Cubic Film

Interdisciplinary development of a digital participatory moving image medium

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Abstract

The initial research proposal was to design a digital moving image medium through integrating experimental film and transmedia storytelling.

In the past, the way we have organised information has limited our vision and, moreover, information is limited to those who control the organisation of information. With the development of technology, when everything tends to be assembled from small components, the boundaries of power have been challenged. My research shows an integrative approach to designing a new medium that encourages creative participatory use of digital visual information, involving moving image, interaction design, data visualization, and parametric design.

My initial proposal evolved into two research questions: (1) can I integrate film and space to design a medium to view a video from various perspectives? (2) if yes, can the new medium enable participants to create their own ways of navigating video and, if so, how?

I have incorporated non-linear, iterative and qualitative methods to design and evaluate a digital medium and produce results that are unexpected and divergent from my initial research proposal. I use an autoethnographic approach to describe my experience of designing the medium from a perspective of a filmmaker and an architect, and I use a participatory approach to assess the audience's experience of the medium.

Through considering film not as strip but as a pile of frames, I consider the integration of film, space and participant, thus allowing viewers to walk into a frame-layered space, and enabling them simultaneously to construct their individual ways of seeing through actively creating the subject with their bodies. The new medium consequently leads to a new non-linear experience, allowing participants to creatively see the digital visual information from all possible perspectives.

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Author's Declaration

1. During the period of registered study in which this thesis was prepared, the author has not been registered for any other academic award or qualification

2. The material included in this thesis has not been submitted wholly or in part for any academic award or qualification other than for which it is not submitted

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1. Introduction

In this thesis, I discuss and analyse the research and development of a new digital moving image medium through integrating experimental film and transmedia storytelling.

In the first part of this thesis, I synthesize the research in a contextual review and discussion of two exploratory projects, *To Be Different* and *Grid 9*, which helped to refine my approach. The second part examines the development of the medium through three main projects, *Hand Painted Film Plus*, *Cubic Film* and *Walk In Cube*, adopting a reflective practice approach and iterative method. The third part evaluates the final project, the digital medium called *Walk In Cube*.

The initial research proposal was to **design a digital moving image medium through integrating experimental film and transmedia storytelling**.

The first part of this proposal indicates that my research aimed to design a digital moving image medium. A medium is a tool that stores and delivers information or data (*Oxford English Dictionary*, 2012; *Online Etymology Dictionary***,** 2010). Between the Renaissance and the mid-nineteenth century, Western art was underpinned by the logic of perspective and attempted to replicate the semblance of visible reality. However, the invention of the first photographic camera in the 1820s, followed by celluloid photographic film and, importantly, motion picture cameras in the late 1880s, liberated artists from a single perspective and from the limitation of time and space (Vertov, 1923). These new media made new ways of seeing possible, new ways of seeing enable people to see new things, and new knowledge encourages the emergence of new media, and vice versa.

While human vision differs from the mechanical single-vanishing point perspective and nanosecond capture of the camera (Yarbus, 1967; Hockney, 2001), Dziga Vertov famously humanised the movie camera and highlighted its revolutionary contribution: “I'm an eye. A mechanical eye. I, the machine, show you a world the way only I can see it” (Vertov, 1923). In the context of our discussion, designing a medium makes a new way of seeing possible by introducing the unfamiliar/familiar in a unfamiliar way that enables people to explore their own ways of ‘seeing’ by creating their own subject matter with the new medium.

Since the 1990s, domestic computing and mainstream digital technologies have provided tools that encourage people to create their own content, such as homemade videos and games (e.g. Minecraft, 2011, a computer open world game, which allows players to build a space by breaking and placing blocks in their own way). People can now access tools very easily, make their own content with software, and collect and organise information. For example, movies can be made and video distributed easily on a single smartphone without the burden of having to use cumbersome equipment for editing and printing. In other words, the tools are generalised; making and viewing can be undertaken relatively simply, quickly and cheaply.

These new digital tools also facilitate the exchange of information. When they are accessible to the general public, information is not limited to those who control the organisation of information and knowledge becomes socially constructed, discussed and shared. Companies also embrace this trend towards self-empowerment by providing platforms that motivate mass participation. Reon Brand and Simona Rocchi, for instance, have shown that end-users can now create and share their own value through digital media (Brand and Rocchi, 2011). For example, the online auction company, eBay, has created an *eBay University*, which teaches people how to trade on eBay and become successful internet entrepreneurs. Beyond the digital, the multinational company, Lego, has established the *Lego Factory*, a platform that enables end-users to design their own Lego components using basic online CAD tools for both personal use and to sell on a profit-sharing basis.

As more and more digital data is being generated, collected and shared, many design practices, such as platform design, interface design and data visualization (MoMA, 2011), aim to present and reveal information from these data. These practices encourage the convergence of different media such as sound, text and video. Yet while they encourage the assemblage of these different media and the sharing of the created content, they also impose a 'seeing' structure onto the audience. For example, online platforms are designed to deliver personal or commercial information effectively, and people can reorganise or reframe others' content using platforms such as web blogs or RSS feed aggregators; gaming environments have a designed path for gamers to fulfil missions; interfaces are designed to guide users to communicate with a content or a machine, and data visualization aims to communicate information with a graphic structure. While all these

approaches seek to pragmatically set up rules for user environments, they limit participants' ways of seeing the content. In short, these digital tools have not yet achieved Gene Youngblood's ideal of the computer as a feedback device that would engender a "non-hierarchical structure of authority and reality" (Youngblood, 1983, p.14). As Jaron Lanier has argued, older software can shape and therefore limit the way newer software is created (e.g. Musical Instrument Digital Interface [MIDI]) and digital media can de-emphasise the human (i.e. a person can be considered merely as a source of digital fragments to be crowd-sourced by others) (Lanier, 2011).

The research outputs presented in this thesis differ from conventional user interface design, platform design and data visualization, which concern a target group and solve a problem by focusing on interactivity or the aesthetics of graphic design. Neither is designing a new medium the same as designing interaction because the former focuses on the framework into which participants can input their own content and interact in their own ways, and does not limit what and how the participant's want to reflect. It is not a matter of building relationships between specific input(s) and output(s).

Many designers today are aiming to create engaging experiences through, for example, data-object and natural user interface (NUI). "Data-object" refers to the physical objects networked with computer systems and to digital artefacts linked to the physical environments, which consider the relationship between a digital device and its surroundings and the human body (Gwilt, 2013). NUIs are controlled via natural physical behaviours and movements (Buxton, 2010). Oblong Industries, the developer of the gesture-speak spatial operating environment, is one example of NUI (*Oblong Industries*, 2006). Gesture-speak spatial operations allow the user to navigate vast amounts of information. For example, a networked glove enables the wearer to perform analysis using large, gesture-driven displays. In short, the more senses we incorporate, as input and output in media, the more holistically we engage with what is happening in all stages of the experience.

However, through the design of a new medium, this research seeks to create experiences that are not only engaging (i.e. they incorporate the senses) but also participatory (i.e. they encourage viewers to become participants). In the 1980s, Ernst von Glasersfeld argued that the responsibility for learning resides with the learner, who must actively engage in the learning process (Glasersfeld, 1989). Whilst digital tools have enhanced and

allowed for individuality, Amy Harrington argues that "self-directed learning is a necessary component of education and yet there is little emphasis on this in both public and private schools" (Harrington, 2013). Ken Robinson also suggests that engaging and successful education should promote diversity and encourage the individualisation of the learning process (Robinson, 2013).

For Marcel Proust, "The only true voyage of discovery […] would be not to visit strange lands but to possess other eyes, to behold the universe through the eyes of another" (Proust, 1996). I aimed to design a medium not through assembling but through integrating different media in order to enhance individuality by enabling participants to construct their ways of seeing by actively creating the subject through moving their bodies. I argue that through an integrative process, the structure of previous media have to be changed in order to be merged, collage-like, into a new single entity. As a result, if I can create new perspectives (using the new structure) to view a video, viewers can compose new information from that video. I also postulate that, if participants can explore a video in their own ways, they are more engaged with the content and experience. I consequently argue that the new medium enhances individuality and encourages recreational exploration and creativity.

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The second part of the initial proposal indicates the general research and methodological approach. My first project, *To Be Different*, compared abstract film and transmedia storytelling. I found that: (1) abstract films generally have a beginning and an end, whereas transmedia storytelling has a multi-entry structure because of its interconnection between the online and physical space; (2) abstract film originally focuses on authorship, whereas transmedia storytelling involves collaborative problem solving. Based on these findings, my initial proposal evolves into the following questions: (1) can I integrate film and space to design a medium to view a video from various perspectives; (2) if that is the case, can the new medium enable participants to create their own ways of navigating video and, if so, how?

To answer both questions, I therefore discuss how each approach generates unique results and participatory experiences.

Can I integrate film and space to design a medium to view a video from various perspectives?

In other words, I aim to design a medium that allows viewers to view a video other than how it was sequenced and framed by the filmmaker(s). To answer this first question, I discuss film and space separately as a medium to show that they are both closely associated with movement but in different ways. I also present four studies that illustrate previous examples of how film and space have been combined: expanded cinema, transmedia storytelling, parametric design, and the slit-scan technique. I select these four studies because: (1) each of them generated new results from the integration of film and space; (2) each is rooted in different fields — film, storytelling, space and photography — and offer unique ways to move from analogue to digital. I therefore discuss how each approach generates new results and participatory experiences.

In my third project, *Hand Painted Film Plus*, I deconstructed the filmstrip and gained a deeper understanding of frame and sequence, and formed a space through layering frames. I concluded that all existing videos can be transformed into cuboids. As a result of this research and development, I built project four, *Cubic Film*. Through integrating film and space in *Cubic Film*, I analysed how recorded time and space is disrupted, and what new information and aesthetics are revealed through choosing to view the film along different axes of the frame-layered cube. The findings from this project helped me to engage viewers with the process of exploring new information in the fifth project, *Walk In Cube*, and thereby provided answers to the second question.

Can the new medium enable participants to create their own ways of navigating video and, if so, how?

To answer the second question, I considered the work of previous experimental filmmakers who had explored how holding a camera affects the output, and who had used the projection space successfully to involve the audience with the creation of the output content. More than this though, transmedia storytelling engages participants by allowing them to become both storyteller and audience. The slit-scan technique has also been applied to interaction, but I argue that the technique limits the participants' control of the subject and their interaction. Lastly, I argue that if parts of the three main stages in parametric design (setting parameters, forming a parametric model by deciding the

relationship between parameters, and flowing data through the parametric model) can be completed by participants, it is possible to allow them to have control over the ways of viewing the input video and seeing the content.

My second project, *Grid 9*, was constructed for a very specific purpose: to explore the difference between hand drawing and using a digital interface for participants, especially in terms of their creative expression and reflection on their creative processes. Maximising the results from *Grid 9*, I sought to integrate in my final project, *Walk In Cube*, the intuitiveness of the participant's body movement with the generative power of the digital interface. In my third project, *Hand Painted Film Plus*, I explored using the camera as a brush, and discussed the movement between the moving body and the recorded subject. I found that the dialogue between body movement and the form of the subject can create unexpected results, and the participants can re-explore a familiar subject in their own ways through seeing it from different perspectives.

With the *Cubic Film*, I saw how the unanticipated results from the movement of human hands could be combined with the *Cubic Film* system. I found that film shooting became the process of cubing reality. Through holding the camera, the creator is deciding not only which objects or events will be in the cube but also where they will be placed in the cube. I continued this exploration of and discussion about the relative movements between subject and body in the fifth project, *Walk In Cube*, after the previous exploration in *Cubic Film* of the deconstructing and reconstructing process of the input video. I experimented with ways to involve the viewer with both processes by deconstructing the cube and linking the projection frame with the participant's whole body. This led me to create a medium that allows the participant's body and movement to control both the projection frame and sequence. As a result, the linear sequence of film became a non-linear path in space; the two-dimensional frame became a three-dimensional distortable cross-section, and thereby, viewing became creating.

In summary, *Walk In Cube* gives individual control to viewers, encourages them to become participants, and thus they can navigate the recorded moving images by moving through it non-linearly. Consequently, participants create their own ways of viewing from all possible perspectives and through compositing new information from the chosen video intuitively.

1.1 The method

The methods selected to address my research questions must embrace making as the necessarily practice-based element of the research (Candy, 2006); the reflection that follows the processing (Schön, 1991), and the methodological flexibility that an iterative and exploratory approach demands. I have taken David Kolb's "Experiential Learning Cycle" (Kolb, 1983) and combined it with Vijay Kumar's process for practising design innovation (Kumar, 2009). Kolb's theory combines an experience-reflection-based learning cycle (which is adequate for the nature of research through practice which explores a new medium) with the flexibility required to adapt to the iterations and additional methods of my research. Concurrently, Kumar's process offers a clear diagram to illustrate the stages of the design process and addresses nonlinearity as a means of solving the design problem and the iterations (for taking new understanding and translating it into predictions) of the research.

The essential stages of my research cycle are: (1) contextual review, (2) reflection to experimentation, (3) concrete experience, and (4) reflection to realisation and conceptualisation. The contextual review enables me to identify differences and similarities between different types of media and outcomes, and highlights the importance of the social and cultural context of abstract art, experimental film and current digital media movements. Concrete experience consists of a series of projects and participatory experimentation. Projects are used to integrate experimental film and transmedia storytelling, which link film, space and the audience, using a highly exploratory and iterative approach. Participatory experimentation is used to determine what the participants define as relevant and to understand how they utilise the newly created medium in a real world setting. Reflection is employed to clarify the basis of communication of research as well as to understand the foundations and value of design thinking in an increasingly complex technological culture. Through such reflection, I hope to create a dialogue which acknowledges the interdisciplinarity of my design research projects, and to show that design is "a medium through which we can make otherwise awkward connections and comparisons" (Arnold, 2011) and simultaneously engage across different disciplines.

1.2 Thesis structure

Chapter 2 precedes discussion of the research with a brief historical review that traces developments from photography to digital media in order to explain how the emergence of a new medium makes new ways of seeing possible, and vice versa. I then explain how my research is different from interaction design and how previous researchers and practitioners look at film and space as a medium. The relevant studies (including expanded cinema, parametric design, transmedia storytelling and the slit-scan technique) shed light on previous approaches to understanding how film and space have been combined. Chapter 3 explains the research methods, describes my approach to developing a new medium, and outlines the combination of theory and design practice with complementary disciplines towards the definition of media. As I show further, I created a contextual review in order to understand the related theory, research precedents and prior projects so as to gain an understanding of existing media, and, through deconstructing and reconstructing them, to make a new medium. Reflection was undertaken after each project to help me understand what I had learnt from the design process and how this could feed in to the next research phase. To capture feedback from participants, I used a semi-structured interview approach and video recording. These methods helped me to understand participants' interpretations of the project outputs, such as moving images and frames, and their experience of making them.

Chapter 4 details the development of the new medium and includes a discussion of the practice-based research projects (exploratory and main) and participatory experiments. Discussion of each project is then followed by a reflective section that shows the journey towards combining film and space and participatory ways of seeing. Chapter 5 offers a critical evaluation of the final project, *Walk In Cube*. It explains how the final medium enables participants to make decisions about their own ways of viewing the recorded video, and how the medium records their decisions in visual forms, sequencing these forms to create new moving images. Chapter 6 presents summative conclusions and consideration of the potential application of my research for further research and practice. It articulates future steps to advance thinking about designing a new digital moving image medium that encourages a new relationship between filmic material and the viewer.

2. Contextual review

This chapter begins with a brief historical review tracing developments from photography to digital media in order to explain how the emergence of a new medium introduces new ways of seeing. Whilst seeing is an interaction between the viewer and the subject, I argue that designing a new medium is not the same as designing interaction. I then explain how previous researchers and practitioners have considered film and space as a medium to show that they are both closely associated with movement but in different ways. Following this discussion, I present four studies offering previous approaches that combine film and space: expanded cinema, transmedia storytelling, parametric design and the slit-scan technique.

- Expanded cinema refers to film and video works that expand the traditional one-way relationship between audience and screen to incorporate the context they are being watched in.
- Transmedia storytelling is the method of relaying stories across multiple platforms and formats using digital technologies.
- Parametric design refers to parametric modeling, which formulates a strategy to contribute to non-parametric design processes.
- The slit-scan technique shows the possibilities of deconstructing photography and video with mechanical and digital tools, and integrating spatial parameters when reconstructing the deconstructed parts.

I evaluate each to show how they support the approach of integrating film and space to design a new digital moving image medium. I do so by revealing how and what new outcomes and new ways of seeing have been introduced to the participants: the creators *and* the viewers.

2.1 Historical review

2.1.1 Photography to film

Perspective was invented in the Renaissance (Battisti, 1981). Between the Renaissance and the mid-nineteenth century, Western art was underpinned by the logic of perspective (making the single eye the centre of the visible world) and attempts

to replicate the illusion of visible reality (Hockney, 2001). For example, addressing the issue of proportion, the 15th century artist Albrecht Dürer wrote *Four Books on Measurement* (see V&A, 2013), which included illustrations of drawing frames and perspective machines designed to help other artists create the illusion of three-dimensional space on a two-dimensional surface. Over the next three hundred years, the frame became the basis of the art of painting in the West. The inherent contradiction in perspective was that it structured images of three-dimensional reality to address a single spectator, and caused distortion when presenting the spherical as linear. This contradiction became increasingly apparent following the invention of the first photographic camera in the 1820s. As a new medium, nineteenth and early twentieth century photography captured more detail and information than traditional media such as painting and sculpture, prompting the question of whether photography was the mechanical reproduction of an image. As the filmmaker Dziga Vertov argued in the 1920s, as a way of seeing, the new "mechanical eye" liberated artists "from human immobility and from the boundaries of time and space. […] I co-ordinate any and all points of the universe, wherever I want them to be. My way leads towards the creation of a fresh perception of the world. Thus I explain in a new way the world unknown to you" (Vertov, 1923).

By the end of the 1880s, lengths of celluloid photographic film had been introduced and, importantly, motion picture cameras invented. As a medium, film enabled people to see things in motion for the first time. Fast-forward 130 years, and we still benefit greatly from these nineteenth-century inventions. In film, each frame is a still and time is broken into a number of samples. Those people with the camera can move together with the subject while shooting a film. In other words, the view can be continually changed within the frame. Through framing, the filmmaker presents his or her own point of view to the audience. As the artist, filmmaker and theorist Malcolm Le Grice argues, "Real TIME/SPACE is now and here" (Grice, 2001, p.155) and, for experimental filmmaker and writer Nicky Hamlyn, "Film frame is a temporal and spatial unit" (Hamlyn, 2003, p.73).

2.1.2 Inventing abstraction

Historically, abstract artists have emphasised these changing 'ways of seeing'. By the end of the nineteenth century, some artists wanted to create a new kind of art that would

encompass the fundamental changes taking place in society – especially in terms of technology, science and philosophy (Gooding, 2001). In his seminal 1905 work, *Special Theory of Relativity*, Albert Einstein introduced the viewer to multiple perspectives with his own scientific representation of space and time (Einstein, 1905). Just two years later, Picasso painted his masterpiece, *Les Demoiselles d'Avignon* (1907). As Chris Welsby explains, in these two works by Einstein and Picasso, "the pictorial frame remained intact but the space beyond the frame was fractured by introducing time as additional dimension, transforming the static viewpoint of Renaissance perspective into a multi-positional dialectic of space and time" (Welsby, 2011, p.277).

Abstract art evolved during the first decades of the twentieth century as a visual language of form, colour and line to create a composition that existed with a degree of independence from visual references in the world (Arnheim, 1970). The key precipitating factor for the development of abstraction in art was Cubism. The Cubists – spearheaded by Picasso and Braque – did not attempt to imitate form, but to create it; they did not seek to imitate life, but to find an equivalent for it. Cubist painters depicted real people, places and objects, but not from a fixed viewpoint. Rather, they illustrated different parts of the same subject at one time – from different angles – and reconstructed it into a composition of planes, forms and colours. Thus the Cubists reconfigured the concept of space: the front, back and sides of the subject become transposable elements in the design of the work. As Malevich argues, the Cubists sought reality rather than illusion: "The logical extreme of such a method would undoubtedly be the attempt to give up all resemblance to natural form, and to create a purely abstract language of form [...]. Regarding Cubism the brilliant solution to our problems, the liberation from objectness, we move into space, color and time" (Cited in Gourianova, 2012).

2.1.3 From film to digital

Analogue video goes a step further than film by sampling the film frame along the vertical dimension (or scan lines). Video images exist as a series of dots traced horizontally, line by line, down the screen (Bateson, 1972). In fact, the image does not exist in a specific or determined point in time but, rather, in a state of flux because it is continuously updated (Gleick, 2011). Information stored can be in the form of either an analogue or digital signal. Through sampling and digitizing, an analogue signal can be transformed into digital information with the pixel as the smallest unit of digital media.

Lev Manovich shows that when existing media, such as moving images, sounds, spaces and texts, are translated into numerical data, "the pretence of modern media to create simulations of sensible reality is cancelled; media are reduced to their original condition as information carrier" (Manovich, 2002, p.48). Hamlyn also reminds us that the way we see picture data or numbers output as sound or text, "threatens the idea of medium-specificity and indexicality" (Hamlyn, 2003, p.17). While the medium moves swiftly from analogue to digital, the physical act of seeing has become an unnecessary step in the generation of visual representation.

In summary, medium and ways of seeing are entwined. As John Berger argues, "The way we see things is affected by what we know or what we believe" (Berger, 1972, p.8). For example, in the Middle Ages, what people believed in, such as the sight of a fire or a painting, would have had a very different significance from what it means to humans in modern society. On the other hand, a new medium introduces new ways of seeing. As Marshall McLuhan argues, "what we are considering here […] are the psychic and social consequences of the designs or patterns as they amplify or accelerate existing processes. For the "message" of any medium or technology is the change of scale or pace or pattern that it introduces into human affairs" (McLuhan, 1964, p.9). As a result, a cycle of change has occurred: a new medium introduces new ways of seeing, new ways of seeing enable people to see new things, and new knowledge encourages the emergence of new media, and vice versa.

2.2 Designing a medium

As we have seen in the previous section, a new medium has the potential to make new ways of seeing possible and change the scale or pattern of human affairs. In other words, in the present research, the discussion of the participatory aspect of seeing is essential. So, what are the differences between designing a medium and designing an interactive work?

Due to advances in computing science, artists in the 1970s began to use new technology such as video and satellites to experiment with live performances and interactions (Paul, 2008). For example, Myron W. Krueger's *Videoplace* (1991; Figure 2.1) provided 25 different programmes or interaction patterns visitors could interact with (Krueger, 1991). In Krueger's work, a switch from one programme to another usually takes place when a new person steps in front of the camera. This trend challenges the one-direction

relationship between creator and audience. Audience and machine are now able to work together more easily in a dialogue, producing a unique artwork for each audience (Muller, Edmonds and Connell, 2006). For example, David Rokeby's *Very Nervous System* (1990) is an interactive sound installation which uses video cameras, image processors, computers, synthesizers and a sound system to form a space which enables a spectator's movements to create sound (Rokeby, 1990).

Figure 2.1: Image from Myron W. Krueger's *Videoplace* (1991)

In his paper 'Transforming Mirror' (1996), Rokeby discusses four models of interaction: navigable structures, the invention of media, transforming mirrors, and automata. While interactive works provide feedback to participants, here I briefly evaluate these four models to explain the differences between my research, designing a medium, and designing an interactive work.

The navigable structure is the first model, which can be thought of as the articulation of a space. Rokeby notes that, "The artist structures this space with a sort of architecture, and provides a method of navigation" (Rokeby, 1996, p.3). In other words, the surrounding architectural structure defines a point of view for each position within the conceptual space. In contrast, my research focuses on allowing participants to mix their points of view by deconstructing and reconstructing (with their body) the unit of the space, which is the pixel. How these pixels form a structure is decided by an input video selected by the viewer. Since the structure is not fixed in my research output, there is no single authorised method of navigation.

The second model, the invention of media, focuses on the blurring of the line between the artist and the audience. As Myron Krueger has argued, "it is the composition of the relationships between action and response that is important" (Krueger, 1991, p.86). The participant's image is presented as a silhouette, which is analysed, and a response is generated and shown on the screen. In contrast, my research is about the composition of the relationships between the participant's action and the frame of the response, not the

response itself. In other words, the response is not fixed to several designed options but can be anything chosen by the participants as long as it can be fitted and reconstructed into the designed frame.

The third model, transforming mirrors, refers to interactive works that use visual references of the spectator, such as his or her image, to create "recontextualized reflection" and, as Rokeby explains, "The transformations of this silhouette are the keys to the understanding of the work depicted on the video screen" (Rokeby, 1996, p.7). For example, with Rokeby's *Very Nervous System*, the interactor is made aware of his/her body reflecting the translation of their gestures into sound. On the other hand, designing a medium is not just about making links between the participants and a specific subject, such as their own images, but also about creating a type of framework to contain or sustain multiple content. For example, the development of the railways in the mid-nineteenth century transformed regions and countries, leading to new communications, the development of new cities and new kinds of work and leisure. As McLuhan argues, "This happened whether the railway functioned in a tropical or a northern environment, and is quite independent of the freight or content of the railway medium" (McLuhan, 1964, p.8). With a medium, the participants can decide what they want to reflect.

The fourth model, automata, refers to artworks that are self-motivated and autonomous. The spectators are only one aspect of the environment surveyed by the automata. For example, the artist Norman White used his robot's ability to make sense of its environment (White, 1987). White's *The Helpless Robot* (1987) used an electronically synthesized voice to ask for physical assistance from passers-by in a convincing tone, which then slowly changed to a commanding tone. For instance, media theorist Lev Manovich's *Soft Cinema* (2002) edits movies in actual time (Manovich and Kratky, 2005). *Soft Cinema* can be considered as a "semi-automatic film jockey" (Manovich and ZKM, 2002, p.1) which determines the content and the location on the screen and the music tracks by selecting the components from the database using the designed rules. My research seeks to design a medium where participants need to initiate the interaction. No input equals no output. Nothing is autonomous; participants need to actively make some effort before gaining any feedback.

My research explores the question of how participants' experience is shaped by the medium and how the medium enhances their individuality by encouraging them to create

their ways of seeing. In this manner, the medium becomes the content. My ultimate aim has been to design a digital moving image medium in which participants are able to choose what and how they want to explore, rather than to design a relationship between the participants' actions and the desired response.

2.3 Film and space

Viewing film always takes place in space and at a specific point in time so a moving image experience involves both space and time. Therefore, I document below how previous researchers and practitioners have looked at film and space individually as a medium and show that they are both closely associated with movement though in different ways. I then examine approaches by which time and space are combined.

2.3.1 Film as a medium

In this thesis, I discuss film, which clearly has different usages. When 'film strip' is used, I mean the physical/digital film strip. When I use 'filmic space', I solely mean the space within which moving images are viewed. When I use 'cinema', I mean the experience of viewing moving image. When I discuss 'shooting' and 'filming', I refer to moving image recording. When I use 'film', such as in the project titles, I consider both the design process for reconstructing film strip and shooting and the resultant cinematic experience.

