge of) the artist really informs how I look at the artwork, but there used to be an Anthony Gormley here, and I thought that I'd really like it because I have seen his 'Angels of the North'. But when I got here, I thought it was a bit underwhelming and it's actually the (unexpected) stuff, there's a one by, I don't know how to say it of Joan Plenza - 'Wilted face' - and I'd never heard of that sculpture before and that was like quite breath-taking. I don't know, I think I like sculptures with faces in them.

[00:00:44.260] - SH

OK, so what is it about the faces that that captures your attention or connects to? It is just a human instinct thing, do you think?

[00:00:52.170] - AM

Yeah, I think it's probably that and it's a bit, it's a bit scary as well, but I quite like it.

[00:00:58.310] - SH

It provokes a reaction.

[00:00:59.570] - AM

Yeah exactly, and just I feel like I'm staring at something that's staring back at me.

[00:00:00.510] - SH

As a creative person, we kind of organically, we have methods and rules and processes that we might go through to create something, but we generate organically, or generatively. We gradually come to a conclusion or come to a resolution as to what we're creating. And we magically have a conclusion to the project, not magically, through hard work, clearly. So, what my research is trying to adopt, or is trying to promote, or trying to research, is the role of the designer as a participant within this kind of field of creativity. How (or why) does a (creative artefact) work? And there aren't necessarily, quantifiable mechanics that you can build into it properly.

It's almost like an intuitive process rather than, uh, anything else.

[00:00:57.950] - AM

Yeah. Yeah.

With regards to the Sitting artwork, it initially sort of strikes me as something quite domineering and it looks like it's looking over the landscape saying, 'I own you'. I like the face thing, it sort of freaks me out a little bit and I'm not sure why it's dissected as well. I'm not sure about the materials it's made out of. I don't know if Sophie Ryder designed this one for, Yorkshire Sculpture Park.

[00:00:44.890] - SH

She tends to use this this method of using this wire worked quite extensively throughout multiple pieces, doesn't she? It makes you wonder if it was her that had a say in where it was placed or how much of a say.

[00:00:57.690] - AM

Yeah, because it looks like quite a 'gardeney' material. If you know what I mean, like wired things. And I know she's got a big garden of her own.

[00:01:10.560] - SH

It's the resilience of the material as well though over a long period of time.

Does that determine how the how the artwork communicates itself in some ways, because if you've got a sculpture that isn't a permanent piece of, not land art as such, but a very long-term piece of work like a Henry Moore or something like that. What is the suggestion about how we receive the work or what we think about the work? So, what if this was temporary?

[00:00:32.160] - AM

Like swapped over every now and again. But what we're saying about the environment actually it's like, all of the leaves like are sort of embedded into the sculpture which is quite interesting.

[00:00:44.640] - SH

Yeah. As the leaves get old, they gradually erode and disappear then as the summer goes through and then it'll start all again. So, there's this cyclic thing to it that's quite subtle, I suppose.

[00:00:56.220] - AM

Maybe she did that on purpose.

[00:01:00.600] - SH

It could be a source of stuff gets caught in this, the skin of, the fibre of this being, basically, erm where you wouldn't get obviously get that with a stone sculpture. In the same way you might get nooks and crannies and stuff where it gets caught, but not actually stuck in a way.

[00:01:18.670] - AM

Yeah. And (then there's) the 'godly' thing. The way that she's used the half-hare, half-human, it kind of reminds me like Greek mythology, or whatever. Like a Minotaur sort of mythical being. A mythical creature like you are saying.

[00:00:00.450] - SH

My Ph.D. started with the idea that there was these VR headsets and stuff, quite technological stuff, there was something interesting about it from a just a technological point of view. But there was also a question about the fact that you basically putting a mask over yourself, put in put in some sort of helmet of yourself and basically cutting yourself off from the world as much as you trying to immerse yourself in another world. And what does that say?