Commercial cinema has sought to create effective time/space illusions whilst removing any sense of the physical in the film. As Le Grice argues, "the techniques of film have been primarily developed to 'manipulate' a recorded 'reality' into structures and events" (Le Grice, 1972, p.156). On the other hand, some experimental filmmakers focus on the goal of building a more resolute and reflective relationship between the viewer and the film (Gidal, 1976). The epochs of experimental film are probably the abstract and surrealist films of the 1920s; the underground films of the 1960s; in the UK, the school of Derek Jarman in the 1980s, or the 'Young British Artists' of the 1990s (Rees, 1999). For Al Rees, the avant garde "has sought 'ways of seeing' outside the conventions of cinema's dominant tradition in the drama film, and its industrial mode of production" (Rees, 1999, p. 1). Hamlyn, in his *Film as Art Phenomena* (Hamlyn, 2003), provides tacit knowledge of filmmakers such as Robert Breer and Len Lye, bridging the practice and the theory, and focuses on what makes film different from other media. In the following

section, I will examine some of these key components that are closely related to my research.

2.3.1.1 The frame

The on-screen experience is made immediate through the frame as it flashes twenty-four times per second onto the screen. The illusion of movement is central to the viewing experience. For example, Hamlyn argues that, "it is frames, and not the frame, which sustain the illusion" (Hamlyn, 2003, p.57). Tony Conard's *The Flicker* (1965) and Peter Kubelka's *Arnuf Rainer* (1960; Figure 2.2) illustrate this idea well. *The Flicker* consists of just five different frames: a warning frame, two title frames, a black frame, and a white frame. The combination of only black and white frames creates a tension between flickering/pulsing and duration (Cornard, 1966). In *Arnulf Rainer*, Kubelka used four strips of different materials: blank film (light), black film (the absence of light), perforated magnetic tape with recorded white noise (sound), and blank perforated magnetic tape (the absence of sound) (Kubelka, 2013). In both works, the frame is treated as the fundamental building block to create rhythm and the moving image experience (Barnett, 2008). The frame, rather than the pixel, is always at the centre of my research. I postulate that, if my medium allows viewers to manipulate the frame, they can create their own moving image experience.

Figure 2.2: Peter Kubelka's *Arnulf Rainer* (1960) as a wall installation

2.3.1.2 The sequence

In film, each frame is a still image and put together in a strip, but time is broken into a number of samples. Therefore, these samples can be sequenced in various ways and create new narratives. Ian Kerr's *Tower Retowered* (1978) is a good example of experimenting with sequencing. Kerr cut postcards of a landmark vertically into 16mm strips. The project focuses on how the camera moves; it is also concerned with how a continuous pattern can be cut into frames to create a sequence. Steve Farrer's *Ten Drawings* (1976; Figure 2.3) is another pertinent example of sequencing. For each

drawing, fifty equal lengths of clear film were laid out to make a rectangle, onto which a pattern was drawn, after which the strips were joined together. Through this work, Farrer shows that the two-dimensional lines can be illustrated in three ways: "a drawing of a film, a film of a drawing and a sound of a drawing" (Johnson, 2005; Camden Arts Centre, 2012). My research advances previous experiments of sequencing by digitally reconstructing filmstrip through the transformation between linear filmstrip, two-dimensional image, and three-dimensional space.

Figure 2.3: Film strips from Steve Farrer's *Ten Drawings* (1976)

2.3.1.3 The shooting

The way in which a camera is held balances the elements in the work and gives it meaning. Stan Brakhage's *Aniticipation of the Night* (1958) marked a dramatic change in both experimental filmmaking techniques and aesthetics. It is the way Brakhage handles the camera, using a constantly moving hand-held camera, unfocused images, under- and over-exposure, random compositions, distorting lenses and filters, flash frames, varying camera speeds and fragmented time and space, that constantly refers us back to its operator (Stigsdotter, 2005). Moreover, it is this restless camera operation that reminds us of the presence of an author constantly generating the images. For P. Adams Sitney, Brakhage's film takes us back into their maker's way of seeing (Sitney, 2002). Hamlyn further argues that, "The question of how to support the camera is never a merely technical one, […] this consideration has gone hand in hand with [...] the balancing of the camera's role with other aspects of film making: principally its subject and the makers' attitude or approach to it" (Hamlyn, 2003, p.89). In this research, I extend earlier experimentation with film shooting by furthering the discussion about the relationship between hand and subject to that between body and recorded video.

2.3.1.4 Abstraction

Abstract film is a subgenre of experimental film, with its origins in the work of the Cubists discussed above. Some of the earliest abstract motion pictures to have survived

are those produced by a group of German artists in the 1920s, among them Walter Ruttmann, Hans Richter, and Oskar Fischinger (Rees, 1999). Abstract film deploys a series of cinematic effects to create essentially emotional experiences: most notably, motion, rhythm, light and composition, using concrete elastic shapes rather than employing and manipulating images of external reality (Lawder, 1975). Whilst an abstract film can be based on a narrative, it typically creates a non-narrative experience, for example by attempts to impose a musical structure on film (Moritz, 2004).

2.3.1.5 Sound

If an experimental film is accompanied by non-experimental music, a spectator's attention is inevitably divided, and the illusion fails (Hamlyn, 2003). My research is related to the audio activities of the 1950s when music produced using electronic means became increasingly common because of the interest in the digital transformation between audio, body movement, and abstract visual outputs. Delia Derbyshire's *Mattachin* (1968), originally released on an album of BBC Radiophonic Music in 1968, is a good example of this trend. The selection demonstrated the use of primitive early electronic oscillators. Experimental filmmaker Guy Sherwin's *Railings* (1977; Figure 2.4) has also impacted on my projects, because it is one of a series of films that investigates sound qualities generated directly by the image track (Sherwin, 1977). The video was intentionally shot to be converted into sound. Sherwin explains that in his video, "Images of iron railings are converted into sounds as they pass over the projector's optical sound head. [...] I used the camera like a stick, clattering along the railings" (Sherwin, 2007, p.55). Despite the interest in such a video, my final research project discussed below does not include sound because sound is a vibration: it does not produce sequenced two-dimensional visual frames and therefore it requires a transformation system (i.e. Photosounder, 2008). The latter is distinct from what I design for the filmstrip.

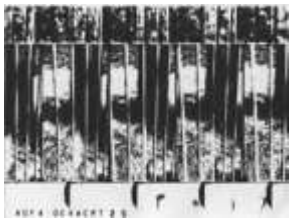


Figure 2.4: Film strip from Guy Sherwin's *Railings* (1977)

I have thus far introduced the essential constituents and issues pertinent to experimental filmmaking such as the frame, sequence, the shooting, abstraction and sound, which filmmakers have identified, investigated and developed in previous works. Experiential filmmaking emphasises the nature of filmmaking's apparatus and medium in order to encourage the audience to be inquisitive and pivotal (see 2.4.1). In short, the precedents of experimental film have enabled me to start investigating film through form and structure and to begin to shape my own experiments. These then become attempts to integrate such apparatus with space to design a digital medium that enables a participatory moving image experience.

2.3.2 Space as a medium

Dynamic spatial experience relies not only on the physically-constructed structure but also on space, that which is not constructed. Therefore, I continue here the discussion about how movement which appears across space design fields, such as urban planning in architectural theory and practice, can be considered to lie at the core of designing a physical/virtual environment, and serves as a precondition for spatiality.

As globalization and technological development increase at unprecedented rates, kinetic architecture (whereby parts of the structure can move) is becoming both a tangible possibility and an increasing need (e.g. in enhancing aesthetic qualities; responding to surrounding conditions, and performing tasks that are impossible for a static structure, (Stevenson, 2012). However, the understanding that architecture can be considered a medium that encourages interaction is not new. Indeed, writing in the early 1960s, the architect Le Corbusier argued that "architecture is volume and movement" (Corbusier, 1961, p.28). Architectural design can indeed be considered a process that programmes rhythm into the relationship between visitors and architecture (Koolhaas and Obrist, 2007; Rubalcaba, 2011). Moreover, architecture affects our way of seeing: the programmed rhythm places the visitor into positions and involves them in processes, allowing them to experience an interlinking of events, directing views, and presenting or disguising parts of the whole (Jie, 2013). Our expectation of a space also affects the way we move through it. Steffen Walz has argued that, through "material and immaterial emphases and the ordering of interior and exterior space, movement affects, shocks, or surprises us, reveals secrets, and, most importantly, asks us to actively participate in a space intellectually, physically, and relationally" (Walz, 2010, p.16). The result is that, as

Le Corbusier showed, the visitor is profoundly affected by the space and continuously interacts with it (Corbusier, 1961). The way we wander through architecture therefore determines how architecture is experienced. In other words, if viewers can decide on a path to wander through a filmic space, such as expanded cinema (film and video works that extend the orthodox one-way relationship between the audience and screen) (see 2.4.1), they can create their own filmic experience.

Henri Lefebvre also argues that it is potent to analyse the city through the rhythms created by bodies and their movements, and he evaluates such spatial practices in his final book, "rhythmanalysis" (Lefebvre, 2004). Rather than deal with space as an aesthetic category, Lefebvre proposes that "there are different levels of space, from very crude, natural space ('absolute space') to more complex spatialities whose significance is socially produced ('social space')", the latter produced by the interaction between humans and their surrounding space (Lefebvre, 1991, p.26). Moreover, Kevin Lynch describes designing a city as layering materials from different times, such as planning greenery and designing shadows that passersby can view (Lynch, 1972). For Lynch, "a city is sensed in motion" (Lynch, 1960, p.107).

Iain Borden has successfully applied Lefebvre's theory to a study on the urban phenomenon of skateboarding, investigating the movements such as gliding, miming, descending and traversing, "as a particular 'skateboarding-architecture' produced by and between skateboarder and skateboarding terrain" (Walz, 2010, p.16). In other words, the interaction executed by and between skateboarders and the ground offers the concept of architecture "not as a thing but a flow" (Borden, 2001, p.9). The space formed by boundaries and connections flows and is experienced in real time.

Besides physical architecture, mixed reality space and kinetic architecture can also be considered as a medium that is associated with both movement and rhythm (Milgram and Kishino, 1994; Fox and Kemp, 2009). With the introduction of algorithmic control, understanding the potential of movement as a communication tool and designing sophisticated kinetic structures becomes critical (Parkes, 2008; Kronenburg, 2007). As Bart Lootsma has explained, "Movable floors, partitions, ramps, ladders, bridges, and stairs are used to construct veritable labyrinths of the most heterogeneous forms in which desires continuously interact" (Lootsma, 2007). Thus, when visitor and spatial form

relationships become interactive, architecture comes alive and experience is created (Naos, 2000).

Furthermore, whereas the form of a filmstrip suggests the linearity of temporal experience, space allows non-linear pathways. Lucy Bullivant argues that multimedia works and games can be considered like theme parks in which the interactors make a space come alive by entering an environment, visiting areas in a particular order, and exploiting the space (Bullivant, 2006). Celia Pearce further argues that architects, when designing a building, knowingly or unknowingly create "nonlinear experiences with variable paths or outcomes" (Pearce, 1997, p.26). In *The View from the Road*, urban designers Donald Appleyard, Kevin Lynch and John R. Myer (1964; Figure 2.5) offer a good example of the nonlinear experiences through spatial paths. They illustrate their driving experience on highways with filmic sequences, summarizing the visual experience of motorway driving by using a series of events including cinematic conditions such as sequences, orientations, transitions, and overlapping and layering of spaces. In this way, they render a holistic driving experience through rhythms, recollections of the past, glimpses of the future, views and apparent motion (Borden, 2012). In this research, I argue that if my medium integrates film and space, viewers can choose their own paths through a video and use their body movements to transform the projection frame, consequently creating their own non-linear experience, which disrupts the recorded time/space (Cooke, 2000).

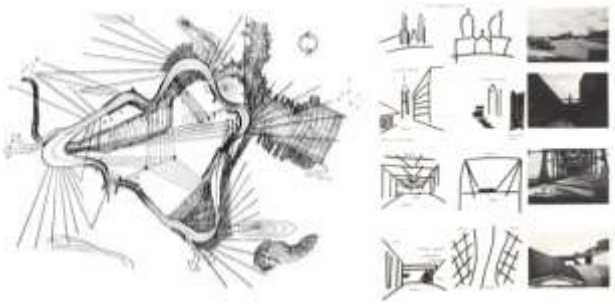


Figure 2.5: Diagrams showing cinematic conditions such as sequences, orientations, transitions, from *The View from the Road* (1964)

In sum, while all these cited architects, urban designers, practitioners and theorists come from different design disciplines and have different philosophies, they all acknowledge that movement and rhythm can play an important role in architecture and space.

As I have discussed above, both film and space can be involved with movement and rhythm, but in very different ways. Film is finite, two-dimensional, encircling, linear and ephemeral, while space is infinite, three-dimensional, extended, non-linear and lasting. My research projects aim to integrate film and space, transforming an input video into a space for viewers to navigate through. By coordinating the differences, I propose to design a new medium, one that at its core sees the consideration of shooting as a way to design and explore a filmic space.

2.4 Studies: approaches to film

Following this discussion, I present four studies that offer precedents of how film and space have been combined: expanded cinema, transmedia storytelling, parametric design, and the slit-scan technique. I select these four studies because: (1) they all generate new results from the integration of film and space; (2) each is rooted in different fields —film, storytelling, space and photography — and show a unique approach in moving from analogue to digital and in engaging participants. I will therefore move on to discuss how each approach generates unique results and participatory experiences.

2.4.1 Expanded cinema

Viewing film always takes place in space. Expanded cinema, a term coined in the mid-1960s by US filmmaker Stan VanderBeek, has its origins in the experiments of early twentieth century avant-garde film and performance art. Expanded cinema refers to film and video works that extend the orthodox one-way relationship between the audience and screen by recognising the environment in which the film or video is being viewed. For Rees, “expanded cinema is a form of live art, linked to theatre and performance rather than to recorded media as such” (Rees, 2011, p.12). This medium creates a “recognisable and tangible” connection between film and other visual art forms (Arnolfini Programme, 1976).

Filmaktion performances are a good example of how a film projection event can be considered a live art. Filmaktion, which was a loose-knit group of British filmmakers, worked and performed together during an intense period of activity in the early 1970s: “Endorsing a more active, participatory experience of cinema, they re-imagined the possibilities for film projection as a live event” (Tate Modern, 2012). The use of screens

and projections, and often the presence of the artist's own body in the work, "carved out a more sculptural, immediate and embodied space for cinema. The role of the spectator was also implicated, as the direct spatial and temporal experience of viewing film became more of a priority than the medium's ability to record narrative actions staged in the past" (Tate Modern, 2012). Filmaktion's improvisational, participatory and immersive approach to film required a more flexible architectural environment than conventional cinema (Reynolds, 2005). For example, Lis Rhodes' *Light Music* (1975; Figure 2.6) uses film and sound to push the spatial and performative boundaries of cinema. As Charles Danby argues, "Formed from two projections that face another in a smoke-filled room, the work is inhabited by the films' viewers, who cast shadows and become caught in its beams" (Danby, 2012, p.7). The body in the space becomes part of the film (Lozano-Hemmer, 2001), and the project turns the audience into the actor/actress, through "a confrontation of the cinematic as a physical experience in the context of their real world" (Le Grice, 1996, p.278).

Figure 2.6: Image from Lis Rhodes' *Light Music* (1975)

In Jeffery Shaw's *The Legible City* (1989), the visitors are invited to ride a stationary bicycle in front of a projection screen showing a simulated representation of a city which is constructed by computer-generated three-dimensional words and sentences along the sides of the streets. Through this designed setting, the space encourages viewers to actively choose their own path (and thus see their own computer-generated texts) rather than lull them into a state of passivity which occurs in a traditionally cinematic space (White, 2011).

Elliott Ashton's installation, *Interactive Feedback No. 1* (1996) is another good example of how the spatial arrangement is considered a crucial part of the video screening event. As Hamlyn explains, "By creating a large, convoluted loop in which each camera is connected not to the monitor opposite, but to the next one downstream, Ashton has expanded and elaborated the crude feedback loop that is created when a video camera is pointed at its own monitor" (Hamlyn, 2003, p.161). The camera-monitor feedback loop

does not start on its own; rather, it requires a viewer to pass between the rows of cameras and monitors and generate an image that immediately passes from one screen to the next, then back to the beginning of the line. A feedback relationship between the technology and the participant is also constructed (Willis, 2005). The participants gradually understand the way to partially control the outcome of images through a process of trial and error so that, ultimately, it could be said that the viewers become the generators of imagery.

In expanded cinema, the video provides a passage of time in the space (Collective-iz, 2013). While walking through this passage, spectators are involved in the "structuring of 'meaning' between time and space from the layers of their perception, memory, prediction and conception" (Le Grice, 2011, p.169; Figure 2.7). There is an interplay between the spectators' own motivations, the investment of time investigating the work and the original temporal experience offered by the video (Le Grice, 2011; *Nightworks*, 2013). Therefore, the assumption of the singular interpretation based on matching spectators' experience to artistic intention is broken through the reconfiguring of the cinema space (Morse, 1998). By creating an unrestricted connection between the artists, the mechanics of production and the viewers, expanded cinema runs in many ways "like an analogue version of today's user interfaces" (Welsby, 2011, p.283). In short, by combining media, expanded cinema offers excellent examples that mix film and space and consequently opens up the range of possibilities of interpretation and experience.

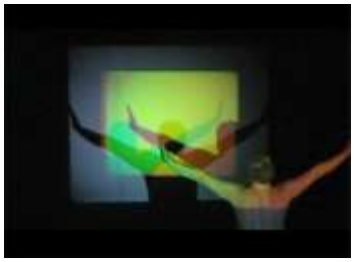


Figure 2.7: Image from performance of *Horror Film 1* by Malcom Le Grice (1971)

2.4.2 Transmedia storytelling

As a result of the pervasive impact of computer programming on contemporary society, the way we share, access and process the world around us is being transformed and so too is the way we tell stories and understand narratives. While media theorist and artist Martin Rieser argues that the multi-lineal possibilities of new media reduce the depth and

flow of the narratives (Rieser, 2002), both traditional and emerging entertainment studios have begun to search for a new storytelling form that is innate to networked-digital content and communication channels (Jenkins, 2010).

Transmedia storytelling is the technique of relaying stories across multiple platforms and formats using digital technologies. What is unique about transmedia storytelling is that each platform makes its own distinct contribution to the telling of a story. An event that is user-generated through one platform, such as an online space, will have an influence on the ongoing story in another platform, such as a physical space (Jenkins, 2011). Engagement with each successive medium is intended to heighten the audience's understanding and enjoyment of the story. To do this successfully, "the embodiment of the story in each media needs to be satisfying in its own right while enjoyment from all the media should be greater than the sum of the parts" (Pratten, 2011, p.1).

A good example of effective transmedia storytelling is a recent project called *HIGHRISE* (2012 onwards), a collaborative documentary experiment at the National Film Board of Canada, directed by Katerina Cizek, and produced by Gerry Flahive (Cizek and Flahive, 2012). *HIGHRISE* is currently generating numerous projects, including mixed media, interactive documentaries, mobile productions, live presentations, installations and films. The producers anticipate that the projects will "both shape and realize the *HIGHRISE* vision collectively: to see how the documentary process can drive and participate in social innovation rather than just to document it; and to help re-invent what it means to be an urban species in the 21st century" (Cizek and Flahive, 2012). *HIGHRISE* shows that one of the strengths of transmedia storytelling is that it links the professional and the public, and enables the users to become makers. For example, *One Millionth Tower*, part of *HIGHRISE*, re-imagines a dilapidated high-rise neighbourhood in a Toronto suburb by bridging the residents' experience and expectations of their living environment with professionals' ability to reveal their expectations online and in the real world (Cizek, 2012). While many creative professionals have started to use digital tools for internal communications, such as building information modelling, transmedia storytelling extends this communication externally to the public.

Another example of enabling the users to become makers through telling a story across media is *The TATE Movie Project by Daniel Efergan* (2010; Figure 2.8). The project used the film production process to help children develop their creative impulses and

participate in filmmaking at a fundamental level. This project provides an opportunity for children to draw. The interface was very well designed. However, the project simply digitizes the traditional tasks and methods to embrace and connect with a much bigger online audience, rather than finding new digital forms for storytelling.

Figure 2.8: The interface of The TATE Movie Project by Daniel Efergan (2010)

Pandemic 1.0. (2011) was a transmedia storytelling experience involving film, mobile, online, social, gaming, print, and real world interactions (Weiler, 2011). *Pandemic 1.0* unfolded at the 2011 Sundance Film Festival over the course of 120 hours; 40,000 festival attendees and over 250,000 online global players participated in the filmmaking project to help stop the spread of a mysterious sleeping sickness affecting the adults in a small rural town, portrayed by actors who provided updates through their Twitter accounts. The attendees both participated at a physical control room, equipped with interactive surfaces and projectors that broadcast the story, and seeded into the festival populace to search for hidden objects and complete tasks. Participants online were able to influence the outcome by following along on social media such as Twitter and Facebook as well as the project website, where their actions unlocked new possibilities on the ground. In short, the physical world becomes a new storytelling playground.

Telling stories across multiple media aims to form a larger, cohesive, and more rewarding experience because the audience can receive content that is right-sized, right-time, and right-place (Pratten, 2011). While transmedia storytelling is aiming to connect physical and digital media, it focuses on how to bring together the fragmentation of audiences across television channels around the world (Bernardo, 2011), rather than to mix the basic components of the existing media. In short, the story, the content, interconnects media but does not structurally integrate media to create a new entity. My research involves an integrative approach. I argue that the required structural changes of the previous media for integration introduces new ways of structuring the way that we actually see, therefore making seeing new things possible.

As discussed above (see 2.2), this thesis is concerned with designing a dynamic medium, and not transferring a scripted story across media. Therefore, transmedia storytelling is used mainly in my first project as a study subject and triggers my interest in media transformation and participatory experience. In the following projects, transmedia storytelling offers precedents and counter examples (showing that linking film and space through storytelling can create networked media although not a new medium that is structurally reconstructed from previous media) to help me better understand my integrative method rather than as a reference from which I adopt my method.

2.4.3 Parametric Design

Parametric design refers to parametric modelling, which formulates a strategy that contributes to non-parametric design processes. Many architects use parametric design to design and construct buildings in relation to a variety of changing forces including climate, technology, use, character, setting, culture, and mood. I use parametric design to construct the relationship between the frame, video input and participant. By involving participants in the stages of parametric design, I seek to enable them to construct their own ways of seeing.

The conventional design medium is pencil, eraser and paper. We use pencil to add and the eraser to subtract, soften lines, and provide smooth shading, etc. With tools such as the triangle, scale, and T-square, drawings can illustrate a design idea accurately and precisely. Parametric design introduces a fundamental change: parts of a design relate and change together in a coordinated way. The designer no longer simply adds and erases. As Robert Woodbury suggests, “They now add, erase, relate and repair” (Woodbury, 2010, p.11). Relating requires making definite decisions about the kind of relationship: is a point inside/outside a square or on the edge of the square? Repairing occurs after parts that depend on an erased part are related again to the parts that remain.

Businesses and research labs have built numerous parametric systems (Smart Geometry, 2001; Appendix O). In other fields, such as architecture, their impact did not begin to be felt until the turn of the twenty-first century (Moon, 2005). For example, architects such as Greg Lynn envisage form as “animated”, which “arises from its production through calculus serving as a mathematical engine allowing for direct deformation or parametric variation” (Picon, 2010, p.75). In *The Fold*, Gilles Deleuze introduced the term

"objectile" to designate the capacity of calculus to generate an infinite number of objects as elements of a continuous series (Deleuze, 1993). The term has been employed subsequently by French designers Bernard Cache and Patrick Beaucé to name their design and architecture workshop that combines engineering, mathematics, technology, and philosophy (Cache and Beaucé, 1998; Figure 2.9). They uses this potential for variation in order to work on the industrial design and manufacturing of curved and variable forms of every proportion including sculpture, design, furniture, building components, architecture, town planning and landscaping (Cache and Speaks, 1995).

Figure 2.9: *Objectile* by Bernard Cache and Patrick Beaucé (1998)

Architectural historian Antoine Picon also states that "modeling software and its underlying calculus-based frame produces usually a continuous series of forms, something more akin to a geometric flow or film obtained from direct deformation or parametric variation then to a fixed configuration" (Picon, 2010, p.74). Form-generation is closely related to time, growth and movement. In fact, depending on the selected frame or breadth of measurement, all objects change over time. Therese Tierney analyses the architectural image in her book *Abstract Space*. She states that, "Architecture digital design has been documenting numerous and variable slices of time, when applying the temporal theories" (Tierney, 2007, p.123). Digitally-produced architectural forms can therefore also be considered to be a frozen moment of a flow or an event.

Architect Mark Burry explains that parametric design is "designing the design" (Burry, 2003, p.151) and argues that it predisposes "a strategy to form part of any non-parametric design process. [...] The parameters are not just numbers relating to Cartesian geometry – they could be performance-based criteria such as light levels or structural load resistance, or even a set of aesthetic principles" (Burry, 2003, p.151). There are three main stages in parametric design: setting parameters, forming a parametric model by deciding the relationship between parameters, and flowing data through the parametric model (Woodbury, 2010). I argue that designing a medium is like setting the initial parameters,

such as the size or the material of the medium, to frame participants' experience. If my medium can involve viewers with parts of the three main stages, rather than all completed by the designers, they can determine their own content and create their own ways to interact with it. In other words, I seek to design a design that will be initiated and completed by the participants.

Form produced through this approach does not appear determined and cast from outside but rather, "shaped by those often invisible fields and forces that constitute the true context of the project" (Picon, 2010, p.80; Figure 2.10). Tierney also recognises that the process is, "neither purely technique driven nor concept-driven" (Tierney, 2007, p.144), but shows that new insight is gained as a result of the interaction between the two drivers (Terzidis, 2006). Moreover, as Christopher Alexander has suggested, "a class of method which I call relational methods" are capable of generating form that meets complex human needs (Alexander, 1966, p.96). In my research, I discuss the relationship between film, space, and participants. Parametric design allows designers to follow their intuition within a broader frame; it shows me the possibility of dialogue with the intrinsic complexity of film and space, such as transforming a frame from two to three-dimensions (see 4.6.3), while allowing nonlinearity and participation from the viewers.

In contrast, the most commonly discussed limitation of parametric design is that it hinders effective design exploration by restricting representational flexibility (Gursel Dino, 2012). The flexibility of parametric modelling is a result of the parameters that it internally and initially specifies, so the design outputs are limited to the parameters and are resistant to unanticipated changes. In this research, I use parametric design in my final project, *Walk in Cube*. Therefore, my exploratory process is not affected by this weakness of the parametric design method.

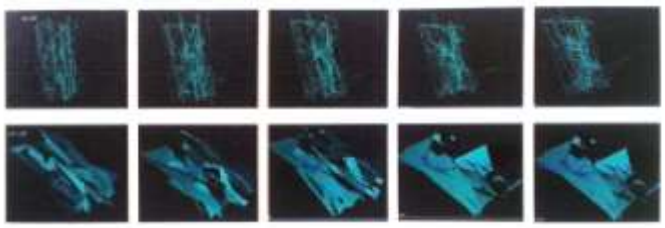


Figure 2.10: Greg Lynn, *House Prototype* (1994), showing how the project evolves based on a gradient field of attraction

2.4.4 Slit-scan techniques

My research is also closely related to slit-scan techniques, which show that swapping time and space creates visual outputs that are distorted, lack perspective and reveal a sequence of time. In traditional film photography, slit-scan images are created by exposing film as it slides past a slit-shaped aperture (Levin, 2008). A film-based strip camera uses a thin slit mask inserted between the lens and the film plane, which is oriented perpendicular to the film's travel path. Light must pass through the slit in order to reach the film. To record an image, the film is set in motion, and the camera shutter is opened for a very short period, depending on the length of the event being recorded. Since the film is moving, stationary objects in front of the lens produce streaks. However, an undistorted image is recorded if a moving object passes in front of the lens with a speed and direction in sync with the film's motion (Dahlin, 2008; see figure 2.11 for a simplified diagram of this process). In digital film, thin slices are extracted from a sequence of video frames, and concentrated into a new image (Levin, 2008).

Many visual artists, notably Andrew Davidhazy (2009) and Maarten Vanvolsem (2011), have experimented with the slit-scan technique. Davidhazy has written extensively about the technique of strip photography, whilst Golan Levin has compiled an important list of people who work with the strip technique in photography, film, video and digital media, called *An Informal Catalogue of Slit-Scan Video Artworks and Research* (Levin, 2008). However, only one book focusing on strip photography (static photography) has been published to date, namely *The Art of Strip Photography*, by Vanvolsem in 2011. Vanvolsem argues that, "the building of a tradition and a certain accumulation of knowledge [of slit-scan applied in video] is, therefore, probably happening" (Vanvolsem, 2011, p.97).

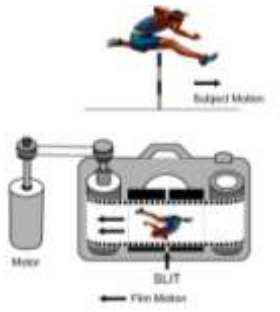


Figure 2.11: A slit camera operates by moving film past a thin slit located in-between the lens and the film

2.4.4.1 Strip photography

Vanvolsem claims that the most prominent uses of strip photography are for panorama photography, photogrammetry, peripheral photography and photo finishes (Vanvolsem, 2011). All these techniques have scientific needs for precision in order that they function: the need to record a wide and static scene difficult to capture with other techniques; to determine the geometric properties of objects from photographic images; to project images of cylindrical objects (Kerr, n.d.), and to take a photo at the finish line for a more accurate check (Dahlin, 2008). Due to its additional mechanical parts, such as the stepper motor, the strip camera has to be fixed on a tripod so that the film moves while the exposure is being made (Dahlin, 2008; see Figure 2.12). In other words, the movement of the strip camera is either static or mechanically controlled. Therefore, the relative movement in strip photography happens either between static subjects and a moving camera fixed on a tripod, or between a moving object and a static camera. The hand movement of holding a camera, which is discussed in 2.3.1, has rarely been explored in detail.

Figure 2.12: Three examples of camera modification for slit scan photography. The motors are controlled by an external microprocessor

2.4.4.2 Slit-scan video

Filmmakers such as Zbig Rybczynski have applied this technique to explore its choreographic and narrative potential and create desired distortions of filmmaking (Rybczynski, 1988). Reflecting on his film, *The Fourth Dimension* (1988; Figure 2.13), Rybczynski notes that, "in the printing phase I visualized the image in 480 lines and reproduced the images delaying, for example, each frame by one line" (Rybczynski, 1988). Consequently, Rybczynski's film shows various objects, simultaneously, in time,

space and movement. Though this type of effect is now often created through computer animation, slit-scan is essentially a mechanical technique. For example, it was adapted for film by Douglas Trumbull, the special photographic effects expert, during the production of Stanley Kubrick's *2001: A Space Odyssey* (1968). Trumbull used the technique with a machine capable of moving the camera and its frame, most notably in the film's 'star child' sequence, which showed complicated mixes of colour and shape (FilmmakerIQ, 2013; Kelly, 1999; Kubrick, 1968). This special effect was subsequently used in other film and television programmes. The British designer Bernard Lodge, for example, used slit-scan to create the now classic BBC *Doctor Who* title sequences (Bernard, 1973). The effect was innovative and popular in the 1960s and 1970s, but has since been superseded by special effects created by digital software and tools.

Figure 2.13: Frames from *The Fourth Dimension* by Zbig Rybczynski (1988)

The filmmaker Martin Reinhart has worked with digital slit-scanning techniques on a variety of time-based and interactive projects since 1992, including a film, *tx-transform* (1998; Figure 2.14), co-produced with director Virgil Wildrich. As Reinhart writes on the project website: "*tx-transform* is a film technique [...] in which the time and space axes are transposed. [...] the interactive *tx-transformator* turns the familiar perception of time and space upside down" (Reinhart, 1998). The *tx-transform* technique produces sequences in which filmic representation is not fixed exclusively through the spatial presence of an object. Instead, the form depends upon a complex interplay of relative motions. The resultant object or film is thus defined as a condition over time rather than simply the mirror of a concrete form.

Figure 2.14: Image from Martin Reinhart's *tx-transform* (1988)

Importantly, slit-scan opens up new artistic possibilities that have been used in commercial film. However, these projects focus on the transformation between one of the spatial axes, the horizontal axis of the frame and the time axis, but ignore the transformation between the y axis of the frame and time axis (that is why the project is called *tx-transform*). Also, there is no complete research on slit-scan techniques used in video which addresses the produced aesthetic and the impact of the outputs.

2.4.4.3 Volumetric video

Volumetric video refers to a display that forms a visual representation of an object in three physical dimensions by stacking each frame of a video on top of the next. Eddie Elliot was one of the first people to research how slit-scan techniques could be applied to digital video and he came to focus on the volumetric video (Elliott, 1993). His project *Video Streamers* (1993) shows both utilitarian and playful uses of digital slit-scans (Figure 2.15). Elliot further tried to use *Video Streamers* to inspect and edit, or cut, the recorded video, and created playful transformations of *Streamers*, such as the folding paper box template. Elliot focused on the application of volumetric video as an interface and did not look at the video from the other side of the *Streamers*. In contrast,, in this research, viewers of the video could decide from which face of the cube they wanted to watch a video and in doing so, they could see new things from various perspectives.

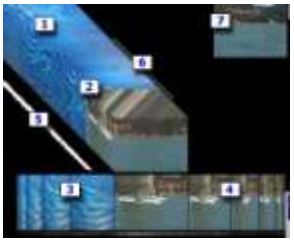


Figure 2.15: A screen capture of *Video Streamers* (1993) by Eddie Elliot

German digital artists Joachim Sauter and Dirk Lusebrink have also explored the transformation of film into objects. In their project, *Invisible Shape of Things Past* (1995; Figure 2.16), the transformation is based on camera parameters such as location, perspective and focal length, relating to a particular film sequence on screen. As a result, the rough edge of the output object reveals how the viewer has moved through the recorded space. Another example is Tamas Waliczky and Anna Szepesi's *Sculptures* (1997). The artists created sculptural 3D forms by treating the silhouettes of human performers, recorded over time, as slices of cylinders. The sculptures were displayed on

screens in the form of virtual computer-graphic constructions. More recently, Tania Ruiz Gutierrez has undertaken a thorough assessment of spatiotemporal imaging, including both an historical overview of relevant precedents as well as documentation of several of the artists' own computational projects, such as spatial-temporal objects (Gutierrez, 2004; Figure 2.16). Through the treatment of the spatial-temporal objects, she also creates the same effect as time transposing the space and time axes of a video. However, she does not view the creation process as a way to create participatory moving images; rather, she uses the cross sections of the spatial-temporal objects to analyse previous slit-scan photography and visually related images, focusing on applying her analysis to installation proposals.

Figure 2.16: (left) *Invisible Shape of Things Past* (1995) by Joachim Sauter and Dirk Lusebrink; (right) spatial-temporal object (2004) by Tania Ruiz Gutierrez

All these projects and related research explore the idea of volumetric video for various purposes, such as revealing the recorded content, or as a tool to study strip photography, rather than challenging the existing moving image form.

2.4.4.4 Interaction

Some artists use volumetric video to alter the relationship between the audience and the projection. Martin Hilpoltsteiner's *Recreating Movement* (2005; Figure 2.17) explores the same topic as Étienne-Jules Marey's *Chronophotograph* (1882). Hilpoltsteiner notes that *Recreating Movement* is "an experimental tool approach for analysing film sequences" (Hilpoltsteiner, 2005). He extracts and arranges single frames of film behind each other in a three-dimensional block. The frames, which are generally only visible for a split-second during a film, are rendered into a tubular frame that 'freezes' a particular time span in a film. The viewer can apply different filters and settings to the film sequence by using a displayable menu bar. These examples of designing a medium reveal the trace of an action, while my research separates a trace of an action from its original reference. My research is not about designing a medium that reveals movement, but a medium that

could explore a bigger range of subjects through movements, treating the filmic material like a house in a space, not as a solid block.

On the other hand, there are projects that allow wide input subjects but have specific and limited visual output style. Camille Utterback's *Liquid Time Series* installations (2002) use a participant's physical motion in the installation space to fragment time in a pre-recorded video clip. As Utterback argues, "The interface of one's body—which can only exist in one place, at one time—becomes the means to create a space in which multiple times and perspectives coexist" (Utterback, 2002). Her project only uses the location of the participant as the input of the interaction. Therefore, the style of the visual output is limited. The displayed frame is stripped of its pixels and are replaced with pixels from other frames in the same input video by the viewers' movement.

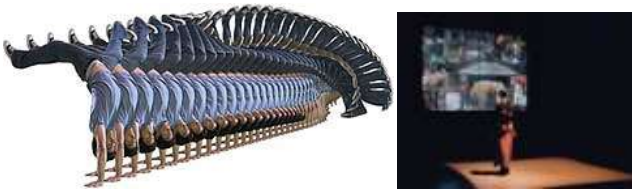


Figure 2.17: (left) Image from Martin Hilpoltsteiner's *Recreating Movement* (2005); (right) Image from Camille Utterback's *Liquid Time Series* (2002)

He-Lin Luo's *Maelstrom* (2009) was an installation that allowed participants to dip their hands into the walls and watch their abstracted hands swirl on the screen (Figure. 2.18). The latter effect was created by digital slit-scanning. Luo showed that anything hand-sized can be the subject (Luo, 2009). However, both Luo and Utterback deconstructed the input video only by using slit-scan, and so the style of the outputs became limited and predictable. In *Maelstrom*, every input swirls. This style-limitation of the output was also applied to the slit-scan applications on the iPhone (Funner Labs, 2011).

Alvaro Cassinelli's *Khronos Projector* (2005; Figure 2.18) is an interactive-art installation that allowed people to explore pre-recorded movie interactively. When participants touch the projection screen, "the user is able to send parts of the image forward or backwards in time**"** depending on how deep they push the projection screen (Cassinelli, 2005). The direction of the participants' touch has been limited and aligned with the timeline of the input video. In other words, the input from the audience is used as a location indicator to cause interaction or response, and the depth of the participants' touch is used as a time indicator. The input videos, which should have a clear linear time

sequence, have been carefully selected for this specific interface design. *Khronos Projector* focuses on a specific mode of interaction, and the interactivity between the people and parts of the moving image content. What it does not do is create a new and complete moving image experience which allows exploration in multiple ways and embraces the wider input subjects.

Figure 2.18: (left) Image from He-Lin Luo's *Maelstrom* (2009); (right) Image from Alvaro Cassinelli's *Khronos Projector* (2005)

In summary, the slit-scan technique shows the possibilities to deconstruct photography and video with mechanical and digital tools, and integrate spatial parameters when reconstructing the deconstructed parts. As the examples have shown, if the design is only focused on a certain type of interaction, the subject is limited to match that kind of interaction, and vice versa. Many projects have been produced based on the slit-scan technique. There are complete research projects that have focused on slit-scan photography but currently no thorough research on slit-scan video. My research, rather than applying the slit-scan technique, aims to look into ways to deconstruct moving images in a complete way so as not to limit the participants' ways of exploring or embracing wider subjects, and to understand the network between input and the output more thoroughly.

2.5 Summary

Through this historical review, from conventional painting to digital media, I have demonstrated that the emergence of a new medium introduces new ways of seeing and further, that all these media deal with time and space to different degrees and on various scales. While seeing is achieved through interaction between the viewer and the subject, designing a new medium is not the same as designing interaction. I evaluated David Rokeby's four models of interaction to argue that designing a medium focuses on the

framework into which participants can input their own content and interact in their own way.

Furthermore, I showed how previous researchers and practitioners who studied film and architecture as a medium dealt with time and space respectively. The review of the experiential film showed that emphasising the nature of filmmaking's apparatus and medium challenged the film viewing experience and encouraged the audience to be inquisitive and active. The review of architects and theorists showed that architecture has been analysed and understood as a medium that reflects movement and rhythm. Both reviews supported the idea that design and research of a medium can develop without being limited to a certain content or interaction, and showed that film and space deal with movement and rhythm in very different ways. Through integrating film and space, my research aims to design a medium that enables viewers to navigate through a video. It considers elements of shooting toward the input video as a way to design and explore a filmic space, thus allowing viewers to create their own experience.

These selected studies supported the approach of integrating film and space to create a new medium. Expanded cinema showed that integrating film and space introduced a new experience through challenging the previous one-way relationship between the creator and audience and opening the range of possible forms of interpretation and non-linear experience. On the other hand, transmedia storytelling served as a counter example, showing that linking film and space through storytelling can create networked media although not a new medium that is structurally reconstructed from previous media. Furthermore, parametric design offered the possibility of linking space and time using digital tools; it also suggested that designing a medium is like setting parameters in which participants can initial and complete their own experience by inputting their own data and interacting with them on their own terms, transforming the projection frame with their body movement. Lastly, slit-scan techniques showed that swapping time and space created new ways of seeing and suggested that deconstructing and reconstructing can be useful for integrating media.

3. Method

As established in the Introduction, after the first project, *To Be Different*, the initial proposal to design a new digital moving image medium through integrating experimental film and transmedia storytelling evolved into two research questions: (1) can I integrate film and space to design a medium to view a video from various perspectives; (2) if that is the case, can the new medium enable participants to create their own ways of navigating video and, if so, how?

Rather than designing within a predefined medium and existing design categories, I adopted an integrative approach that culminated in a new digital moving image medium. This medium integrates film, space and the participant. My research is interdisciplinary, involving cross-media (film, image, space), visual abstraction (interpretation, input/output, process and data visualisation) and design interactions (body movement, creators and viewers). This approach is endorsed by the design theorist Richard Buchanan, who highlights the impossibility of relying on any one of the sciences (natural, social or human) for an adequate solution to what are the inherently "wicked" problems of design thinking (Buchanan, 1992).

The next step then, was: how should I articulate the original research question? Initially, I had to define the nature of the research question itself. The uncertain nature of exploratory research questions favours adaptable solutions for multiple alternative perspectives (highlighting iterations and interactions) rather than narrowly-defined designs (Rosenhead, 1996). While defining and designing a new medium in my field is challenging, it nevertheless offers an excellent opportunity to exploit today's technology to create digital aesthetics and methods that help people experience moving image in new and individual ways.

According to the *Oxford English Dictionary*, a medium is "a means by which something is communicated or expressed", or, more broadly, "an agency or means of doing something" (*Oxford English Dictionary*, 2012). A medium can be a set of things working together as parts of a mechanism to store and deliver information or data. Designing a new medium involves: (1) understanding the parts of the mechanism or the interconnecting network through projects; (2) analysing the outputs and its particular

effects; (3) evaluating the outputs and the participatory process to analyse the characteristics of the medium.

In the context of our discussion, designing a medium is a way of making a new way of 'seeing' possible by introducing the unfamiliar/familiar in an unfamiliar way. My research differentiates itself from user interface design, which concerns a target group and seeks to solve a problem by focusing on interactivity or the aesthetics of graphic design (Allen and Chudley, 2012). Moreover, while the research creates new aesthetics, it is not an 'art' project, which might typically focus on a specific subject plus a subject-customized process (e.g. *Railings* by Sherwin, 1977). Rather, my research projects draw on the re-structuring of the relationship between a wide range of medium inputs and outputs. As Buchanan further argues, "The subject matter of design is potentially universal in scope, because design thinking may be applied to any area of human experience" (Buchanan, 1992, p.16).

Thus, I consider various media as they affect the definition of a medium. This does not include a systematic and precise definition of technical parameters such as algorithm or programming (the scope of this research is further outlined in Chapters 4 and 5). This strategy is possible because the key factor towards a new way of seeing is related to the definition of a medium instead of new medium technologies. There are numerous studies on current technology, web media, and human-computer interaction (e.g. Moggridge, 2010). I argue that what is missing in this body of work is a seamless and coherent media research project which looks beyond the content carried by the digital media and experiments with new media, encouraging individuals to construct their own ways of seeing and creatively use digital visual information.

3.1 Research cycle

Having defined the nature of the research question, the next step was to define the method used to explore the question. The selected method had to embrace making as the necessarily practice-based core of the research (Candy, 2006), reflection following processing (Schön, 1983), and the methodological flexibility that such an iterative and exploratory process demands.

I took David Kolb's Experiential Learning Cycle (1983) as the starting point (Figure 3.1). Kolb's theory combines an experience-reflection-based learning cycle (which is useful for

the speculative nature of research by practice) with the flexibility required to adapt to the iterations of this research. Kolb's four-stage cycle is made up of: (1) Concrete Experience, (2) Reflective Observation, (3) Abstract Conceptualization, and (4) Active Experimentation. Through the evolution of the research and through successive iterations (Miller, Galanter and Pribram, 1960), I have taken Kolb's theory and combined it with Kumar's experiential learning cycle model (2009; Figure 3.1). Kumar's process for practising design innovation offers a clear way to illustrate the stages of the design process and addresses the nonlinearity (for solving the experimental problem) and the iterations (for taking new understanding and translating it into predictions) of the research. Kumar's seven-mode process includes: (1) Sense Intent, (2) Know Context, (3) Know People, (4) Frame Insights, (5) Explore Concepts, (6) Frame Solutions, and (7) Realizing Offering (Kumar, 2009).

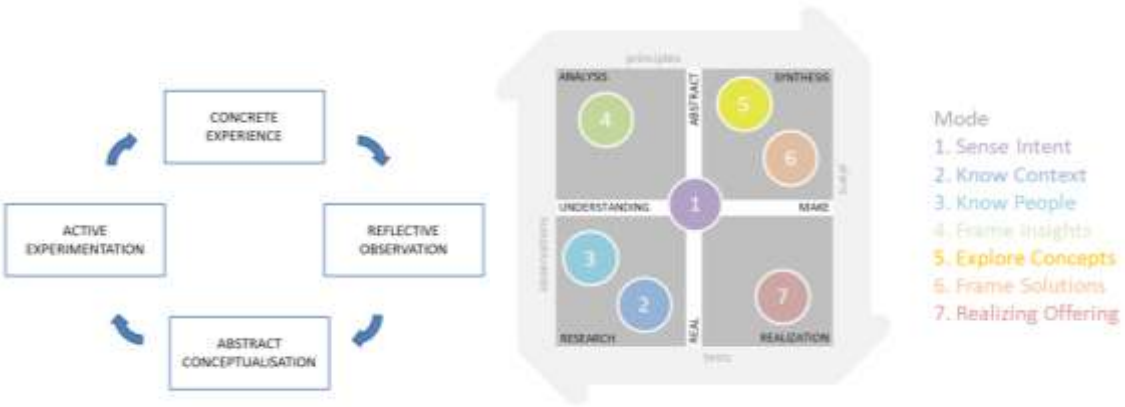


Figure 3.1: (left) Kolb's Experiential Learning Cycle; (right) Kumar's process for practising design innovation

This adaptation of Kumar's process accounts for the exploratory and methodological nature of the design research and the ultimate delivery of a new medium. In my research, the emphasis is on the iterative and exploratory nature of the process: instead of proposing well-targeted stages towards a pre-defined goal, I used an initial simple proposal to find considerations not included a priori. This approach offers an effective strategy to deal with the uncertainty of the exploratory research. In other words, the iterations are not aimed at producing a concrete solution but at identifying design concerns and their effect on the decisions made towards the development of a new medium. The diagram below illustrates the adaptation process (Figure 3.2).

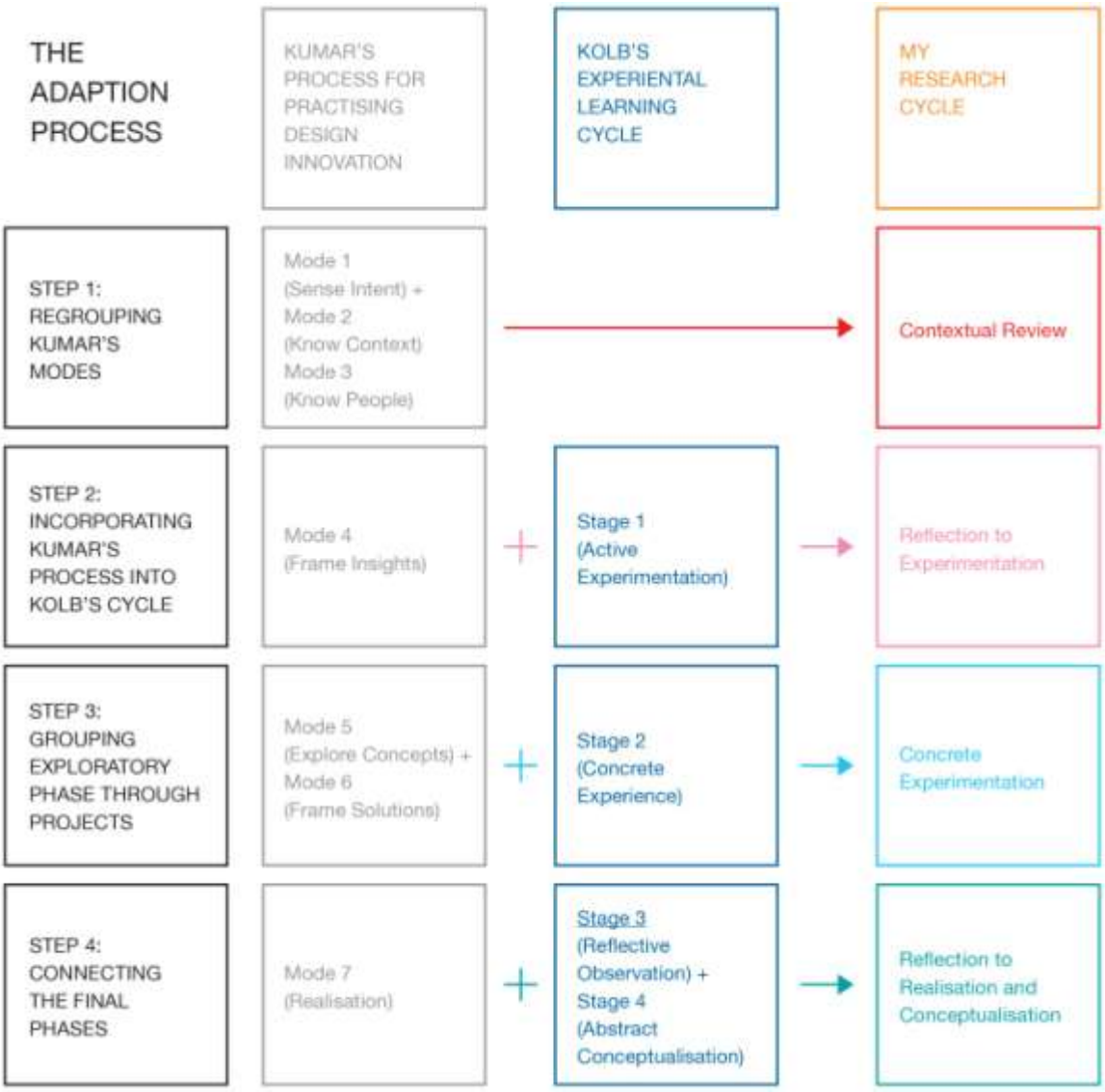


Figure 3.2: The adaption process

The biggest change occurs in the components of Kumar's process. First, I grouped mode 1 (Sense Intent), with modes 2 (Know Context) and 3 (Know People) and incorporated the latter into Kolb's cycle to form the basic framework for a Contextual Review. Second, I grouped mode 4 (Frame Insights) with Kolb's stage 1 (Active Experimentation) and collectively named them 'Reflection to Experimentation' to emphasise that the stage is based on process incorporated creativity, but guided by the findings from the previous research iterations/projects. Third, I added Kumar's mode 5 (Explore Concepts) and 6 (Frame Solutions) to Kolb's stage 2 (Concrete Experience) to highlight the exploratory process through projects. Last, I arranged mode 7 (realisation) with Kolb's stage 3 (Reflective Observation) and stage 4 (Abstract Conceptualisation), and collectively named them 'Reflection to Realisation and Conceptualisation', fitting for the nature of

practice-based research, and producing projects (realisation) and thesis (conceptual-isation) (Figure 3.3).

Figure 3.3: My research cycle

3.2 Methods

3.2.1 Contextual Review

An initial contextual review included case studies on relevant design media as well as a review of the historical study of design and art. The review helped to identify differences and similarities between different types of media, especially regarding how and what new outcomes and new ways of seeing they introduced. Moreover, these studies highlighted the importance of the social and cultural context of the abstract art and experimental film movements, enriching an otherwise merely technical focus. The contextual review is grounded in the works of philosophers and practitioners who put media at the centre of progressive technological discourse but maintain critical positions. For instance, experimental film theorist Al Rees points to non-traditional bodily experience in expanded cinema (Rees et al., 2011), and scientist Jaron Lanier criticises technology's potential for reducing the meaning of personhood (Lanier, 2011) while Howard Risatti refers to the inseparability of human integrity and material organic properties within a technology-led world (Risatti, 2007).

These comparative analyses were useful in my study of other examples of media. For example, in my first project, *To Be Different*, I created two individual test pieces to compare and contrast abstract film and transmedia storytelling with my initial intention to integrate the strengths of each of them. Moreover, alternative proposals of volumetric video emerged a decade before this research as discussed in Chapter 2. Some of these proposals followed similar concepts to those enunciated in my work, such as *Cubic Film*. Therefore, I analysed the proposals to identify advantages and limitations of the proposed conceptualisation of *Walk In Cube*. Additionally, for those approaches referring to relatively recent time-based work, I drew on the work and advice of consulting experts and visited exhibitions and screenings to enrich my approach with insights rarely found in specialised literature. The advantage, in terms of efficacy and time, of expert consultation has already been proven in previous research (e.g. Bogner et al., 2009), but here, their contribution was of further importance because the experimental film know-how is usually very tacit. Visiting exhibitions (e.g. *The Tanks* exhibition at Tate Modern, London, 2012 and the major *Inventing Abstraction* exhibition at the Museum of Modern Art, New York, 2013) were important for the experiential learning of the previous media, such as sculpture, expanded cinema and data objects as communication tools, and the temporal and spatial contexts of the media (Dickerman, and Affron, 2013).

A holistic analysis of previous studies established a design scenario for the methodology. The first and most immediate influence was a richer perspective from which to address the analysis of 'ways of seeing', discussed above. Besides the conventional considerations of mechanism, media outputs and protagonists (designer/artist, and audience), my research added other aspects related to craft and architecture. Insights about hand movement (Chapters 4 and 5) were gained from art theory (e.g. Risatti, 2007), design history and theory (e.g. Adamson, 2007) and sociology (e.g. Gauntlett, 2011). As Adamson argues, "craft is only existing in motion" (Adamson, 2007, p.4), and my research shows that hand movement as it affects the holding of a camera provides "special metaphorical qualities", such as the organic aesthetic, which the viewer understands and appreciates as part of a larger world view (Risatti, 2013, p.305). In addition, architect Corbusier (1961) and philosopher Lefebvre (1991) have pointed out that space is a medium that is associated with time and movement. Architectural engineer Picon (2010) has demonstrated that parametric design has been used to design the relationship between film and space. In my analysis, technical factors (e.g. camera

mechanism) also appeared, but were considered in terms of aesthetics and audience perception.