That led on to the idea that there's different forms of VR – for instance some that mix the real world with the computer world and so on and so forth. That led on to me discovering the concept of 'two virtuals'. So, there's the virtual, in terms of the internal virtual the way we internalize the world and try and figure it out. And then the virtual that is the external virtual representation of our world digitally.

OK, so then it went on to thinking about these two virtual worlds and how they could intertwine in some way. That's what mixed reality is trying to do. Mix a digital world with a real world, map them together and try to make something. But there's a fundamental paradox in that because you've got a representation that the computer is trying to make of the world interfering with your own internal view of the world.

They don't always correlate. They don't always mix together properly. So, they might look like they do the job but the way we remember the world in different ways is obviously much more multifaceted in terms of different senses and different memories and different things.

So that was the conundrum. That's the problem, that I'm trying to not solve, I'm trying to understand and maybe explain a little better, because if I could solve it, then I, I don't know. I'll be a genius in some way. This is almost impossible. So, what I'm trying to do now is to test and measure (through creative practice) how these two virtuals correlate and misalign in different ways.

So, by measuring the space and measuring experiences through sound and video that allows me to explore the same space over and over.

[00:00:00.550] - AM

Yeah, oh, yes, it's not really that weird. It kind of like reminds you of Vsauce. He's a YouTuber. He did this video about how he's not the same person he was like three months ago. Oh no it was it was a video he took. I'll have to send you it,

[00:00:32.660] - SH

I'll have a look at it because it's interesting to see other people's viewpoints of it. So, these two virtuals the digital and the real - trying to capture both of them.

Then it moved on to, well it's not just the space that you're capturing, it's the time that you capture as well. Time is interesting in the sense that it can be measured in multiple different ways, depending on your point of view. So, you can talk about time as in eternal time or you can talk about time as in this point in time.

Yeah, time has different meanings at different levels basically. And actually, time scientifically is different for every person, every location in the universe. So, um, duration is different as well. So, your experience of duration is different to mine.

[00:00:00.550] - AM

So weird. Like I said, when I was a kid, I used to think 15 minutes was so long. Yeah, such a long time now it's like gone.

Your attention, basically, you've got perception and attention and depending on where your attention is and what your focus is, will depend on how you experience time, so if we're focused and time passes very quickly. Other times we could be sat in a waiting room and time will be so slow, almost watching the secondhand move, like it's taking forever to get to the 5th second. So, I think it's malleable, especially in terms of experiential terms of where the way we experience it.

[00:01:20.010] - AM

Yeah. Or maybe there are species that don't experience time, it just happens.

[00:01:37.470] - SH

in design terms, these are all constraints. That's what all it comes down to basically is if you understand what the rules and the constraints are, or at least have an understanding of what is being talked about and used as a constraint, then hopefully you can then talk about what we mean by mixed reality and how it manifests itself.

And the fact is that this idea of the digital virtual and the real virtual and then overlapping is almost an impossible problem is a paradox. It can only ever be something that aligns at certain points. It can't be a consistent constant. We're going to be immersed in this world forever. You know, we put this mask on and that's it was lost in this universe. It's just not possible, despite what films and technology companies and everybody else might say.

[00:00:26.550] - SH

So, we spend more time here than you probably ever spent in your life. And sitting in front of or standing in front of the 'Sitting' sculpture, um, and know, I think I think we've got it. We're talking about duration and time and the experience of of that. And I talked too much, but, um, uh, all the influence of context. Yeah. That's that's the other thing. Do you know anything about Sophie Ryder and why she creates what she creates?

[00:00:28.770] - AM

Um, I think she does a lot of like hybrid's. I'm not really sure why. I think it's something to do with being a mother

[00:00:40.520] - SH

Something to do with the spring hair and, uh, that kind of idea. So that emergence and resurgence.

[00:00:46.860] - AM

Yeah, yeah. Yeah. which links in with what we were saying about the leaves and stuff in that material is like nature.

[00:00:56.070] - SH

Yes. Capturing something off of whatever it is in in the earth, in the world. And um and then that gets released in one way or another. So it's always transient in terms of the way it put together, perhaps.