3.2.2 Concrete Experience

Concrete Experience consisted of project and participatory experimentation. Practice-based research involves many actions. To extend knowledge beyond the library or laboratory in order to serve the purpose of enriching human life, the integration of the disciplines of understanding, communication, and action are needed (Buchanan, 1992). Through learning from my own professional experience as an animator and a designer familiar with the process of making exploratory experiments, I gained specific knowledge and deeper understanding of the new medium. Therefore, I used an autoethnographic approach (see 3.2.3 below, Reflection to Realisation and Conceptualisation) to describe my experience of designing *Walk In Cube* from the perspective of a moving image-maker and a designer.

The research was conducted through a series of projects including both exploratory and main projects. An exploratory project follows "a gradual process of accumulating intelligence about the object of study" (Routio, 2007). It means also that it is difficult to start by defining the problem of study. Researchers have to "start with a preliminary notion of the object of study, and of its context. During the exploratory research project, these provisional concepts then gradually gain precision" (Routio, 2007). My exploratory projects, *To Be Different*, and *Grid 9*, set the direction of my research into participatory cross-media. The main projects, *Hand Painted Film Plus*, *Cubic Film*, and *Walk In Cube*, customised pieces of technology for the purpose of experimenting with various inputs. These were used iteratively to create a wide range of outputs for the final project that witnessed the interplay between content, aesthetics, technologies and participants.

After conducting each project (exploratory and main, excluding project 1), a participatory experiment was used to understand participants' interpretation of the cubic film outputs and their interactions with the medium. Figure 3.4 shows my role and the relationship to the participants. My research was carried out in the context of application and marked by its transdisciplinarity (Gibbons et al., 1994) and through the medium of practitioner activity in order to contribute design knowledge that "is of and about the artificial world and how to contribute to the creation and maintenance of that world" (Cross, 2001, p.54).

It is therefore difficult to judge what is the perfect solution and it is rather a suggestion of improvement that the research aims for (Verbeke and Glanville, 2006). While participatory experiments challenged the power relation between researcher and 'objects', they suited the research and helped me to understand and promote the empowerment of the participants (Jupp, 2006). The idea of the researcher in-situ has a long established tradition in cultural anthropology (e.g. Mead, 1928). In my own role in-situ, for example, I asked participants to bring their own videos because in a 'real world' setting they could decide what they wanted to reflect with my medium. Also, when they knew their input content well, they could easily identify what was new in the visual output (see Chapter 5). In other words, through participatory experiment, participants broadened my tested subjects by bringing their own input videos, and surprised me by showing me their unique ways of seeing the content.

The key methodological features of participatory experimentation are semi-structured interview and dialogue. Due to the speculative nature of this research, instead of using a structured interview, which has a pre-determined set and sequence of questions and does not allow one to divert, a semi-structured interview technique was used as this is open, but focused on the key research themes (Curedale, 2013). I used this method in all the experiments to determine what the participants defined as relevant and to describe what they were doing and thinking as they experienced the experiments/medium. Moreover, in contrast to using solely questionnaires with participants, semi-structured interviews allowed me the freedom to adapt my questions to explore interesting experiential issues further in response to the participants themselves (Rubin and Rubin, 2012). For this research, rather than serve as the primary method to gain data, questionnaires were not only open but were used as a supportive method, enabling participants to take notes and reflect on their own experience before/during the semi-structured interview. To allow for additional information on participants' shared experience, the structured questionnaire was further used for collecting self-reporting on non-video subject related physical experiences (Robson, 2011), focusing on specific body posture (see Appendix I). Furthermore, metaphor was used as a method to help participants describe the new, 'look-alike' aesthetic by alluding to aspects of it by analogy. For instance, it might appear like sediment or paper marbling (Thorpe and Holt, 2007).

In addition, through the participatory experimentation, I took notes, photos, screen captures and voice recordings to observe and analyse participants' work created with my medium (Figure 3.4). This approach also enabled me to add my perspective as an observer to participant's experience, and to ensure the accuracy of my understanding of the qualitative data. This method is similar to triangulation, which, in social research, refers to the "observation of the research issue from (at least) two different points" (Flick, 2006, p.305): "Once a proposition has been confirmed by two or more independent measurement processes, the uncertainty of its interpretation is greatly reduced" (Webb, Campbell, Schwartz and Sechrest, 2000, p.3).

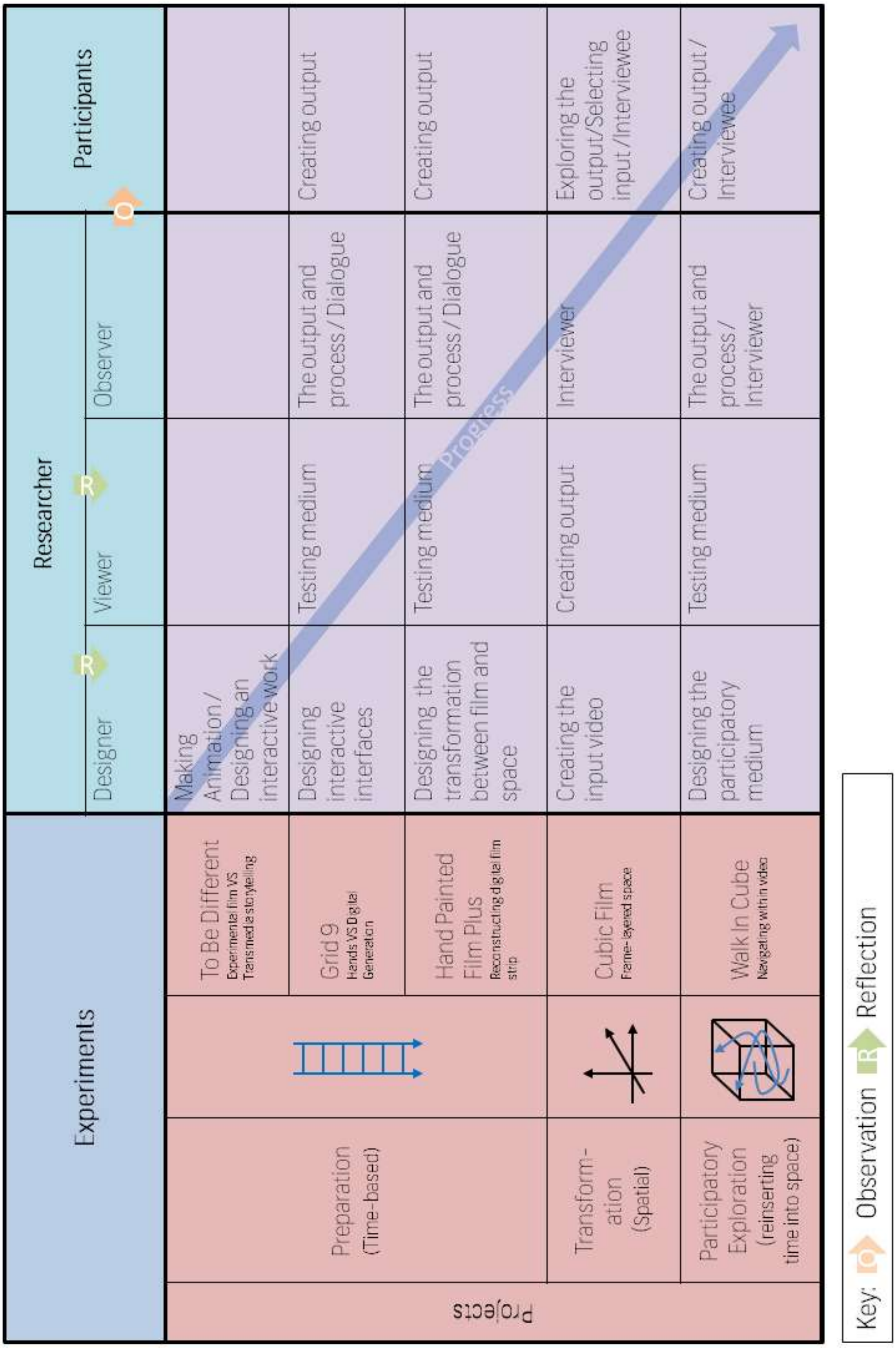


Figure 3.4: My role in the research/design process and the relationship to the participants

3.2.3 Reflection

Reflective practice was used to assess the effectiveness of the communication of my research. This methodology enables the practitioner to reflect on their action and engage in a process of continuous learning (Schön, 1983). Colin Paterson and Judith Chapman (2013) have usefully highlighted the importance of acknowledging the equal value of the experience of an event and the retelling of the experience: when experiencing an event, practitioners are learning, but it can be difficult to understand their actions, emotions and thoughts as an integrated sequence of events. As Michael Polanyi asserts, "We can know more than we can tell" (Polanyi, 1966, p.4). When retelling events, practitioners are more able to categorise events, emotions, ideas, etc. and connect the intentions to the accomplished actions (Glanville, 2005). Practitioners can then distance themselves and their direct emotional attachment from an action, examine it critically and eventually retell the action as a detached observer, to transform it into a story of a sequence of events (Paterson and Chapman, 2013). As Gillie Bolton has argued, reflective practice also involves, "paying critical attention to the practical values and theories which inform everyday actions, by examining practice reflectively and reflexively", which leads to developmental insight (Bolton, 2010, p.xix).

The study of media is the study of process, the relationship between the input and outputs, and most importantly the framework enabling the process. Therefore, reflection after practice is useful for helping the practitioner to withdraw from practice and analyse pictorial representation, focusing on the medium structure behind representation. I used reflection as a key method twice in the research cycle: first, 'Reflection to Realisation and Conceptualisation', to reflect on the process of making the medium and using the medium to create; and, second, 'Reflection to Experimentation', to relate the theory and reposition the initial selection at another point in the framework, raising new questions and ideas.

3.2.3.1 Reflection to Realisation and Conceptualisation

I used a form of thematic analysis to examine themes and capture the intricacies of meaning within the rich textual data from semi-structured interviews (Guest, MacQueen and Namey, 2012). This method helped me to systematically break down the texts that describe individual participant's experience into simpler, manageable clusters of patterns and themes, and most importantly, identifying implicit and explicit ideas within the data. I

compare word and sentence frequencies to recognise the meaningful parts of data that relates to the research question (Boyatzis, 1998; see Appendix K). To interpret these meaningful parts and develop themes, I used keyword and sentence sorting (Berg, 1948; see Appendix K) to identify theme co-occurrence, and thematic networks to graphically display relationships between themes and the raw data (Martin and Hanington, 2012). The approach is reflective because it consists of reading transcripts, identifying possible themes, selecting themes through comparing and contrasting them, describing the process of deciding ways to present the results and explaining why particular themes are more useful for new knowledge contribution (Braun and Clarke, 2006).

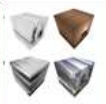
As I have shown, my research is interdisciplinary and is conducted in a 'real world' setting (see also Cross, 2001). The designed medium is not limited to what and how participants want to reflect. I am therefore less concerned with making simplified or standardized measurements of phenomena. As Julia Rouse has argued, in social research, "comparative analysis conducted through qualitative research acknowledges that social relations are difficult to categorize and occur in local contexts that differ and are complex" (Rouse, 2008, p.45). Figure 3.5 shows that I employed comparative analysis for every project in order to discover the tensions between the individual parts (Figure 4.4), and then went on to explore the creative resolution of the tensions. I also used a comparative methodology to categorise my project inputs and outputs and compare these categories to examine the interplay between content, aesthetics and technologies over time and through stages (Figure 4.26; Appendix H and N). This enabled me to develop an understanding of how the interconnection of events is patterned and to form a theory about how these patterns have come into being (Van de Ven, 1992).

Projects	Comparison	Visual results analysis	Dialogue	Photo/ video recording	Semi-structured interview & question-naire	Structured question-naire	Key-word & sentence sorting	Thematic analysis
To Be Different Experimental film VS Transmedia storytelling	Subject comparison							
Grid 9 Hands VS Digital Generation	Subject comparison		Participants	Participation				
Hand Painted Film Plus Reconstructing digital film strip	Relative movements	Results	Participants	Participation				
Cubic Film Frame-layered space	Input/Output	Results	Participants	Participation	Visual results		Semi-structured interview & questionnaire	
Walk In Cube Navigating within video	Input/Output	Results [Triangulation]	Participants	Participation	Participants' experience/ Visual results	non-video subject related experiences	Semi-structured interview & questionnaire	Rich textual data

Figure 3.5: Methods used for evaluating each project

3.2.3.2 Reflection to Experimentation

By conducting the contextual review and by keeping a research diary, I compared my projects to understand the similarities and differences between them. This helped me to ascertain whether I was using the most appropriate method for my research and practice. It enabled me to discern whether other practitioners used similar approaches, understand the importance of what I had undertaken by articulating the differences between the two projects, and determine my next experiment, so as not to replicate what had previously been undertaken by other researchers/practitioners. Moreover, through the evolutionary and non-linear design process, each project relates to different approaches and the latter can transfer and link to projects in different ways (Figure 3.6). Therefore, the stage of Reflection to Experiment is useful for re-examining and updating the built relationship between projects, precedents and theories after each research cycle. Most importantly, through this process, I refined my research questions, developed a new perspective on the core research question, and enhanced my knowledge about linking research, practice and theory in an iterative fashion (Atkins, 1993).

			Approaches to Film					
			Experimental Film	Space Design	Expanded Cinema	Transmedia Storytelling	Parametric Design	Slit-scan Techniques
Projects	To Be Different		Comparison subject			Comparison subject		
	Grid 9		Hand Painting				Generative geometry	
	Hand Painted Film Plus		Adaptation from	Adaptation to		Transforma-tion system	Transforma-tion unit	
	Cubic Film		Key design elements	Structure and output analysis			Structure analysis	Precedent
	Walk In Cube		Key design elements	Structure design	Precedent	Precedent	Method for Participation	Precedent

Transfer

Transfer

Figure 3.6: The relationship between the projects and the approaches

4. Projects

4.1 Introduction

In this chapter, I discuss two exploratory projects and three substantive projects conducted during my research (Figure 4.1). The first two are called *To Be Different* and *Grid 9*. After the first exploratory project and subsequent findings, the initial proposal to design a new digital moving image medium through integrating experimental film and transmedia storytelling evolved into two research questions: (1) can I integrate film and space to design a medium to view a video from various perspectives? (2) If that is the case, can the new medium enable participants to create their own ways of navigating video and, if so, how?

The main projects are *Hand Painted Film Plus, Cubic Film* and *Walk In Cube*. *Hand Painted Film Plus* examined the potential of digital filmstrip, using the camera as a brush. This project enhanced my understanding of shooting, sequencing, framing and the frame specifically in terms of the transformation between linear time, the two-dimensional and the three-dimensional space relationship. *Cubic Film* explored the film as a cube and the consequences when the linear time sequence is disrupted. By considering the cube as a three-dimensional structure, *Cubic Film* also examined how the transformation affects the framing, sequencing, and shooting. The final project, *Walk In Cube,* was the full participatory version of *Cubic Film*. It enabled the audience to become participants by inviting them to 'walk' into the cube. In other words, *Walk in Cube* explored how the audience could actively frame and sequence a film with their own body movement.

I explain and reflect on each project below, and discuss the results of *Walk In Cube* in the next chapter, Evaluation (Chapter 5). The supporting videos can be accessed in the attached DVD.

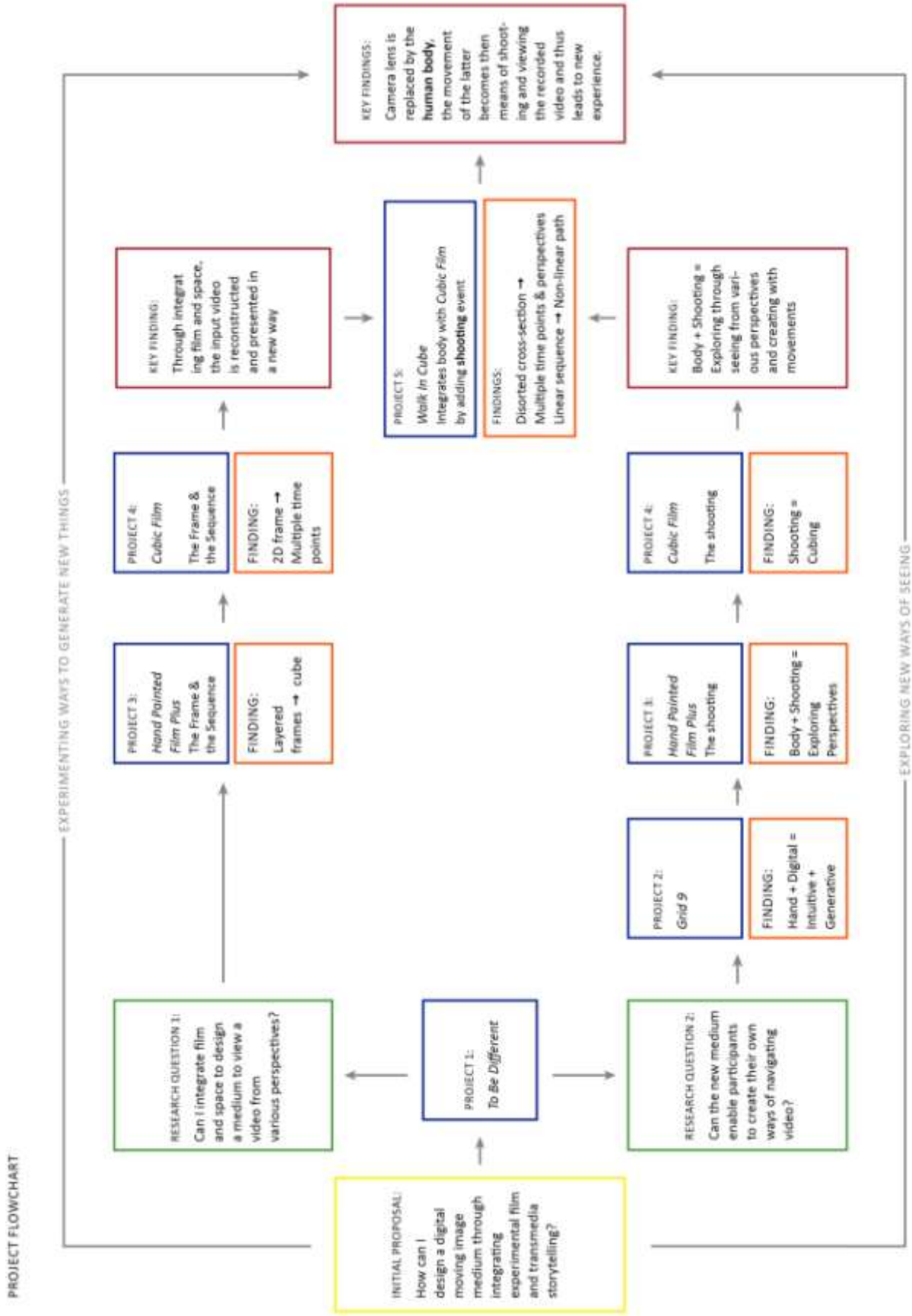


Figure 4.1: Project flowchart

4.2 *To Be Different*

I created two individual test pieces, both called *To Be Different*, to compare and contrast abstract film and transmedia storytelling in line with my initial research proposal to design a digital moving image medium through integrating experimental film and transmedia storytelling.

The inspiration for the test pieces was a Chinese character 異, which means 'to be different'. Many Chinese characters were originally based on the physical forms of objects. 異 consists of '収（廾）'and '畀', which illustrates that two hands separate a group of gifts (Figure 4.2). In other words, the action of splitting is making the 'difference'. For both pieces, I abstracted the movement of separating and splitting to depict the concept of 'difference'.

4.2.1 Abstract film

Only one digital three-dimensional model was made to depict 'difference', and this was revealed to the audience at the end of the animation (Figure 4.2). However, I used animation techniques to make the model look as if it was being 'split' into two or more bodies throughout the whole animation to create a sense of difference.

Figure 4.2: (left) 異 consists of '収（廾）'and '畀', which illustrates that two hands (highlighted in red) separate a group of gifts; (right) A frame from *To Be Different* (abstract film)

4.2.2 Transmedia storytelling

I created the feeling of separating and splitting by making a contrast between one user's movements and other users' reactions. I used monster and worm characters in the film, because, as non-human representations, they could be considered to be different from the

norm. A user designs two looks — a ‘monster’ look and an ‘appealing’ look — for his or her creation. A user can tell how different his/her monster/worm is by the reactions of other users. When a user’s creation is considered different from other creations, the movement of that creature can act like a knife to split the crowd trying to run away from it. Moreover, he/she can switch the monster to the appealing mode and the other users will gather around it again (Figure 4.3).

Figure 4.3: Screen capture from *To Be Different* (cross-media)

On reflection, another platform for this project could be a physical space. A link between a physical installation, which projects user-designed worms into a crowd, and an online community could be established to map and accumulate reactions from both real and online users. Since *To Be Different* was an exploratory project, and due additionally to time constraints, I did not test this idea. However, I attended the *Cross-Media Forum* by The Power to the Pixel in 2011 and 2012 to learn from leading international cross-media creators, thinkers and practitioners from across the fields of film, TV, interactive, online, mobile, gaming, publishing and live events (The Power to the Pixel, 2012). It enabled me to identify the difference between abstract film and cross-media.

4.2.3 Reflection

Making and evaluating the *To Be Different* pieces gave me valuable insights into the differences between abstract film and transmedia storytelling. This enabled me to compare the two techniques, summarised in the chart below (Figure 4.4). I argue that, from the mode of navigation, abstract film audiences are spectators who largely ‘receive’ information from the film. With transmedia storytelling, the audience participates. In terms of story structure, once a film has been rendered, the content is fixed. On the other hand, as long as more people join a transmedia project and there is new input, the narrative keeps evolving. Abstract films also generally have a beginning and an end. In contrast, transmedia storytelling has a multi-entry structure: people have the possibility to

actively input whenever and whatever they want (online, in a physical space, etc.). The basic aim of the two techniques is also different: abstract film originally aims to find new ways for artistic expression and focuses on authorship, while transmedia storytelling involves collaborative problem solving. The transition is from a creator's introspection to another's inner world (Weiler, 2011). Finally, from a distribution point of view, once a completed film is shown (e.g. in a cinema, on a flight, or on television), its format, such as the screen ratio, might alter according to the platform, but the content of work remains essentially fixed. On the other hand, transmedia storytelling aims to reduce the repetition of the content between media. In short, each medium tells a story: by combining individual tales, a complete story is revealed.

Transmedia storytelling allows people to read a story from different perspectives and find pieces of the content. While abstract films generally have a beginning and an end, transmedia storytelling has a multi-entry structure because of its interconnection between the film and physical space. It also empowers the audience as individuals and enables their self-development by providing a framework through which they can make their own decisions and participate in collaborative problem solving. Based on these findings, the initial proposal to design a new digital moving image medium through integrating experimental film and transmedia storytelling evolved into the two research questions set out above.

Abstract Film		Transmedia Storytelling
Spectator	Mental model (Navigation)	Participant
Launch and leave	Production	Real time and responsive
Authorship	Intention	Collaborative problem solving
Single entry / Fixed content	Story structure	Multi-entry / Evolving story
Repeating content across media	Distribution	Little repetition between media

Figure 4.4: Comparison between abstract film and transmedia storytelling

4.3 *Grid 9*

Having considered how new digital media can encourage viewer participation, the second experiment, *Grid 9*, aimed to explore the second research question (can the new medium enable participants to create their own ways of navigating video and, if so, how?). It explored further by gauging the difference between personal artistic expression through physical drawing and using an digital interface to draw. This work extended one of my earlier abstract films, *Kapsis* (Cho, 2010). *Kapsis* is based on a Nahua myth about a girl who falls in love with a star but does not reach it; instead, she becomes a starfish. Kapsis is essentially about the emotion of unrequited love. The story has a sad ending: Kapsis does not reach her beloved star. It aims to convey the message that, whilst the pain of unrequited love might not heal completely, one's emotions do stabilise eventually. Most people have experienced difficult situations and problems that can seem insurmountable. However, most of us realise that things do get better as time passes, which is what I wanted this work to show.

4.3.1 Experiment

To design an open structure for engagement, I analysed my previous creative process, and dissected this to see which parts could be collaborative. I found that the material collection process, modelling design, story formation and key-frame identification could be collaborative. Therefore, I asked participants to visually express their emotions through drawing with any drawing instruments and then using digital generative interfaces to respond to the state of feeling (1) overwhelmed, (2) confused, and (3) better.

I collected two sets (one hand drawn and one digital) of nine images from participants, three each for space, colour and facial expression (i.e. a grid of nine images; Figure 4.5). Each of the three images of the same type represents the three emotional states: feeling emotionally unsettled, a middle stage, and feeling more stable.

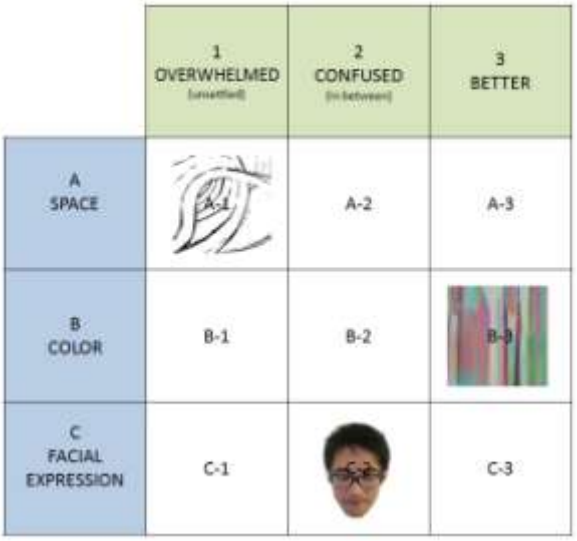


Figure 4.5: A grid of nine images

4.3.2 Reflection

Through dialogue with participants during and after the experiment to understand their responses to and experience with the two different approaches to expression, I found that they generally felt it was helpful to use an interface to create images (Figure 4.6). This was especially the case for those who were not familiar with the visual thinking process. On the other hand, those who were good at visualization preferred to draw the image directly. Moreover, breaking the process into two stages with digital interface (generating and selecting images) was very helpful for participants who had less experience in visual thinking: it helped them find their ideal images to reflect their thoughts. I therefore wanted to create a digital interface that integrated both the strengths of drawing (intuitiveness of the participant's body movement) and digital generation (spontaneous excitement) (Pearson, 2011). Furthermore, the interface would break down the drawing process into stages, which would facilitate the participant's reflection on both the process and result.

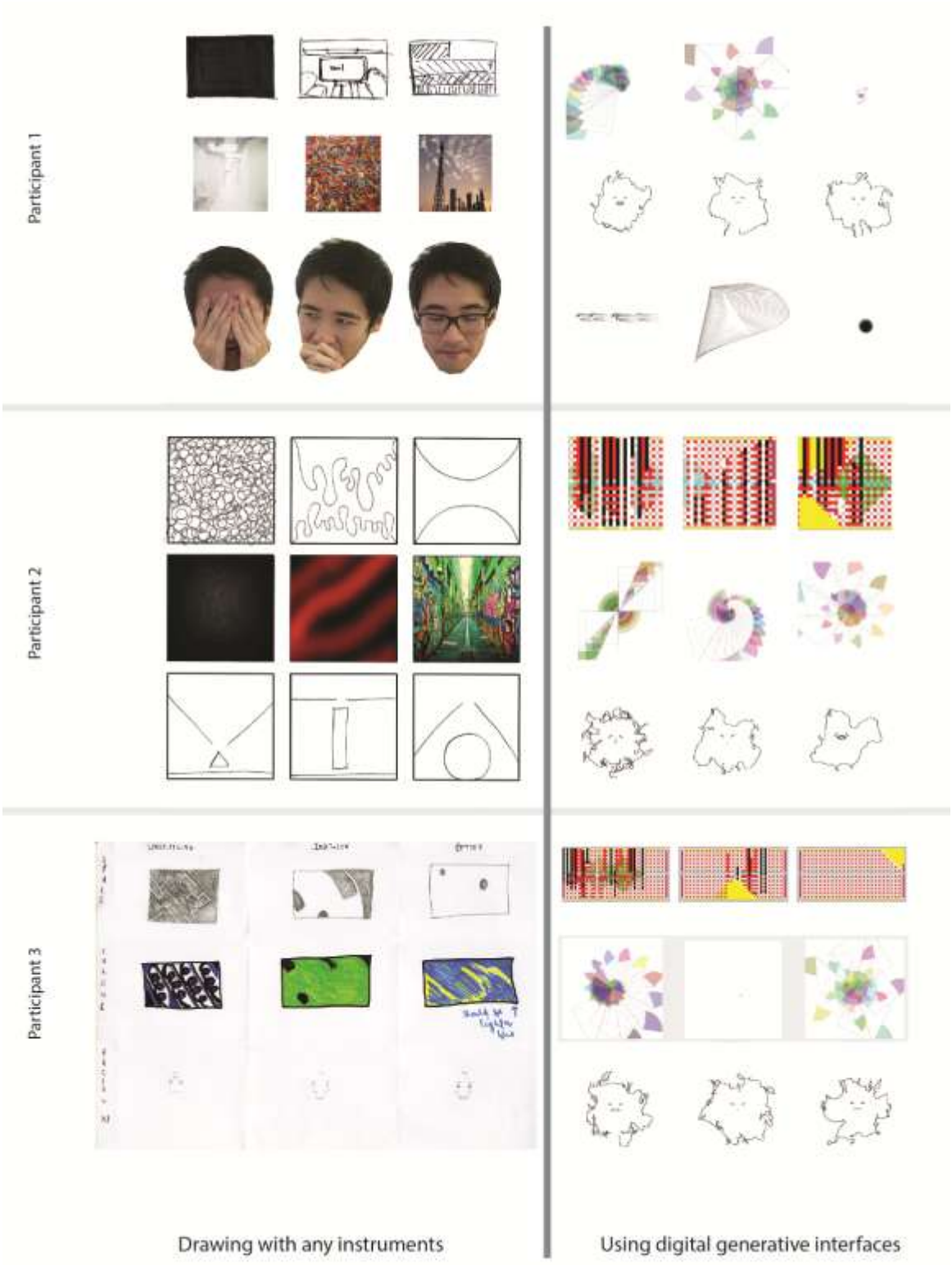


Figure 4.6: *Grid 9* experiment: three sets of images from participants 1, 2 and 3

4.4 *Hand Painted Film Plus*

In January 2012, I joined a workshop for the *Unravel* project by Jo Daniels and Maria Anastassiou at the Ikon Gallery in Birmingham, UK (Figure 4.7) (Anastassiou and Daniels, 2010). *Unravel* is a project that creates a hand-painted film in collaboration with various institutes, such as art galleries and community spaces across the UK. The creators held touring workshops which aimed to create a sixteen-hour film, manipulated by hand, by a diverse demographic of the people of Britain. Through the workshop, I gained experience of drawing on the filmstrip. I also observed how people enjoyed the experience of drawing on filmstrips and how these are connected and played on an 8mm projector.

To continue the idea of designing a medium that is participatory, integrates film and space, and also has the strength of both drawing/painting and digital generating images, I developed *Hand Painted Film Plus* (Figure 4.8). This project enabled people to make their own abstract films through various spatial relationships.

In the Contextual Review (Chapter 2), I identified the key components of experimental films: the frame, the sequence, the shooting, abstraction and sound. To continue exploring the first research question – to design a new medium by integrating film and space to view a video from various perspectives - the following discussion focuses on the frame (the unit of time) and the sequence (transformation between time and space). For the second question – to enable participants to create their own ways of navigating video – I focused on the shooting event and considered the relationship between the hand/body and the shooting subject.

Figure 4.7: *Unravel* workshop, Birmingham, UK, 2012

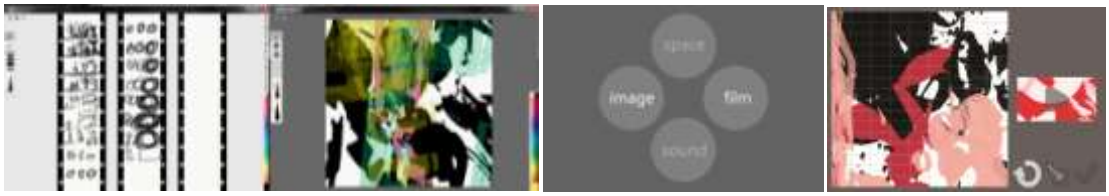


Figure 4.8: Interfaces of *Hand Painted Film Plus* (film, image, portal, and transition)

4.4.1 The shooting: the camera as a brush, seeing with hands

People use a brush to paint directly on a filmstrip, or use a camera to shoot a film. As Hamlyn argues, "The question of how to support a camera is never a merely technical one...it shows that subject and the makers' attitude or approach to it" (Hamlyn, 2003). But, can we use a camera to paint? How might the change of medium affect the outcome?

I used the camera for colour tracking, motion tracking, colour and motion tracking, and distance tracking. These forms of tracking capture an object from a certain angle at a certain moment. Movement makes the spatial (perspective) and time relationship between the camera and the subject change. Participants are able to navigate spatially in all dimensions. Even the same movement path with different moving speeds creates different results. The co-created rhythm can be very organic and unexpected (Figures 4.9, 4.10, 4.11 and 4.12; Appendix B).

I also went beyond the hand, and used a Kinect sensor to collect the data from the participants' bodies (Figure 4.13). Thus, my project question was: how can the ambient spatial and time relationship be recorded and visualized? I detected the skeleton of each body, and drew dots to represent the joints of the limbs. Later, I decided to use splines to connect the dots, which do not need extra anchor points like the Bezier curve, and which make the line based solely on the participants' movement (Figure 4.14). I developed the concept of using body data further in my final project, *Walk In Cube* (see below).

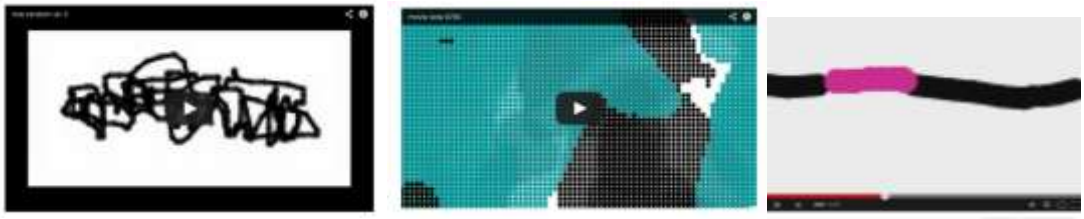


Figure 4.9: Three videos made from early experiments with *Hand Painted Film Plus*

Figure 4.10: Frames created using the camera as brush and/or digital brushes

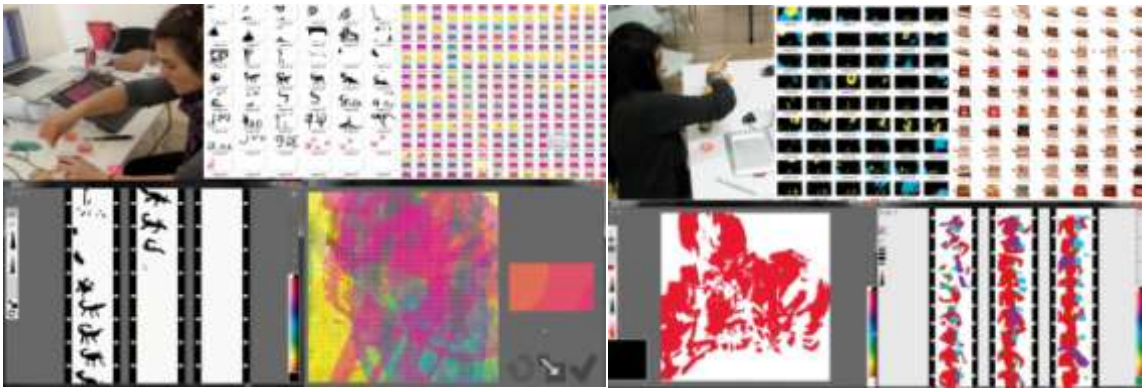


Figure 4.11: Participants 2 and 5 and their outputs

Figure 4.12: Photos and a recording of the participatory experimentations

Figure 4.13: Human skeleton captured by Kinect sensor

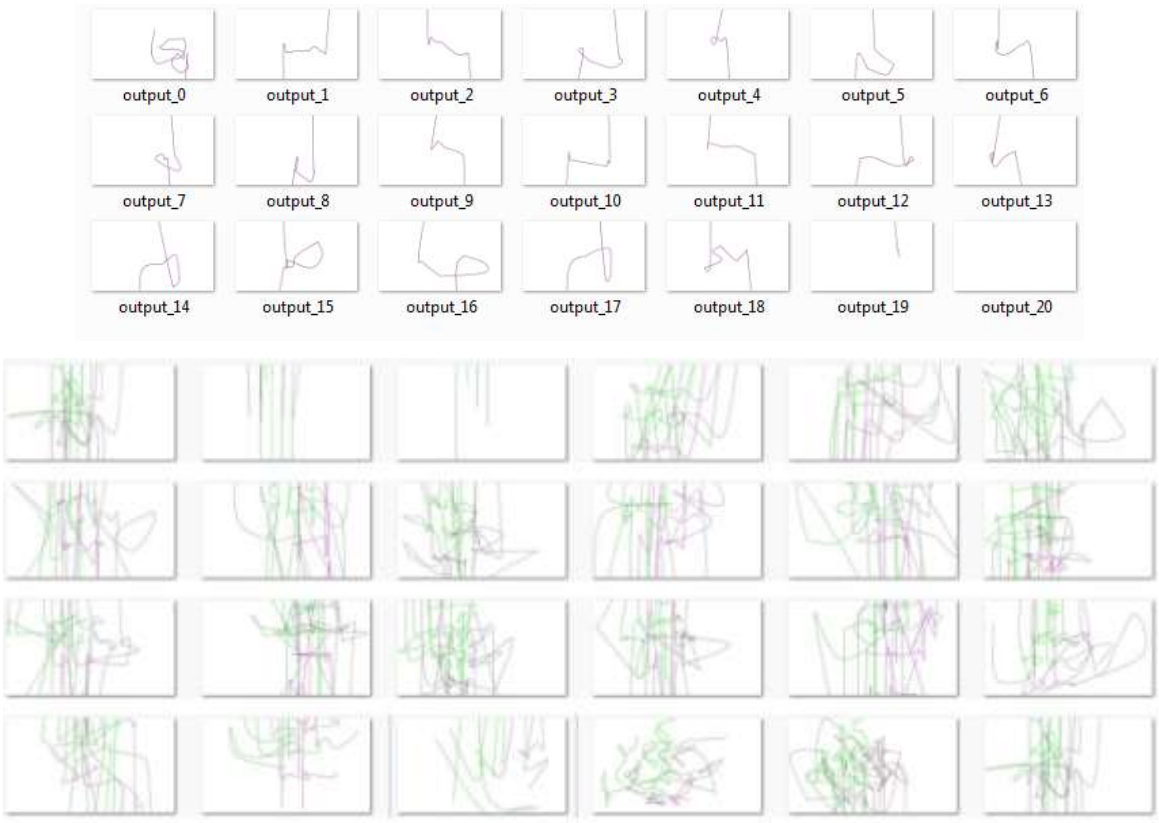


Figure 4.14: Frames of a participant's single hand movement (above) and frames of a participant's body movement (below)

4.4.1.1 Reflection

Using a webcam as a brush enables participants to easily record the trace of the movement of a moving object in front of camera. Frame comparison ensures that participants can easily record the organic outline of a subject. To turn the captured subject into a customised stroke for painting, the process takes advantage of the organic shape of the recorded subject, the chosen perspective of the camera and the relative movements between the subject and webcam. The hand movements control the subject and webcam. Steve Hawley's *Trout Descending a Staircase* (1990) resonates with this project: Hawley used an electronic paintbox, made with a Fairlight CVI, to create a satire about painting and technology. In contrast, my project encourages participants to move the camera and thus actively explore and interact with the surroundings rather than moving themselves as they would if they were the subject of a static camera.

The experiment showed that the relative movement between the hand and the subject has a significant impact on the outcome. By analysing the outputs and the dialogue with participants, four categories of relative movement during the shooting were discernible:

the subject moves and the webcam remains static; both the subject and the webcam move; the subject remains static and the webcam moves; both the subject and the webcam remain static. The outputs of the four categories are: what you see is what you get; what you see plus how you move is what you get; how you move is what you get; what you see is what you get (i.e. the same as the first category; see Figure 4.15).

Most participants were intrigued by the third category – the camera is moving while the subject is static which meant that they could customise the shape of their brush and draw any shape they liked with the subject. For example, even when filming a simple dot, if the webcam is moved in a circular movement, the end result is a circle. If the angle of the webcam changes while moving, the end result is a circle as if drawn by a continuously transforming brush. All kinds of movement/perspective can be traced and revealed on the filmstrip. Hand movement plays an important role in the dialogue between the object and the webcam. Unlike *I/O Brush* (2006) (a video camera embedded brush), using the brush as a camera to pick up colour/texture and re-locate a recording to a static digital canvas, I used the camera as a brush together with the digital filmstrip, and simultaneously, the visual result revealed a sequence of the exploration towards a subject with hands. I thus saw/viewed the subject by moving around it with the camera and using the perspectives and movement to create individual results. These four categories will be further discussed in relation to *Cubic Film* below.

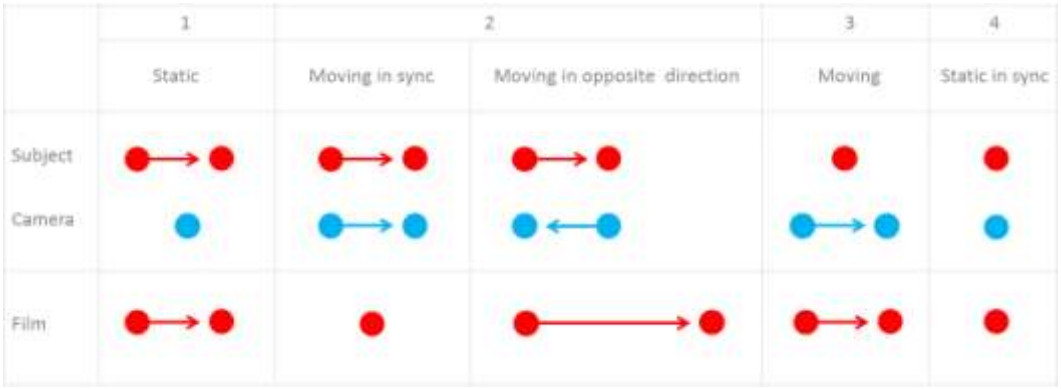


Figure 4.15: Four categories of relative movement during the shooting

4.4.2 Framing and Frame: The Unit of Time

In film, each frame is a continuous photograph, but time is broken into a number of samples. Video goes a step further by sampling the frame along the vertical dimension (scan lines). I questioned how I could push this further by giving the opportunity to the

participant to customise the unit of the media. I was interested to see how the making changed when the extrinsic rhythm, such as the lens size or frame rate, changed. With this project, participants could control their own rolling unit whilst painting. They could change the lens size (while filming) and the rolling speed (while filming and when viewing) of the filmstrip (Figure 4.16 and 4.17). As a result, the same movement of a subject can leave very different traces when at least one of the parameters changes (Figure 4.18).

4.4.2.1 Reflection

Participants are able to adjust the spatial relationship by changing the position on which the captured frames are pasted. Even when the same movements are captured, they can be presented in various ways, based on the unit the participants choose. Both the parameters change the 'resolution' of participants' movement, and the structure of the cubic space. The inconsistency of the lens size and the projection frame meant that more than one time point appeared in the projection frame. The unit of time is not defined by the projection frame. This result is similar to strip photography, but *Hand Painted Film Plus* allows participants to change both the length and width (through sequencing) of the lens, and thus fully customise their own lens. As the lens size is smaller than the projection frame (the unit of recording is different from the unit of projection), participants can deconstruct the projection frame and the subject, which is key to the next project, *Cubic Film*.

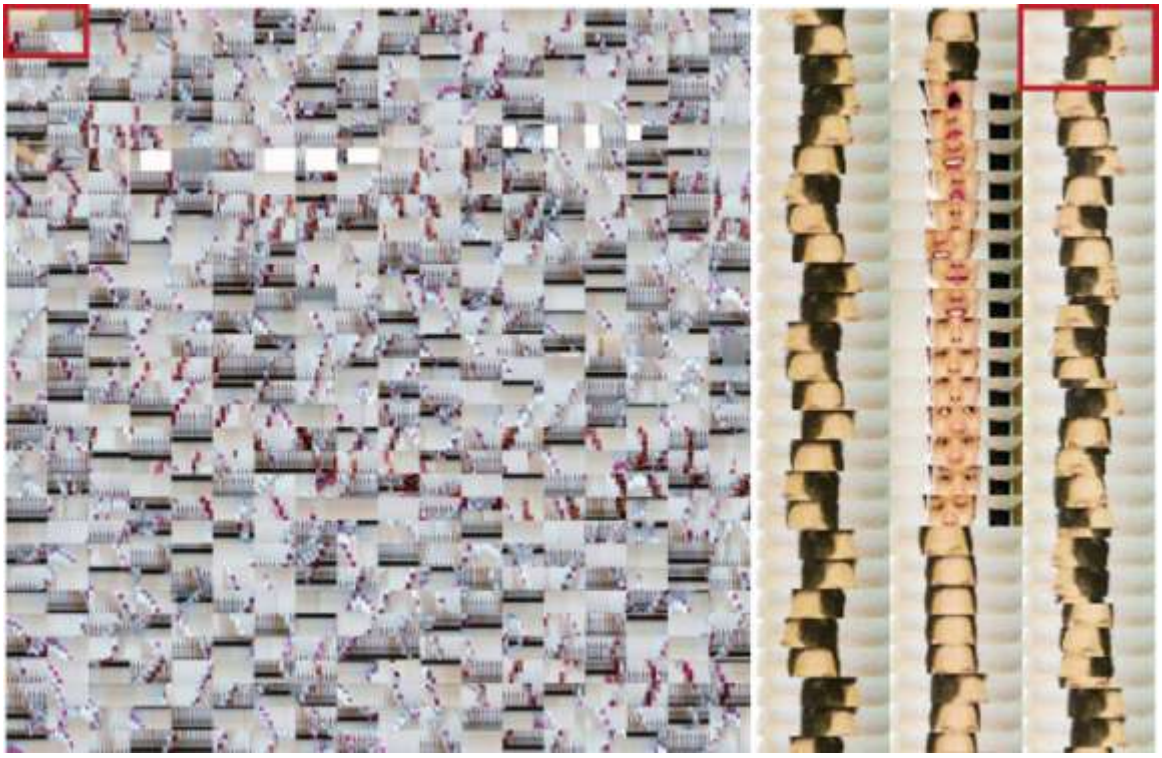


Figure 4.16: Results of changing the lens's size

(the red square indicates the size of the projection frame)

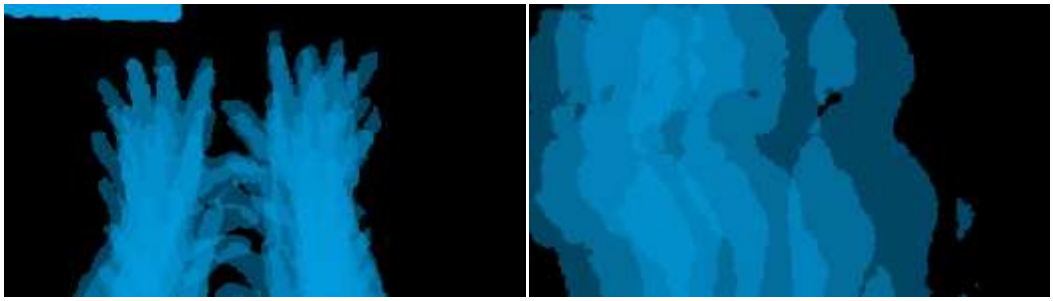


Figure 4.17: Results of slowing down the rolling speed while filming (multiple exposure)

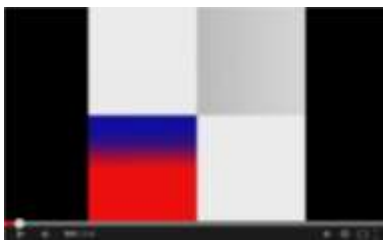


Figure 4.18: A video result of changing the lens size to be half of the frame

4.4.3 Sequencing: the transformation between time and space

Following the previous tests with cross-media, which encouraged people to see from different perspectives, I experimented with the transformations between the linear relationship of the filmstrip into two- and three-dimensional spatial relationships. Here I focused on the conversion between one and two dimensions. The conversion between one (film strip) and three dimensions (cube) is discussed below in the *Cubic Film* project.

Sequencing involves two processes: cutting and assembling. Cutting refers to the breaking of the film strip or image into frames whilst assembling refers to how these frames are connected to become film or image. Through the two processes, the possibilities of mutually converting between spatial and time relationships are delineated and analysed.

I worked on the synthesized version of my medium, building the connection between film and image. This connection contained a main loop and a sub-loop. Participants could view their works from various perspectives along the main loop. The sub-loop created further opportunity for participants to edit the transformation between presentations. I undertook participatory experiments, which tested how well the transformation reflected each medium's characteristics and the ease with which participants continued their works.

I also started experimenting with integrating space into film and image, by connecting the shot content and the frame. Connecting the shot content is technically more difficult (it requires recording all the information of all kinds of inputted content from both camera and digital tools) than connecting the frames (Figure 4.19). I explained in the last section that deconstructing the frame into smaller units than the projection frame caused more than one time point to appear in one frame. I developed the experiment by sequencing these deconstructed frames back into a video. For example, if the length of the inputted video was 6 seconds (the frame rate was 6 per second and the resolution was 36 x 36 pixels), I sequenced the frames which had been divided into 36 parts and each part formed a second of the original video (Figure 4.20). In other words, while viewers could see all 24 seconds in each of the frames, it still took them 24 seconds to see all the information. Through illustrating this idea (Figure 4.20), a cube is formed from the video.

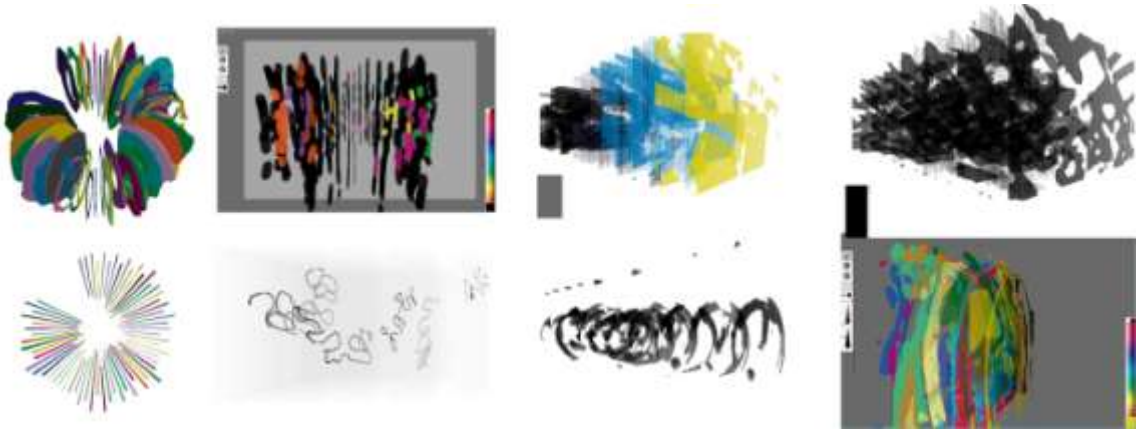


Figure 4.19: Tested examples of space formed by connecting the shot content

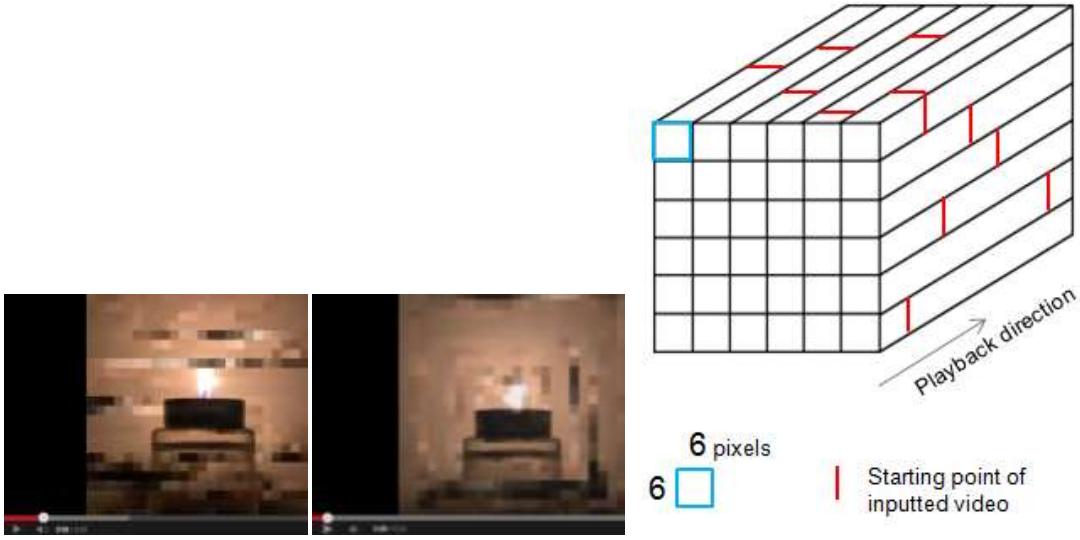


Figure 4.20: Two video examples resulted from sequencing the deconstructed frames and an illustration showing the sequencing of the deconstructed frames to form a video

4.4.3.1 Reflection

By having constant dialogue with the participants throughout and after the experiments and looking at various presentations of their images, I noticed that generally they improved their understanding of the images and the process of making them. The transformation helped participants to see the potential sequences of the original set of data (Figure 4.21; Appendix P). Participants were especially surprised to see how static images moved and vice versa. As participants could decide where to break the original time and spatial sequence as well as how to reconnect the frames, new sequences and patterns of time or space could be created using the same set of data. Participants had the opportunity to see sequence/pattern options and choose a better result. The iterative process in my experiment also gave participants the opportunity to reflect on their own artistic

skills/creativity. I found that re-sequencing could enable them to see new things in what they had made. In other words, it was beneficial to show these new ways to disrupt and display the time sequence, and revisit the data with a fresh eye.

These processes provided me with important knowledge about making connections between media. I learnt that, to create media transformation based on parameters, the key items which need to be formatted are: the dimension of the space and time, database structure, and the digital creation tools with each medium (Appendix A). I also experimented with sound but I learned that sound is a vibration that does not produce sequenced two-dimensional visual frames, and thus requires a transformation system different from that which I had designed for the film strip. Therefore I did not continue the experiment on sound in the following project.

Most importantly, through testing with content, through shooting and by using digital brushes, I found that the benefit of transforming a video into a space through layering frames was not only technically easier than connecting shot content but also allowed all existing video to become a cube for further experiment. This allowed the designed medium to be tested with a bigger range of subjects, and prevented limiting what the participant wanted to reflect with the final medium.

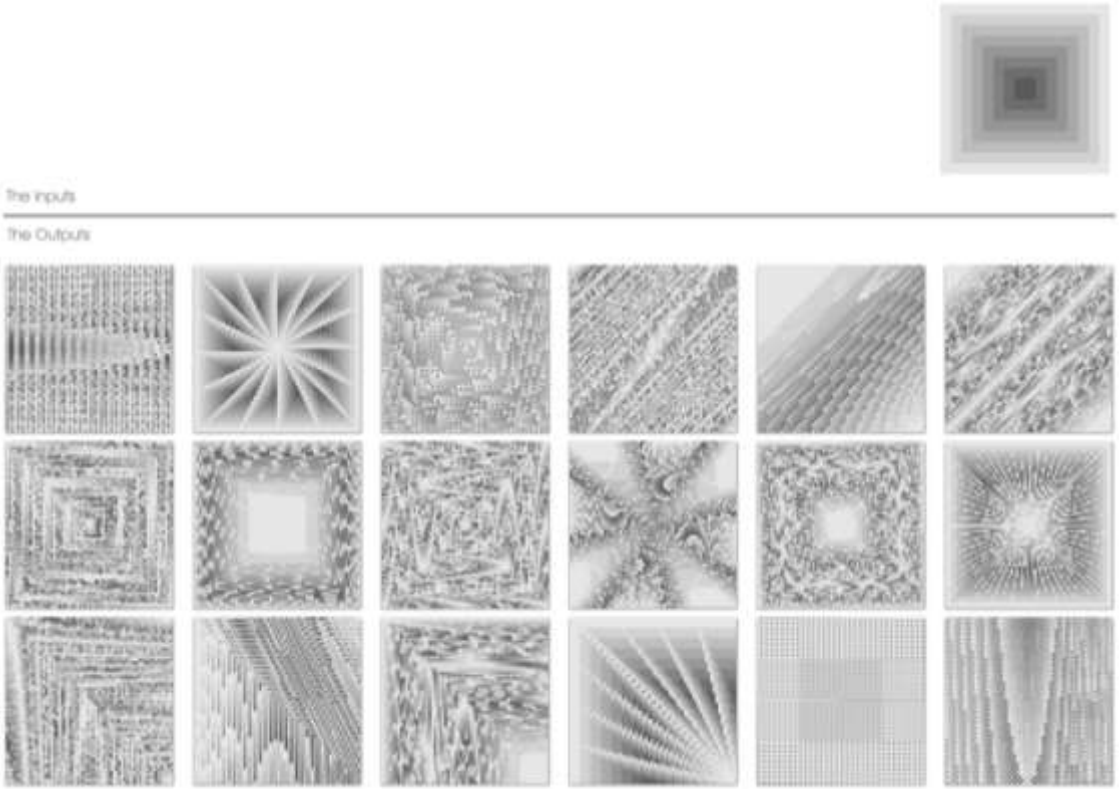


Figure 4.21: An example of the input and re-sequenced outputs

With *Hand Painted Film Plus*, I started to explore the unexpected organic results of hand movement in terms of holding a camera, and set the relative movement during the shooting in four categories, which was used for further reflection on shooting in subsequent projects. I also started to explore deconstructing the projection frame, which is important for the next project, *Cubic Film*, and to separate the unit of meaning – frame – from the unit of the digital medium – the pixel. I started to consider film as both a time-based event and as a static image. The transformation between the two caused by re-sequencing (deciding where to break and connect) the frames could enable people see new things from what they had made. I found that, when forming a space, instead of connecting the inputted content shot/painted by the participants, layering frames was technically much less complicated, and thus all existing videos could be transformed into cuboids.

This project not only helped me to develop my own understanding of film as a medium, but also made experimenting on film accessible to participants who had no moving image experience. Through the participatory experimentation, I learned how participants re-explored a familiar subject in their own ways by seeing it from different perspectives through their own choice of movement.

4.5 *Cubic Film*

Following my work on the unit of video and transformation between time and space, forming a cube from a video, I continued to explore the cube of pixels. When layering up digital frames as a cube of pixels, we always watch a video along one axis (Figures 4.22 and 4.23). Reflecting on this, my initial question for project 4 emerged: "Can we watch film from the other sides of the cube?" I analysed the inputs and outputs to understand the process of deconstructing the input video and reconstructing the output, and to discuss how the recorded time and space is disrupted through the shooting.

I chose to make a perfect cube, so all the perspectives of the cube could be visually presented equally and could receive unbiased attention. If one edge of a frame is longer than the other, the audience can identify the horizontal and vertical orientation easily. As a result, the previous discussion on the slit-scan paid much more attention to the horizontal transformation (for example, Martin Reinhart [1998] called his project, *tx-transform)* and ignored the vertical transformation because the former shares the same

horizon line with the reality and thus the image is familiar to the audience – the kind that is easily adopted in commercial production.

To make a perfect cube, I shot a film for 24 seconds, and 24 frames per second to reach 576 frames. The resolution of each frame was 576 x 576 pixels: these make a perfect cube with each side comprising 576 pixels. Since it is a cube, I can rotate it, select other sides, and watch the film from another side. With this method, participants can make a cube with the frames made through previous experiments or any video they have previously made. Figure 4.24 shows an example of *Cubic Film* from a video of a lighted candle in a windy environment.

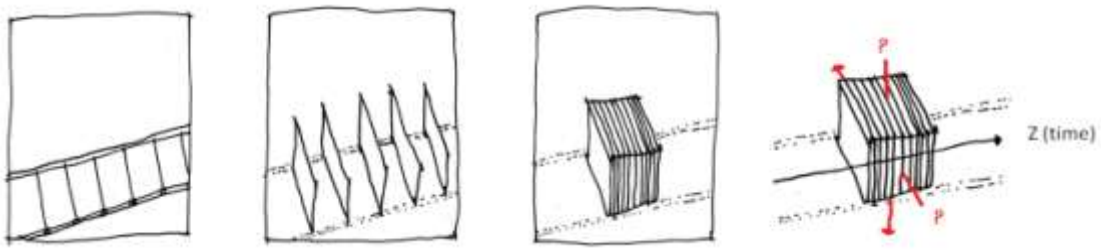


Figure 4.22: The process of forming a film cube

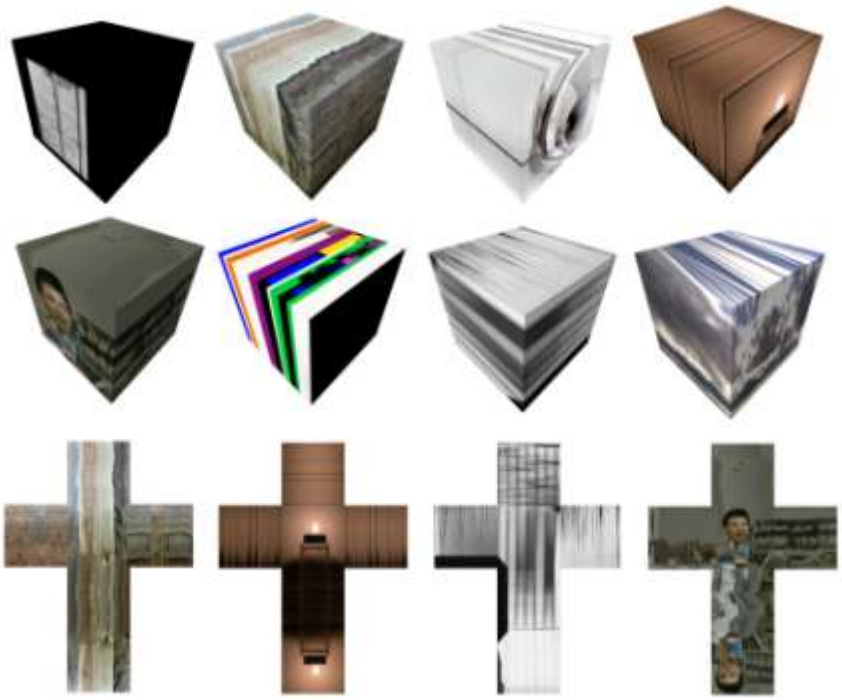


Figure 4.23: Some examples of *Cubic Film*

Figure 4.24: An example of *Cubic Film* from a video of a lighted candle in a windy environment along all three axes

The *Cubic Film* system allows viewers to watch a film along three axes: x, y and z (forwards and backwards), similar to a sculptural approach. The z axis indicates the recorded sequence, and viewers can see a distorted version of that sequence along the x and y axes. These distortions reveal the recorded movements in a form relative to the recorded time and space. When analysing these frames, the indexing of each frame is required because it indicates which roll or column of the recorded time and space (like a scanning bar) we are looking at.

To understanding the image and video output, I undertook semi-structured interviews with twenty people during the RCA research exhibition (2013) and the Digital Futures event at the V&A Museum (2012). I asked each participant or visitor three questions and had a conversation with them to understand how they interpreted the output and the distortion. Their interests and experience helped me to scope the project (see Appendix C, D and E).

Cubic Film is a medium for viewing a recorded time and space rather than viewing the here and now. Therefore, project 4 focused on understanding the medium, trying subjects and analysing the outputs, rather than adjusting the medium. To evaluate the *Cubic Film* outputs, I tested fifty-six different video inputs chosen by myself and other participants (Figure 4.25), and employed comparative analysis to categorise phenomena and compare the subject categories diachronically (Figure 4.26). Image 4.21 shows the examples of tested subjects and the resultant frame in each relative movement category (Figure 4.27). The four categories helped me to simplify interconnected events between input and output for further discussion. Category 1, static camera and moving subject, represents the results from the professionally-made video. It was helpful when the analysis focused on the subject (4.5.1). Category 2, moving camera and moving subject, represents the results

from home videos. While it is less useful for analysis because of the difficulty of telling whether a pattern is caused by the movement of the subject or the hands, it created the most unexpected and complex patterns. Category 3, moving camera and static input, helped me focus on the effect of the hand movement holding a camera while shooting (4.5.3). Last, category 4, static camera and static input, enabled me to consider the transformation between film and space and understand the filmic structure (4.5.2.2 and 4.5.2.3).

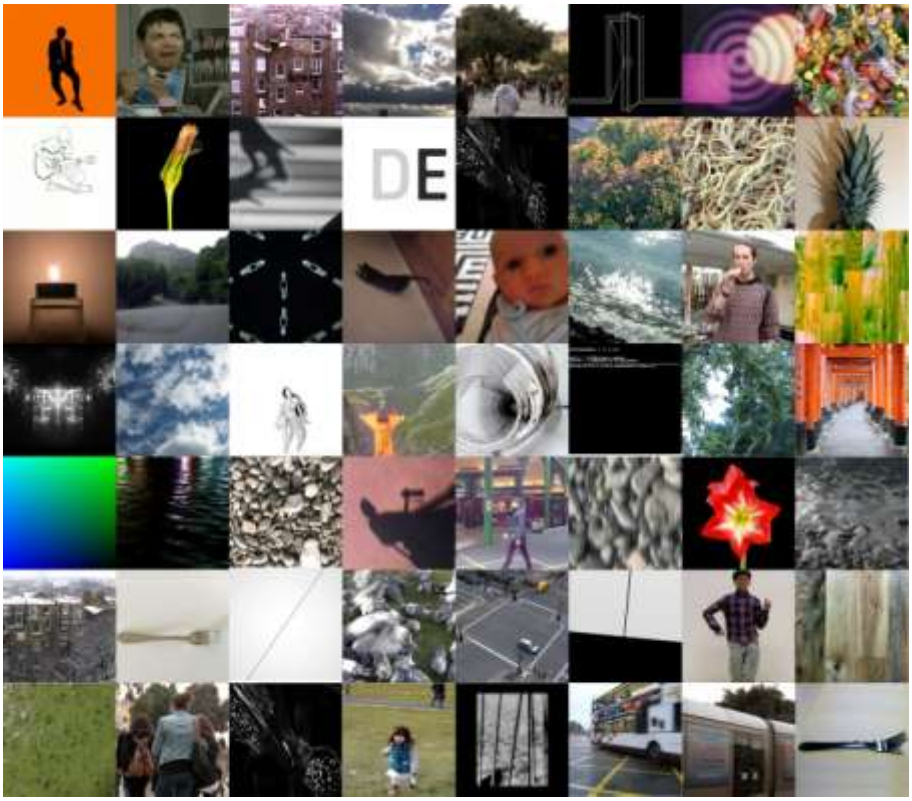


Figure 4.25: Fifty-six inputs

Relative movement during shooting	Input			Camera	Output: Cubic Film	Tested Video Examples
	Leading	Supporting	Background			
Category 1: Static camera moving subject	D	N	N	S	Disrupted subject by itself	Strip Photography; Grow2; Grow3; Cloud; Tree; Guitar; Line; IDE
	D	N	S	S	Disrupted subject by itself with strip background	Strip Photography of Dancing; Cloud; Wave, Baby
	D	N	D	S	The relative in the reality is revealed	Leaves; Bean Dancing
	D	S	D	S	Spatial relationship revealed, Volume changes	Windy, Cloud and buildings
	D	D	S	S	Moving subject with strip background	Claudia's street view; Bean Dentist; Dancing Girl; Early abstraction; Hands; Door; Kapsis; Road Cross
	S	D	S	S	Spatial layered relationship revealed	Pineapple
Category 2: Moving camera moving subject	D	N	N	D	Disrupted subject mix	Chin-Wei Dancing; Kapsis; Walking on stones; Color
	D	N	S	D	Disrupted subject by hand with pattern background	Crowd; Wei-Dan; Cloud; Railings; Cat; Kapsis; Eating Paper
	D	N	D	D	Mix; fight/balancing each other	Sailing; Base Jumping; Kyoto Path; Sailing; Walking with a camera;
Category 3: Moving camera static subject	S	N	S	D	Disrupted subject by hand with lines moving	Food; Noodle; Moving Fork; Driving on the road
	S	N	N	D	Disrupted subject by hand	Wood; Building; Snowbuilding; Stone; Soup
Category 4:	S	N	N	S	Skating through the subject	Static Folk; Static flower
Static camera static subject	S	N	S	S	Lines moving according to volume	Static Wood; Static Stone
	S	S	S	S	Mix Patterns	Static Candle; Static Bean
	D=Dynamic					
	S=Static					
	N=None					

Figure 4.26: The inputs and outputs matrix for comparative analysis

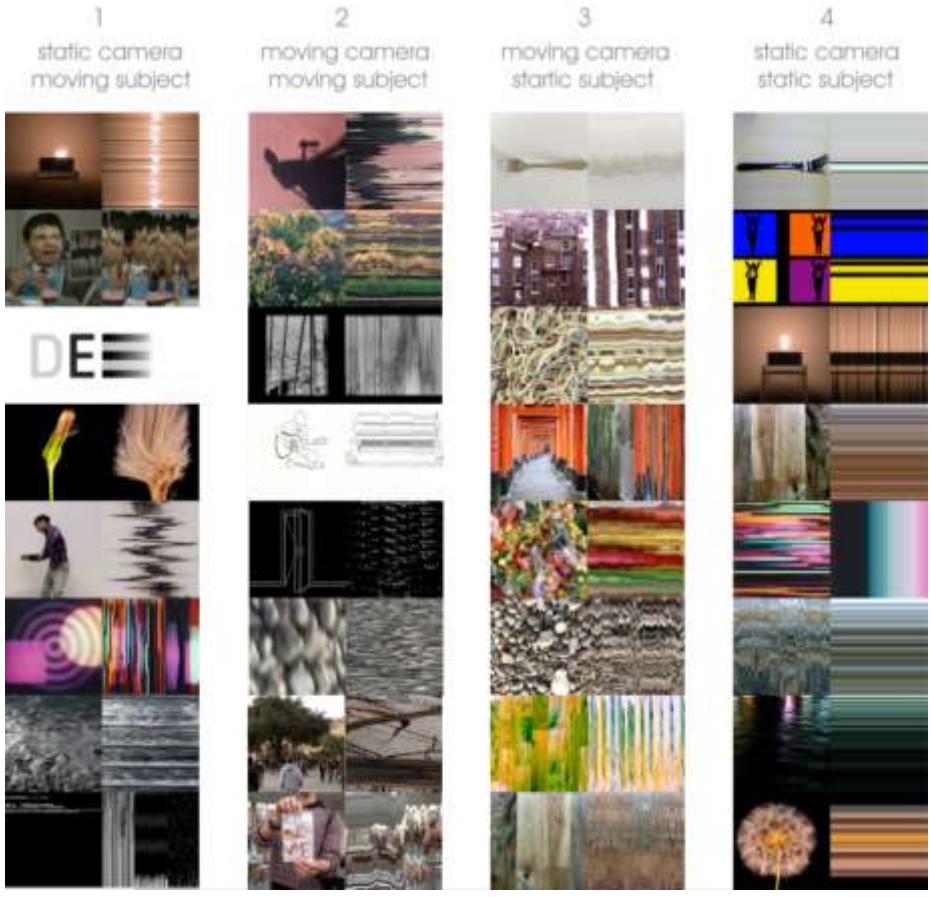


Figure 4.27: Examples of tested subjects in each relative movement category

4.5.1 Framing and frame: from time to space

Watching the *Cubic Film* along the x and y axes is like keeping the data static but rotating an empty 'frame' 90 degrees perpendicular to the x and y axes. To enable the following discussion, the frame along the x and y axes are referred to as frame TY, and frame XT respectively: the horizontal axis of frame TY is time and the vertical axis of it is height; and the horizontal axis of frame XT indicates left and right and the vertical axis of it is time. Frame XY is the frame of the original video (Figure 4.28).

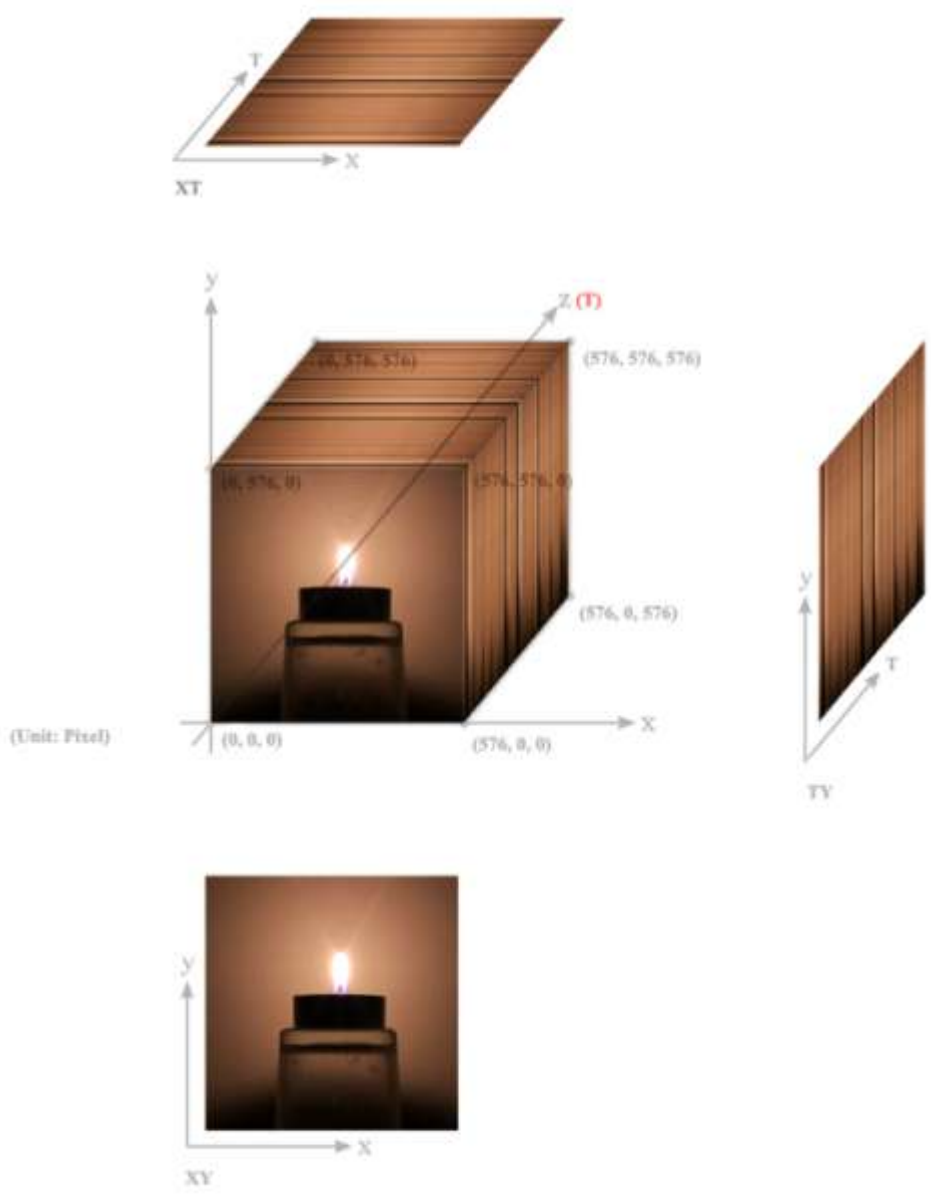


Figure 4.28: Illustration of the coordinate system of *Cubic Film*

The index numbers of frame XY, TY and XT have different meanings. The index number of frame XY represents time information, but we can tell the spatial information from the index number of the frame TY and XT. The index number of frame YT indicates which vertical line of pixel of the frame XY is, and the index number of frame XY which horizontal line of pixel of the frame XY is. In other words, all the pixels in the frame XY represent the same time, but each frame TY or XT contains twenty-four seconds, and a line of pixels represents one twenty-fourth of a second. In short, when looking at the film along the x or y axes, the pixels within a frame have been reconstructed, while the frame size remains the same.

Each adjacent twenty-four lines of pixel of the frame TY and XT represents one second and each frame TY and XY displays the recorded twenty-four seconds. Therefore, frame TY and XT shows the audience information at a certain spatial location of the original video through twenty-four seconds. In other words, *Cubic Film* can be compared to a tree trunk or sedimentary rock: the texture in frame TY and XY are like tree rings and strata, which reveal time-based information. Therefore, each frame TY and XT can be read as a chart, which shows information passing through time and can be used to compare information. To give three illustrative examples: (1) in Figure 4.29, we can read which interval between the five waves was the longest; (2) in Figure 4.30, we can read the information that tells us the people in red and white were just about to meet, before they separated; (3) in Figure 4.31, we can read how many times the animation enters and leaves a space through the twenty-four seconds. In sum, *Cubic Film* offers new approaches to both seeing and analysing moving images. When time-based information is displayed as a static image, the information is significantly easier to read and process (moving image files are much larger than image files). Teasing out the value of this method would require further research. However, in terms of this research, the important task (to me) and experience (of the participants) are to explore the information in these unfamiliar patterns and re-see the known (Dewey and Bentley, 1949). For example, participant 3 said that he/she was astonished when figuring out that the paired curvy lines in Figure 4.30 were human legs. (I experiment further with seeing the familiar in unfamiliar ways in the fifth project, *Walk In Cube*). In short, viewers of a video can decide which face of the cube they want to use to watch a video and see new things; that is to say, they have the possibility to explore the video from various perspectives distinct from the authorised (the filmmaker's) point of view.

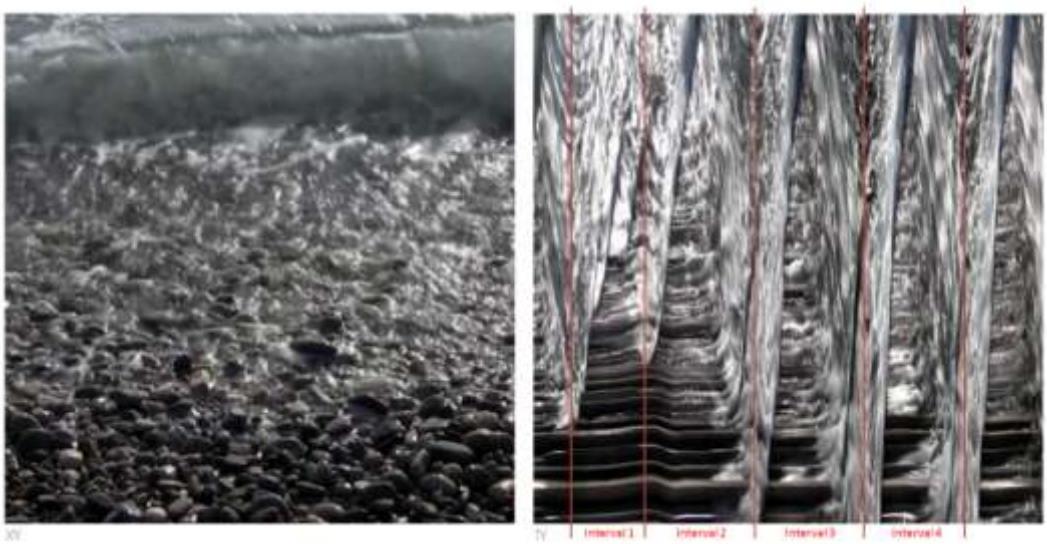


Figure 4.29: Interval 3 is the longest

Figure 4.30: People in red and white have never met

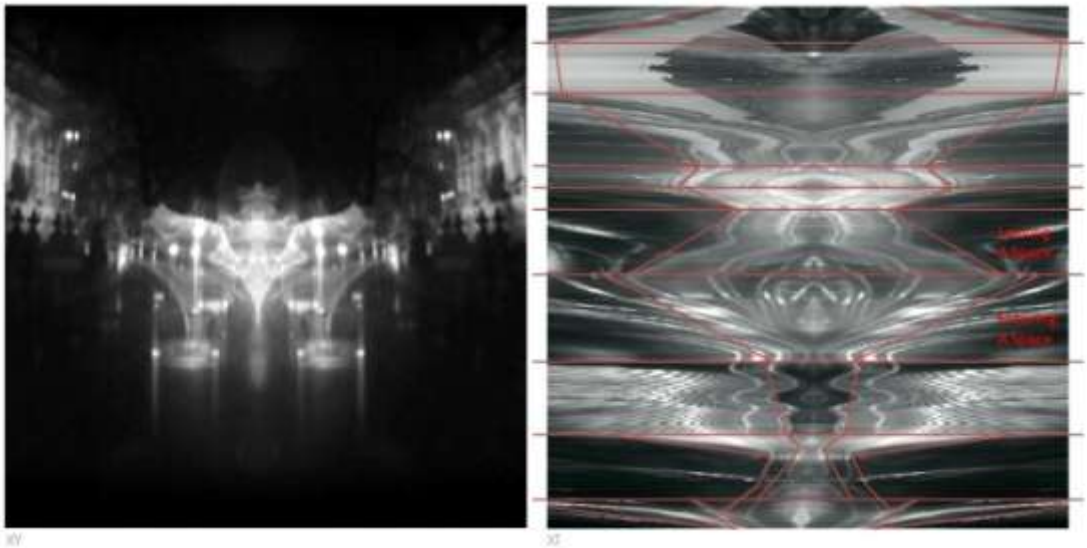


Figure 4.31: We can read how many times the animation enters and leaves a space

4.5.2 Sequencing

4.5.2.1 From one to two dimensions

We have established that sequencing is about where to cut the previous sequence and how to connect the single frame: with frame XT and TY, the transformation from one dimension (film strip) to two dimensions (image) can lead to more complex results (Figure 4.32). As we have seen, each frame XT and TY shows a twenty-four second sequence, so the image output, the combined frames, can be viewed as a panoramic view of all twenty-four seconds, while the sequencing of the original frames, frame XY, is a display of only one set of twenty-four seconds. Connecting the frames in different ways creates various patterns. The output images can be viewed in two ways: from far away, the macro, revealing the pattern created from the combination of sets of twenty-four seconds, or from close-up, the micro, revealing the pattern within each set twenty-four seconds.

4.5.2.2 From one to three dimensions: Cubic Structure

Whilst from the outside, a cube is a simple geometric shape, the content inside the video also forms a three-dimensional structure. This structure is similar to the results from Martin Hilpoltsteiner's *Recreating Movement* (2005) (see Contextual Review), but I related it to parametric design (see Contextual Review) and started experimenting with the latter method to invite viewers to walk into the structure, considering it not only as an object to be viewed but as an object in space like a house, in project 5, *Walk In Cube*.

The difference between parametric design and this Cubic Structure is that, with the former, the structure among the parameters is defined by the designer but the latter is primarily decided by the shape and texture of the filmed subject. For example, in Figure 4.33, a filmed blooming dandelion forms a shape like an abstract green object with wavy hair. The transformation reveals the difference between looking at a film as an object or as a time-based event. As an object, it reveals the entire time-based event from every angle simultaneously and statically. Therefore, as I explain further below (4.5.3), when considering the shooting event, the Cubic Structure emphasises the relative movement between the subject and the camera through time rather than representing an existing object in reality.

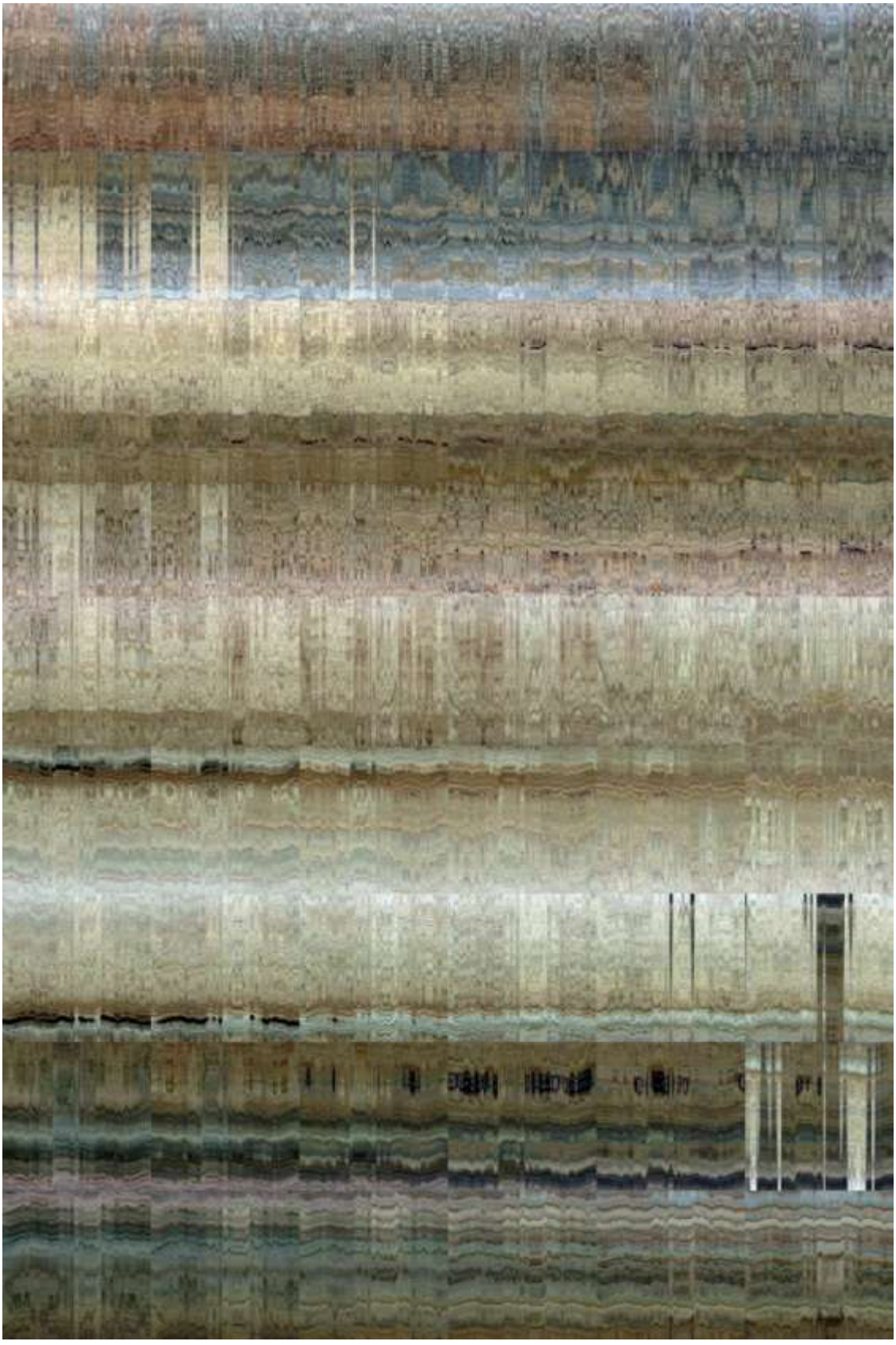


Figure 4.32: Combined texture created from the viewed material – wood – through the *Cubic Film* system

Figure 4.33: An example of the Cubic Structure of a film depicting a blooming dandelion

4.5.2.3 From three to one dimension: video TY and XT

When looking at the Cubic Structure along the X and Y axes, it seems as if we have put a camera into the space and are navigating it through that space. Therefore, video TY and XT reveals the spatial relationship, i.e. what is hidden behind (Figure 4.34), whilst video XY reveals the time relationship, i.e. what will happen later.

We can understand video TY and XT from two perspectives. First, because each single frame is a slit-scan photographic image, we can imagine a row of slit cameras lined up alongside the subject horizontally (video TY) or vertically (video XT), and that all of them took a slit-scan photographic image simultaneously for twenty-four seconds. When playing these slit-scan images in sequence as a film, we see video TY or video XT. The second way is to look at the Cubic Structure first, and then slice it into frames along the X or Y axes to create video TY and XT (this is a similar method by which Fischinger used to make *Wax Experiments*, (Fischinger, 1923; Moritz, 2004)

As discussed in the Contextual Review, we still do not fully understand the consequence of slit-scan applied in video. Therefore, I use here the Cubic Structure to reveal some of the characteristics of video TY and XT.

Figure 4.34: Video TY of a filmed blooming dandelion

4.5.2.3.1 Linear path through Cubic Structure: Line and volume

The first noticeable visual component of the Cubic Video is lines. We have learned from strip photography that, if both the camera and subject do not move, the resultant image is a series of straight lines. In the Cubic Video, these lines move because of the organic form of the subject. Take a video of a static fork as an example (Figure 4.35). First, the

Cubic Structure of a static fork is like an ice skating rink (Figure 4.35). Second, when we look at the video TY, we can see the width of the straight lines move as if we slide on the Cubic Structure from the right to left, and at the end of the video we see the line divided into eight while passing by the tines of the fork and its shadow. In short, in Video XT and TY, the width of the lines changes according to the volume of the subject.

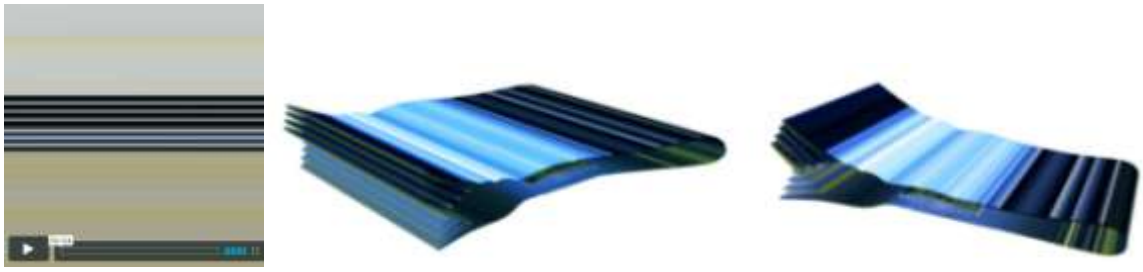


Figure 4.35: Video TY of a static folk and the Cubic Structure of a static fork

Furthermore, if volumes in the original video have sharp edges, such as a square-like outline, we can see fast movement in the video TY and XT. For example, in the video of a candle, we can see that a brown line goes up suddenly around 0:05 seconds into the film (Figure 4.36). This reveals what we would see if we were passing up the glass base with a steady speed. Here is the explanation of the transformation of the gradient of the contour becoming the speed of the movement in the output videos. The gradient of a line in the frame XY is represented by the letter *mxy*, and is defined as the change in the *y* coordinate divided by the corresponding change in the *x* coordinate, between two distinct points on the line ($m_{xy} = \Delta y/\Delta x$) (Clapham and Nicholson, 2009). The gradient of the same line in the frame TY is represented by the letter *mty*, and is defined as the change in the *y* coordinate divided by the corresponding change in the *t* (time) coordinate, between two distinct points on the line ($m_{ty} = \Delta y/\Delta t$). Speed is the distance covered per unit of time ($v = d/t$), so m_{ty} is the speed of a volume, formed by cutting that line, moving in the video TY. In short, seeing a contour from different perspectives makes seeing it move possible.

On the other hand, fast movement in the original video can become slow in the video TY and XT. We already know that, to produce video TY and XT, the time axis has switched with one of the space axes. For example, in the video at around 0:02 seconds (Figure 4.37), the person on the street walks across the screen quickly (long distance for short time), but in video TY (around 0:28 seconds), this person moves along a very short distance for a long time (when the time axis becomes the space axis). In video XT

(around 1:02 seconds), we will see even less movement because the speed of the movement has been transformed into the gradient of the curvy line. The only obvious movement we will see is when frame reaches the head or the feet of the person because that is the transition between the volume of a person and the background. In short, through the transformation from three to one dimension, the fast moving-object in the video XY becomes slow in the video TY and XT, and a static object can create rapid motion in the output videos.

Figure 4.36: Video of a candle

Figure 4.37: Video of a street view

4.5.2.3.2 Linear path through Cubic Structure: bursting faces

In the video TY and XT, we see objects, such as faces, bursting out or disappearing in the middle and elsewhere in the video (Figure 4.38). This effect is especially obvious with video shot when the camera is static and the subject is moving. For example, with the example video of *Mr. Bean at a Dentist* (Figure 4.39), if his face does not move, we only see lines. However, if his face moves, we have the chance to see the full face. In slit-scan photography, as long as the face moves with the same speed and in the same direction as the filmstrip, we will see a full face. With *Cubic Film*, the case is different. As highlighted above, we can think of the making of *Cubic Film* as a row of strip photography cameras simultaneously taking a strip photo over a period of time. Therefore, we know that a camera records a full face, while the camera previous to this one in the row would capture less of the face. Eventually, the front camera catches only the tip of the nose. Playing these images as a film, we can see the nose first, and then the full face in video YT, seeing the face almost burst out from the video.

There is a marked difference between neuroimaging (imaging the structure of the brain) (Reed, 2008) and *Cubic Film*. In the former, we can see the inside of a nose, but in the

latter, we still see the nose from outside. The combination of a realistic appearance with surreal movement, bursting out in a liquid-like way, creates ambiguity.

As discussed above, the video TY and XT reveals the sequence - what we would see if we were passing linearly through the Cubic Structure. While *Cubic Film* enables the viewers to view a video from various sequences distinct from the authorized sequence, the sequence is still linear. In the next project, *Walk In Cube*, I further experiment on the path through Cubic Structure and show how participants can experience a video by navigating it along non-linear paths.

Figure 4.38: Frames of bursting faces

Figure 4.39: Video TY of *Mr. Bean at a Dentist*

4.5.2.2.1 Cross-section as frame: The look-a-like world

Most participants responding to the semi-structured interview said that video TY and XT looked ambiguous. Here I explain how the ambiguity is created: the video TY and XT are abstracts of abreaction.

We know that to create video TY and XT, we can form a Cubic Structure, and then slice it along the X and Y axes. The Cubic Structure reveals the relative movement through shooting. Therefore, the output form is different from all the existing objects in the real world, and Cubic Structure is the abstract form of a film. When slicing the Cubic Structure, we rotate the frame ninety degrees. The unit of meaning, the frame, is therefore separate from the unit of the media, the pixel. Therefore, we deconstruct the Cubic Structure, the abstract form of a film, and reconstruct frames to create the video.

All the pixels are identical and at the same position in relationship to the cube, but not to the frame. In other words, the red in the pixel in the original video is the same as in the outputs, but the sequence between the pixels in the output frames changes. Moreover, while the distance between any two pixels does not change, the distance between a pixel and the edge of the frame does alter. Therefore, we can still recognize the basic shape in the output frame and guess what the original subject is. Take the dandelion video as an example (Figure 4.40). Since all of its components, such as the stem and the bud, have been restructured and re-composited, we still can guess that the dandelion is the subject of these output frames. Video TY and XT forms the outputs of reframing an abstracted structure which is why I argue that they are abstractions of an abstraction. I develop this discussion regarding the connection between the cross-section in the cube and the frame, and show more distortion variations when the frame becomes three-dimensional, in project 5, *Walk In Cube* (see below).

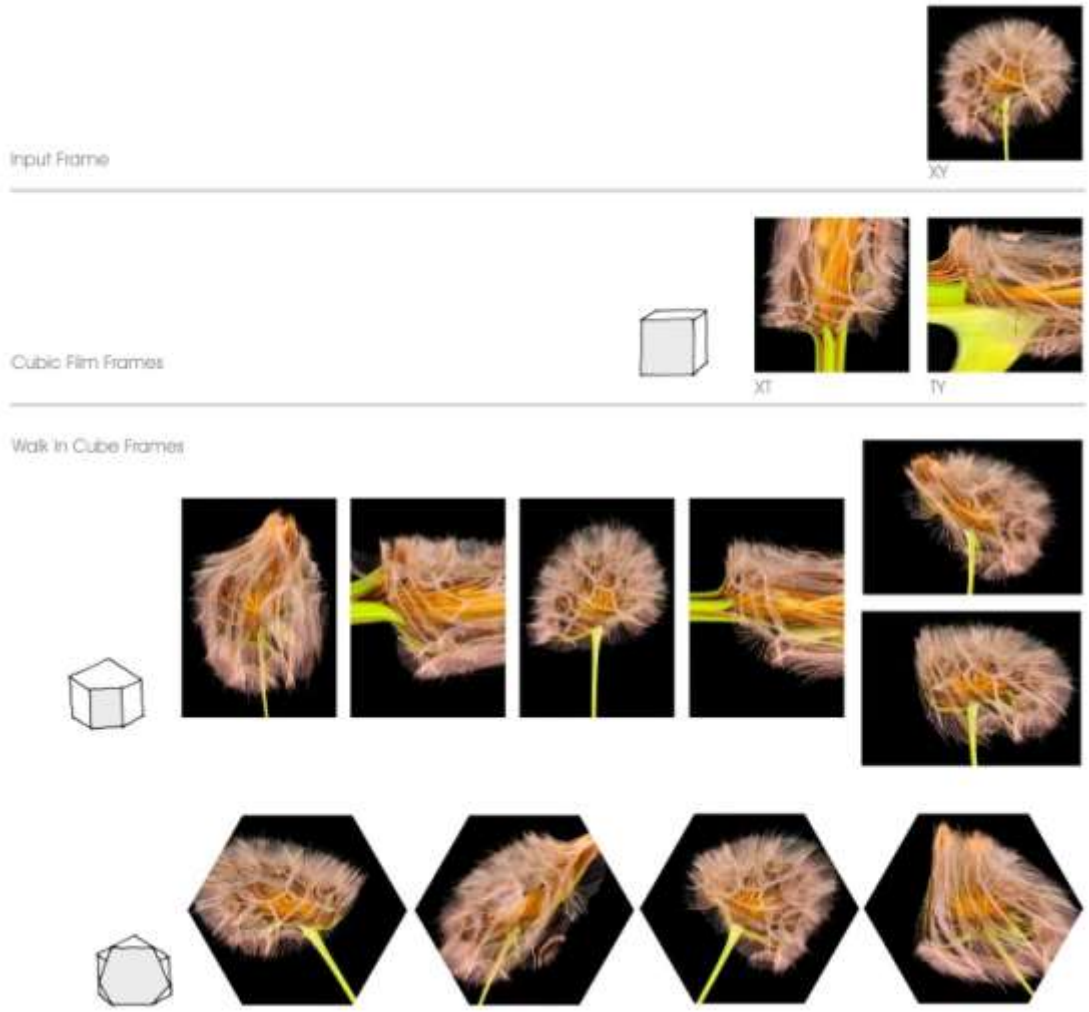


Figure 4.40: The dandelion video frames

4.5.3 The Shooting: Cubing the reality with hands

I discuss here the shooting process in the field of moving image and evaluate whether *Cubic Film* encourages participants to create their own ways of seeing by exploring new ways of using their bodies, arguing that the movement of a camcorder is important because it creates another layer of relativity during the process of film shooting. When I shot my source video, I permitted accidental or intentional hand movements to affect the movement of the camcorder. As result, I obtained many unexpected patterns, which are seldom seen in strip photography. This is not due to the technical differences between the *Cubic Film* and strip photography but rather because I intentionally allowed hand movements in *Cubic Film* (to explore the shooting further), something that is not usually permitted in strip photography.

As I discussed in the Contextual Review, due to its additional mechanical parts, such as the stepper motor, the strip camera has to be fixed on a tripod to move the film while the exposure is being made (Dahlin, 2008). The most prominent uses of strip photography are for panorama photography, photogrammetry, peripheral photography, and photo finishes that have scientific functional needs for precision (Vanvolsem, 2011). Therefore, the movement of the strip camera is either static or mechanically controlled. The relative movement in strip photography thus happens either between static subjects and a moving camera fixed on a tripod, or between a moving object and a static camera. The value of hand movement when considering the holding of a camera has rarely been explored with slit-scan techniques.

When I shot the *Cubic Film*, repeated experimentation and critical reflection developed the sensitivity of my hands, which enabled me to become more creative in my filming. I focused on the characteristic of the subject, namely the colour combination, the composition, and the relative movement on the shooting site. When the camera moves but the subject does not, the quality of hand movement will be transferred to the output. The combination between the pattern of the subject and the path of the hand movement creates a new texture. For example, filming a wood panel (curvy patterns) with a very subtle moving hand and body would result in a distorted and liquid-like pattern. If the hand movement is strong, the movement will dominate the subject's texture. For example, the image below shows that when holding a camera with the end of a tripod leg, the camera shakes significantly and leaves the zigzag pattern in the output (Figure 4.41). When both the camera and subject move simultaneously, the output can contain the information of the subject's movement, while the hand movement adds texture.

The characteristic of the input video, such as colour composition, can thus be considered as the initial interior structure/parameters of the cube. Hand movement adds force/information to disrupt the initial setting and form the final cube. Therefore, the Cubic Structure emphasises the relative movement between the subject and camera through time rather than representing the existing real world.

Moreover, because *Cubic Film* has two specific outputs along the y and z axes, I know the possible output sequences that the viewer is going to watch, so I can create the input sequence through shooting specifically for the Cubic Structure. In the Contextual Review, I introduced Alvaro Cassinelli's *Khronos Projector.* Cassinelli's projects allow the visitor

to push the projection screen along the x axis; therefore, Cassinelli's recorded video has a clear time sequence from the beginning to the end, such as a city view from daybreak to dawn (Cassinelli, 2005). In contrast, my project not only produces moving image outputs, but also allows viewing the video along both the x and y axes and, with *Walk In Cube*, explores full body interaction. Therefore, my project does not limit the type of sequence in the input video as *Khronos Projector* does, but welcomes a wide variety of sequences for seeing from various perspectives. In sum, to make a cubic film, I can 'cube' the reality, but not frame it.

Cubic Film looks into the transformation between the linear time relationship and the three-dimensional spatial relationship. I tested *Cubic Film* with a wide variety of subjects to understand how to read the content of frame TY and XT, and how hand movements affected these outputs. Moreover, I discovered that the transformation created Cubic Structure in the cube, and second, that a camera passing through the Cubic Structure can help us to understand the video TY and XT.

Figure 4.41: Three examples of texture combining the pattern of the subject and the path of the hand movement: wood, fork and stone

4.5.3.1 A New aesthetic

The combination of the movement of the camera together with the pattern of the subject creates unexpected aesthetic results. For example, the dynamic patterns created from the video of a wood pattern resulted from my unintentional hand shaking (Figures 4.42 and 4.43). Adding movement would also disrupt the record patterns in the video TY and XT. For example, in the video TY of a simple fork (Figure 4.44), the hand movement and its reflective surface can create a poetic output; this was also the case in video TY of wood (Figure 4.45).

These experiments resulted in quite a different aesthetic to that obtained through strip photography, which usually shows a distorted subject with a clean strip background (Dahlin, 2008). While hand movements during shooting could be considered to have a negative effect in strip photography, reducing the clean nature of the background, the most notable characteristic of strip photography, and the contrast between the subject and the background, hand movements create a new aesthetic, exposing a grey area between the real world and the strip photography which can be viewed both from far away and close-up. Many participants related the output images to images that mix the representational and abstract and contain layered information, such as tree paper marbling, rings and sediment (Appendices D and E). This was informed by a Cubist approach – to borrow Standish Lawder's explanation of Cubism, in the Cubic Film, "the extra-referential meaning as realistic image was reduced, the significance as pure patterns of two-dimensional movement correspondingly intensified" (Lawder, 1975, p.149). As Martin Reinhart argues, "Nevertheless, the result of a tx-transformation can appear to be completely abstract or completely realistic, depending on the type of shot made" (Reinhart, 1998). As discussed in the Contextual Review, the way a participant handles the camera constantly refers the results back to its operator. It is this hand-making process that makes the familiar become unfamiliar, and the resultant ambiguity allows the audience to interpret the image in different ways.

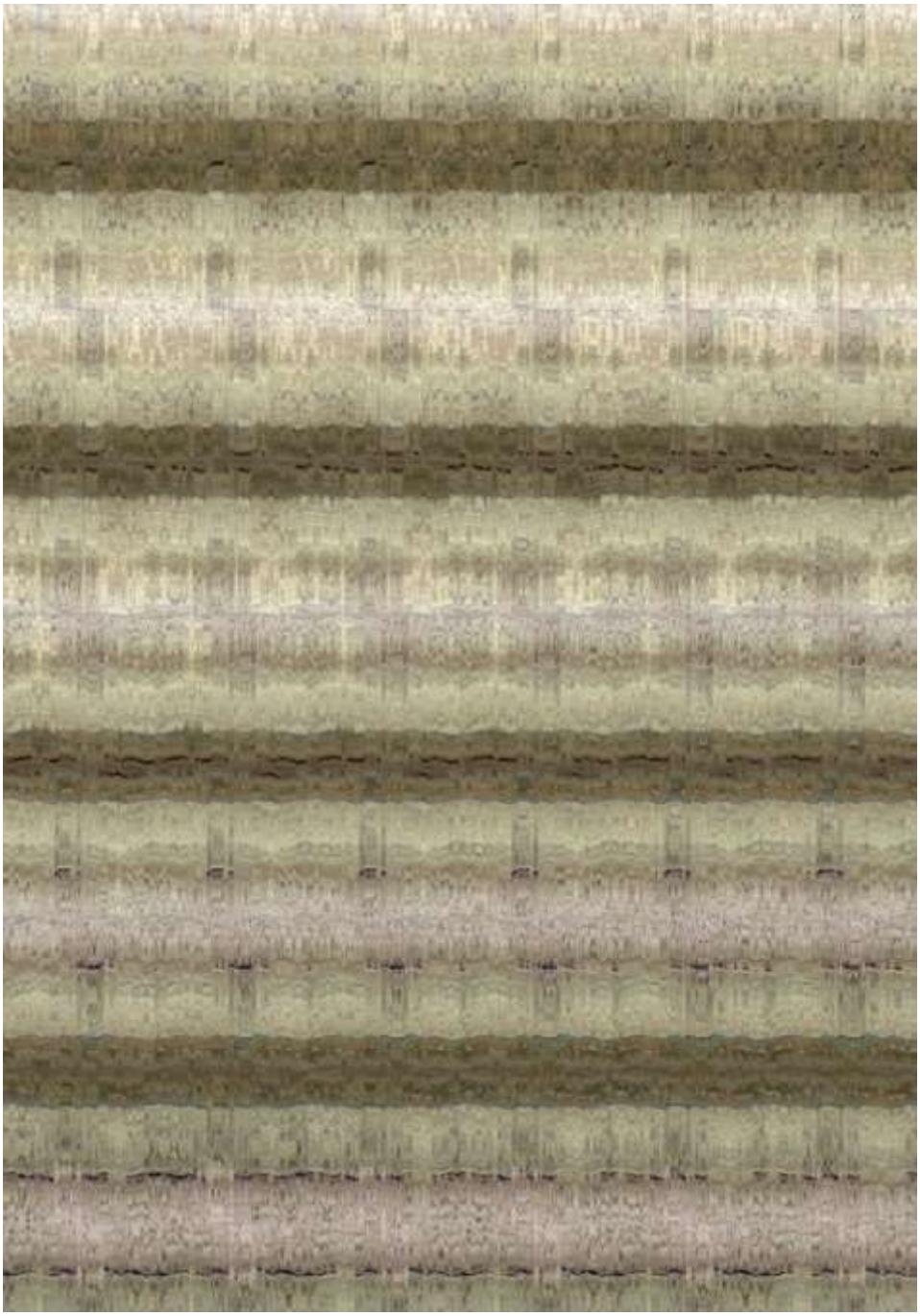


Figure 4.42: Texture created from the viewed materials, wood

Figure 4.43: A comparison between a static and a ‘shaky’ hand movement video input

Figure 4.44: Video TY of a fork

Figure 4.45: Video TY of wood

4.5.3.2 Subject matter

This extra layer of hand movement not only creates an organic aesthetic, but also introduces the experiment to wider subjects. A static subject in strip photography is either presented as stripped background or is similar to its original look as in a panoramic view. This is because the relative movements in strip photography happen either between static subjects and a moving camera fixed on a tripod or between a moving object and a static camera. However, in my *Cubic Film* project, a test video of buildings and food results in different patterns. For example, frames created from the video of buildings are full of geometric shapes (Figure 4.46). In these frames, the triangles are created from the roof, and the complex dark squares result from the variety of windows provided by location and proposition. Last, the brick adds the knitted line to the image. On the other hand, the frames created from the video of food are colourful and more organic (Figure 4.47); the frames created from the video of water in a glass are ambiguous and fluid (Figure 4.48), and the frames created from the video of painted wood are delicate and dynamic (Figure 4.49).

On a slightly different tack, some experimental film is not shot for the audience to watch but to listen to, for example, as in the case of Guy Sherwin's *Railings* (2007). As discussed in the Contextual Review, Sherwin's video was intentionally shot to be converted into sound, using the camera like a stick and "clattering along the railings", so the video TY and XT is very different from other output videos (Sherwin, 2007, p.55). Since varying the exposure alters the volume (the darker the image, the louder the sound; Sherwin, 2007), Sherwin generated sound from a broken image between bright light (the hole between railing) and the dark lines (the railings) created by moving the camera fast

along the railings. Video TY and XT shows the discrete image in lines, while the movement of each line hints at the smooth change of the tone of the sound (Figure 4.50).

Besides the new aesthetic, the experiment provided a method of enhancing the dialogue and observation of our environment, and created outputs which show this dialogue. Through revealing the dialogue, individuality becomes visible and is celebrated not only because of a participant's hand movement but also as a result of his/her choice of subject. Therefore, in project 5, *Walk In Cube*, I encouraged participants to bring their own video for experimentation because I designed my medium to enable the participants to use it freely but also because their choice of video forms a unique Cubic Structure for their own exploration.

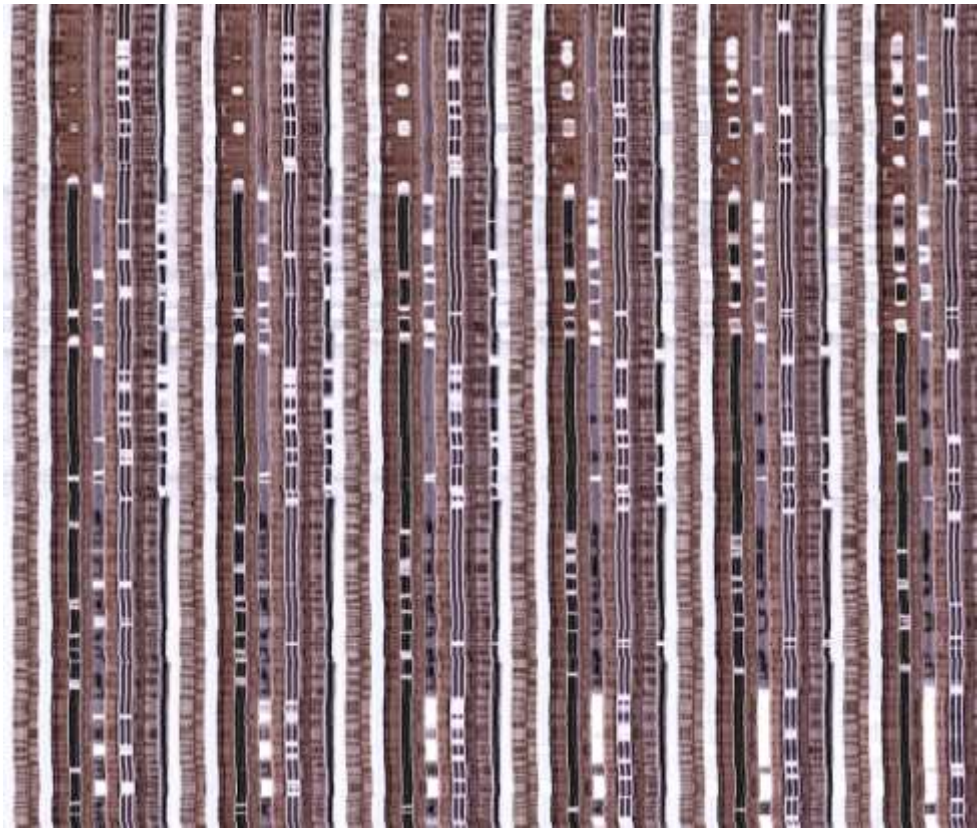


Figure 4.46: Texture created from the viewed materials, building

Figure 4.47: Texture created from the viewed materials, food

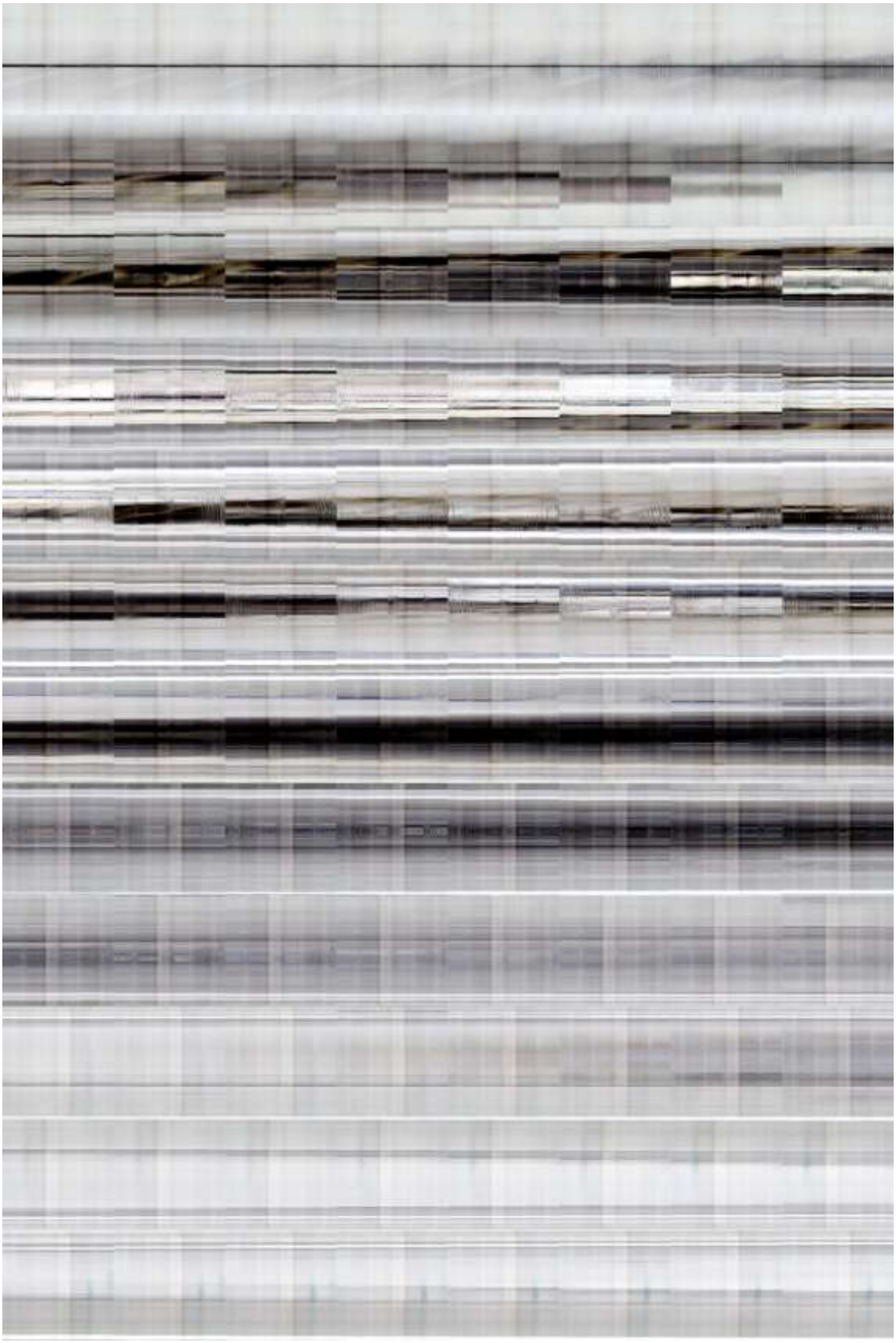


Figure 4.48: Texture created from the viewed materials, water in glass

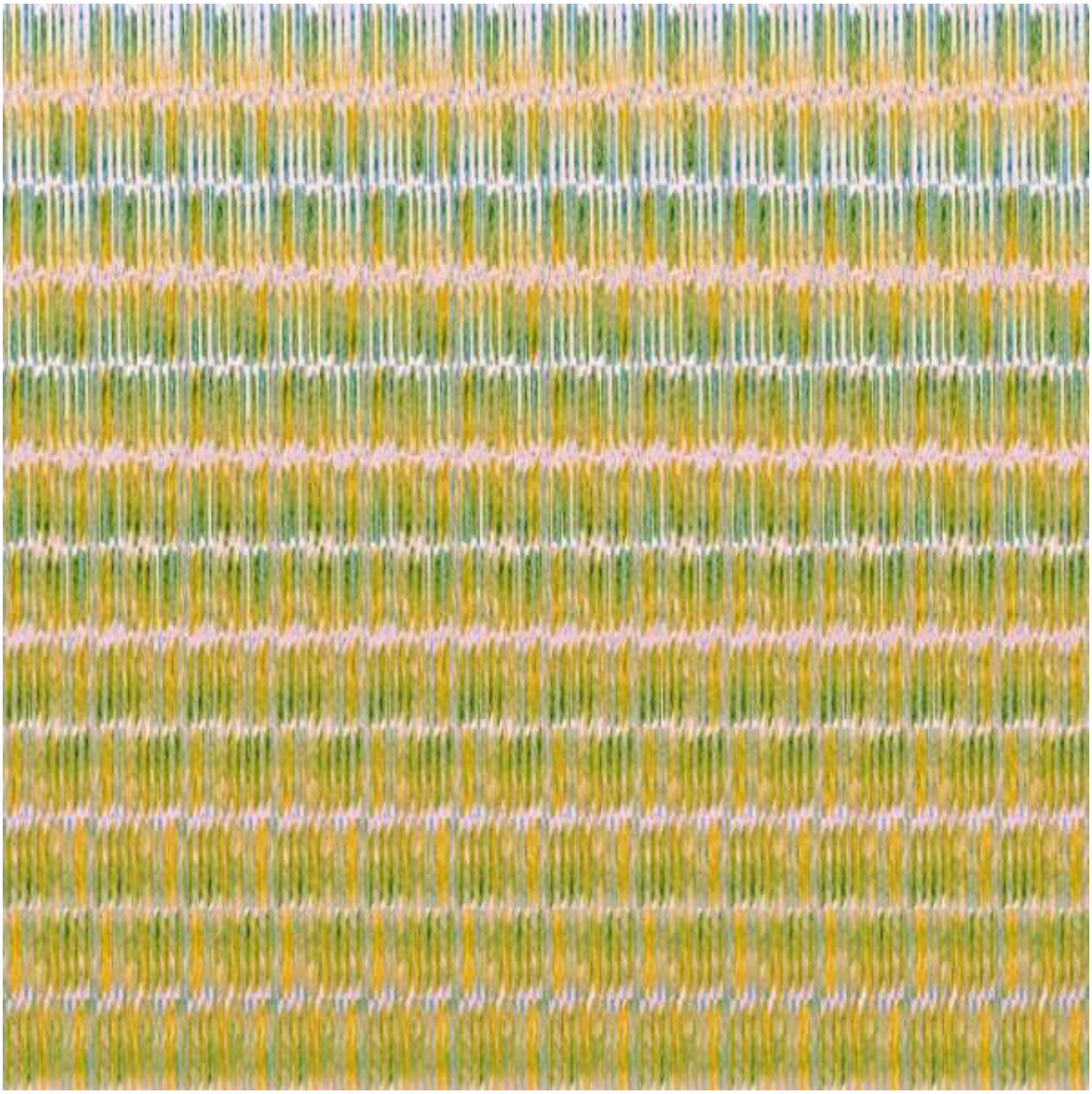


Figure 4.49: Texture created from the viewed materials, painted wood

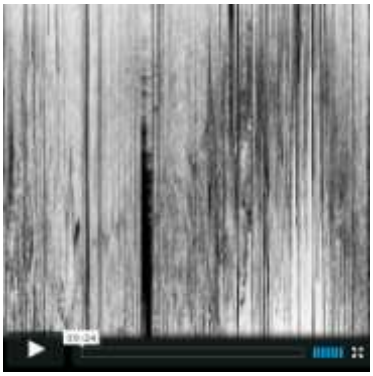


Figure 4.50: Video TY of Guy Sherwin's *Railings* (1977)

While the preparations for strip photography require much calculation (Davidhazy, 1990), in my *Cubic Film* project, the process involved mathematical decisions and also consideration of the creators' own movement. This is where serendipity arises. As Adamson argues, "craft is only existing in motion" (Adamson, 2007, p.4) and, I would add, this is because it requires a human's hands to balance the serendipity.

Jaron Lanier argues that technology is making people lose their individuality: "The deep meaning of the personhood is being reduced by the illusion of the bits" (Lanier, 2011, p.20). While the digital programme is efficient in reconstructing the recorded time/space, as Howard Risatti has argued, the process "has little to do with the material's organic properties", such as the continuity of the real time/space or the cuts in the recorded space/time; however, the hand movements derived from holding a camera provide "special metaphorical qualities", such as the organic aesthetic discussed above, which the viewer understands and appreciates as part of a larger world view (Risatti, 2013, p.305). When craft meets technology, a digital process works together with a human-made action, and the whole process becomes both an approach and an attitude. In this project, I have shown that shooting became the process of cubing reality. My final project, *Walk In Cube*, enables viewers to 'shoot' a recorded video, and thus they become creative participants, actively involved in shaping the outcome of the work.

4.6 *Walk In Cube*

Cubic Film demonstrated that, by integrating film and space, the input video is reconstructed and presented in a new way. Viewers of the video could decide from which face of cube they want to watch a video and in doing so, they could see new things from various perspectives. It also showed that hand movement during shooting can be considered as a way to design the Cubic Structure. *Walk In Cube* further considers this structure in a space like a house and invites viewers to walk into it (Figure 4.51). To explore the second research question further (can the new medium enable participants to create their own ways of navigating video and, if so, how?), I produced *Walk In Cube*, which is the participatory version of *Cubic Film* and has entailed mapping the loaded video cube to the space. Participants can walk around this defined invisible physical cube. I used a Kinect sensor to read information about each participant's body and then created frames to produce the video. Drawing upon my earlier projects, I experimented with three

aspects: the sequence, the angle to enter the cube, and the frame. Later, to answer the research questions, I used participatory experiments and semi-structured interview and questionnaires to elicit detailed feedback from the participants.

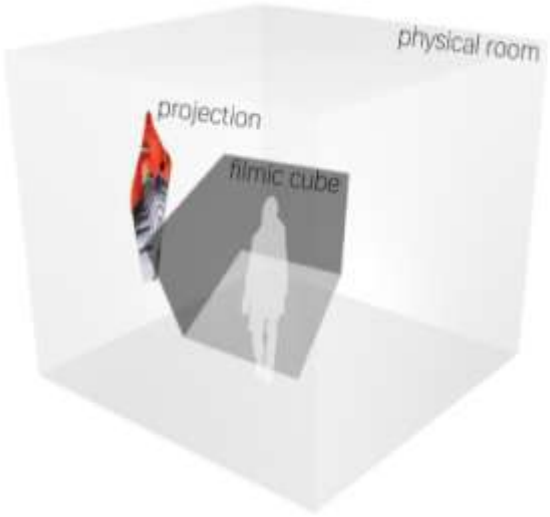


Figure 4.51: An illustration of a participant in the filmic cube

4.6.1 Path as sequence

I first experimented by looking inside the cube (Figures 4.52 and 4.53), and then considered how the movement was connected to the sequence of the input video. When a participant is walking in the cube, their location indicates a specific frame. The participants' movement thus triggers the video to play; when they stop moving inside the cube, the video stops playing. As a result, by simply walking forwards and backwards, the participants use episodic movement to play the video forward and backwards to create rhythm. The participants can also control the speed of the video: if they walk faster, the video speeds up. For example, if in the original video a car is passing the filming camera, the participant can simply move that car forwards and backwards by walking forwards and backwards. The video in Figure 4.54 shows how a participant uses their body to move the video forwards and backwards in sync with the background music (Figure 4.54).

Moreover, in this project, the linear sequence in video TY and XT becomes a non-linear path in space. Participants can move freely and change the direction of their movement. In other words, participants explore the video by walking through it on their own terms. And while it is very difficult to enter the cube from the top because of human immobility

(Vertov, 1923), *Walk In Cube* does allow participants to rotate the filmic cube to choose an angle from which they wish to enter the video (Figure 4.55). In fact, they can do so simply by moving their hands. As a result, they can enter the cube from all angles and can thus navigate through any path in the cube that they choose.

This experiment encouraged the viewers' engagement with the video through the need for them to make a physical effort to create movement as well as the need for them to make decisions about the angle they chose to enter the cube and then their path through the cube to view the video. Viewing became active and participatory, and viewers became immersed participants. The participants' bodies became remote controls, and the engagement with *Walk In Cube* created a strong relationship between each participant and the video content (see Chapter 5).

Figure 4.52: A screen shot from inside of *Cubic Film*: wood

Figure 4.53: A screen recording from inside of *Cubic Film*: wood

Figure 4.54: A screen recording of me moving my body forwards and backwards with the background music

Figure 4.55: A recording of a participant rotating the cube before entering it

4.6.2 Cross-section as frame: Angle

As I have explained, participants could rotate the cube to choose an entering angle, and they could enter the cube from one of its 64,800 degrees (180 [θ] * 360 [φ]; spherical coordinate system). A further interesting question arising from *Walk In Cube* is therefore: 'Does the angle from which one enters the Cube affect the visual outputs?' In *Cubic Film*, I experimented with watching the film along various axes. *Walk In Cube* allows us to develop the question to consider how entering the film from various angles affects the outcome. To keep the experiment precise for the participants, I set the frame flat and the path as a straight line. Before walking into the Cube, participants first used their right hand to rotate it and chose an angle from which to enter. I experimented with the angles that participants used to walk into the *Cubic Film* and evaluated how these affected the output frame and video.

I discovered that each degree lead to a different moving image result. The first difference compared with *Cubic Film* was that the shape of the frame of *Walk In Cube* could not only be square but also a triangle, pentagon and hexagon (Figure 4.56). The changing of these shapes of the frame was smooth because, when participants moved, the path of the centre mass of our body is continuous (Figure 4.57). On the other hand, these frames could be connected seamlessly to form an object, and that object revealed the path of a participant walking in the cube (Figure 4.58). While the path-formed object was similar to the result of Joachim Sauter and Dirk Lusebrink's *Invisible Shape of Things Past* (1995) (discussed in Chapter 2), it delicately revealed not only the path (showing the change of the direction) but also the relationship between the path and the cube (the changing of the shape of the frame). Furthermore, the content of the each frame changed while moving. In the same way that we analysed frame XY, TY, XT above (4.5.2), the change of the

content was created by slicing the *Cubic Film* from various angles and all kinds of distortion happened due to perspective changes (Figure 4.59).

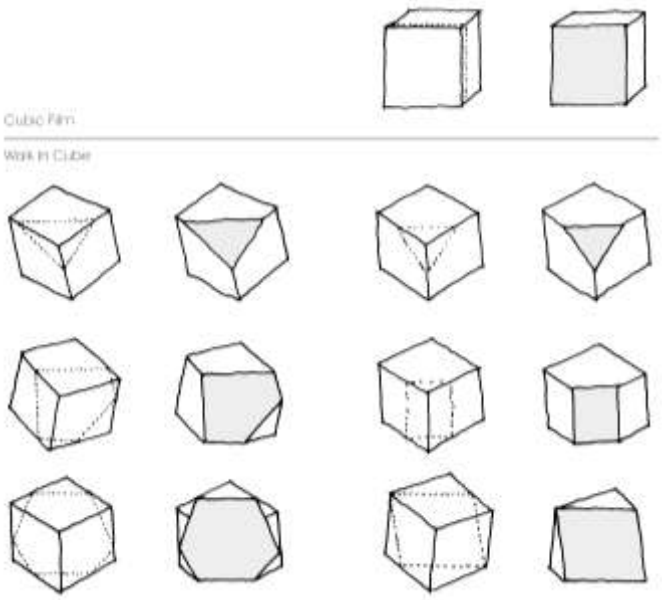


Figure 4.56: Variety of the cross-sections of a cube

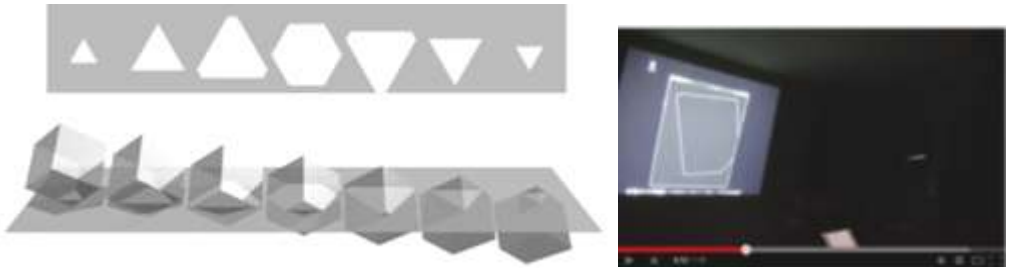


Figure 4.57 An example of the shape of frame changing when a participant walked from one corner to the opposite corner directly, and a recording of the shape of frame changing as a result of body movement

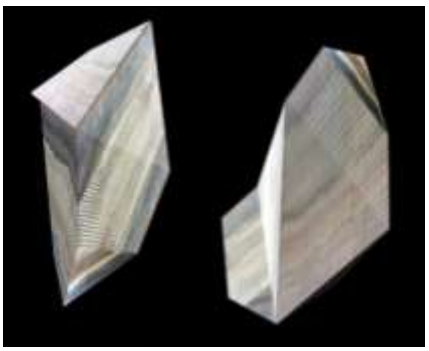


Figure 4.58 Two frame-formed objects showing the participants' paths

Figure 4.59 An output video and frame of *Walk In Cube*: *Mr. Bean at the Dentist*

4.6.3 Three-dimensional frames

If the film is turned into a cube, and if the four corner points of the frame do not need to be on the same plane in the space, why is the frame still two-dimensional? To answer this question, I tested three-dimensional frames in interaction, using body location and movement to create moving image. For example, I covered a participant with a digital bi-pyramid shape, so that when he moved, the bi-pyramid frame moved and changed (Figure 4.60). As a result, a single time point in the original video appeared in each bi-pyramid frame as four connected lines like an imperfect rhombus, which led to interesting visual effects similar to those produced by a kaleidoscope.

I discovered in the previous project, *Cubic Film*, that an output frame can contain more than one time point, but only with three-dimensional frames can each single time point appear as a shape rather than a line. As a result, the time sequence could be designed to create patterns. For example, if the frame is a sphere, the shape of each time point is a circle (Figure 4.61). A three-dimensional frame cutting through a single time point can make it appear as one. Therefore, making a time point appear more often means that the more times a frame cuts through a single pixel or a line of pixels, the more the frame becomes curvy. In short, the form of a three-dimensional frame is like a three-dimensional glass which creates perspective distortion from what the participant sees.

Figure 4.60: An output video of *Walk In Cube*: pineapple with bi-pyramid frame

Figure 4.61: Four outputs of *Walk In Cube* with sphere frame

4.6.4 Body as a frame: shooting with body

To further the investigation of the relationship between frame and body, I looked at the body as a frame. I considered the human skeleton as a form of frame, with the latter being like a cloth worn on the body and able to move with the body. In order to gain the most content, I also added triangles to extend the frame to the boundary of the cube (Figure 4.62).

As a result of the above, the distorted content in the *Cubic Film* could be created intuitively by the participants' body movement. Since the organic movement of the human body easily formed endless shapes of the frame, the output could offer much more variety than was possible through *Cubic Film*. When participants used their bodies to

view the recorded video and to manipulate the frame, viewing became an act of shooting and participants could see through creating.

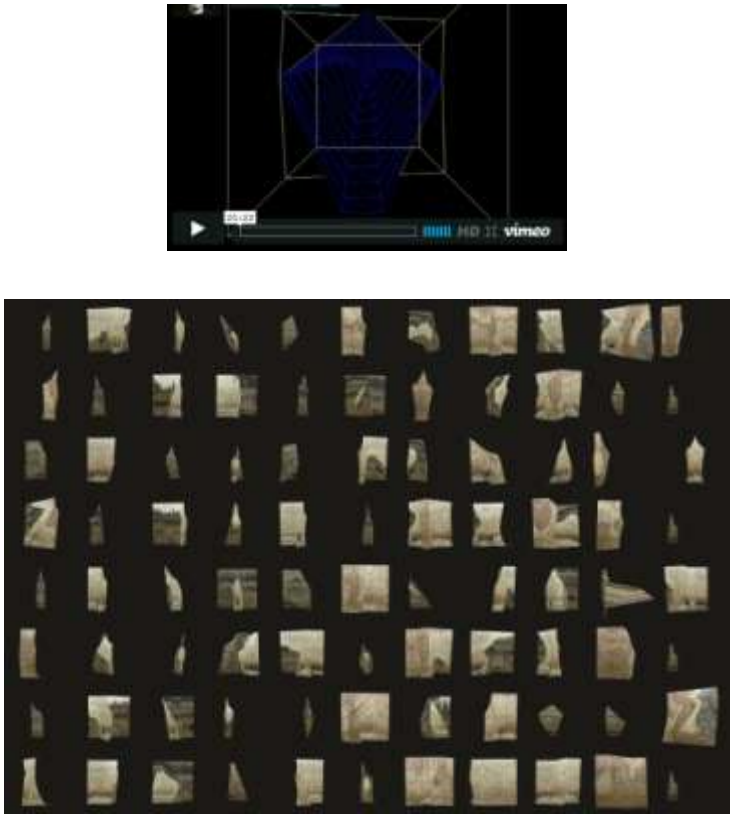


Figure 4.62: A screen capture and a collection of screen captures of a participant walking in the cube with their skeleton-data-formed frame

4.7 Summary

In this chapter, I have discussed two exploratory projects and three substantive projects. The first two set the direction of my research into participatory cross-media. With *To Be Different*, I discovered that cross-media (film and space) allows people to look at information from different perspectives and explore the content piece by piece. It also empowers the audience as individuals and enables their self-development by providing context whilst allowing them to make their own decisions. This led to a redefinition of the initial proposal divided into two related research questions: (1) can I integrate film and space to design a medium to view a video from various perspectives? (2) If yes, can the new medium enable participants to create their own ways of navigating video and, if so, how?

To answer the first question, I introduced my third project, *Hand Painted Film Plus*, through which I deconstructed the filmstrip (gaining a deeper understanding of frame and sequence) and reconstructed film strip (transformation between linear film strip, two-dimensional image, and three-dimensional space). I found that forming a space from a video through layering frames was not only technically much easier than through connecting the inputted content shot by the participants, but also allowed all existing videos to be transformed into cuboids (embracing wider subjects). As a result of this development, I built project four, *Cubic Film*, which integrated film and space.

I analysed the inputs and outputs to understand the process of deconstructing the input video and reconstructing the output, to discuss how the recorded time and space is disrupted, and to examine what new information and aesthetic was revealed through the process. This helped me to then experiment with ways to integrate viewers into the process and thus see new information through creating new ways of seeing in the fifth project, *Walk In Cube*, which addressed the second research question.

To answer the second question, I conducted my second project, *Grid 9*, to explore the difference between drawing and using a digital interface for participants, especially in terms of their expression and reflection on their creating experience. As a result, through all the main projects, I sought to integrate the intuitiveness of the participants' hand movements with the generative power of the digital interface.

In the third project, *Hand Painted Film Plus*, I explored using the camera as a brush, and discussed the relative movement between the moving body and the filmed subject. I found that the interaction between body movement and the shape of the shooting subject could create unexpected results.

With the *Cubic Film*, I explored how the unexpected results from hands could be combined with the *Cubic Film* system. I found that shooting became the process of cubing the reality. In other words, the shooting process can be considered as a process to design the interior space of the cube. Also, the viewer of the video could decide from which face of the cube they wanted to watch a video and see new things through exploring the video from various perspectives. *Walk In Cube* allowed me to continue this exploration of, and discussion about, the relative movements between subject and body movement, with the subject as the inputted video (Appendix N). I connected body

movement with the frame. With the camera lens replaced by the human body, the movement of the latter became the means of creating and seeing. As a result, the linear sequence of film became a non-linear path; the two-dimensional frame became a three-dimensional cross-section (showing multiple time points and perspectives simultaneously), and viewers of the inputted video were forced to move their bodies to create what they saw and thus became fully engaged participants (Figure 5.63).

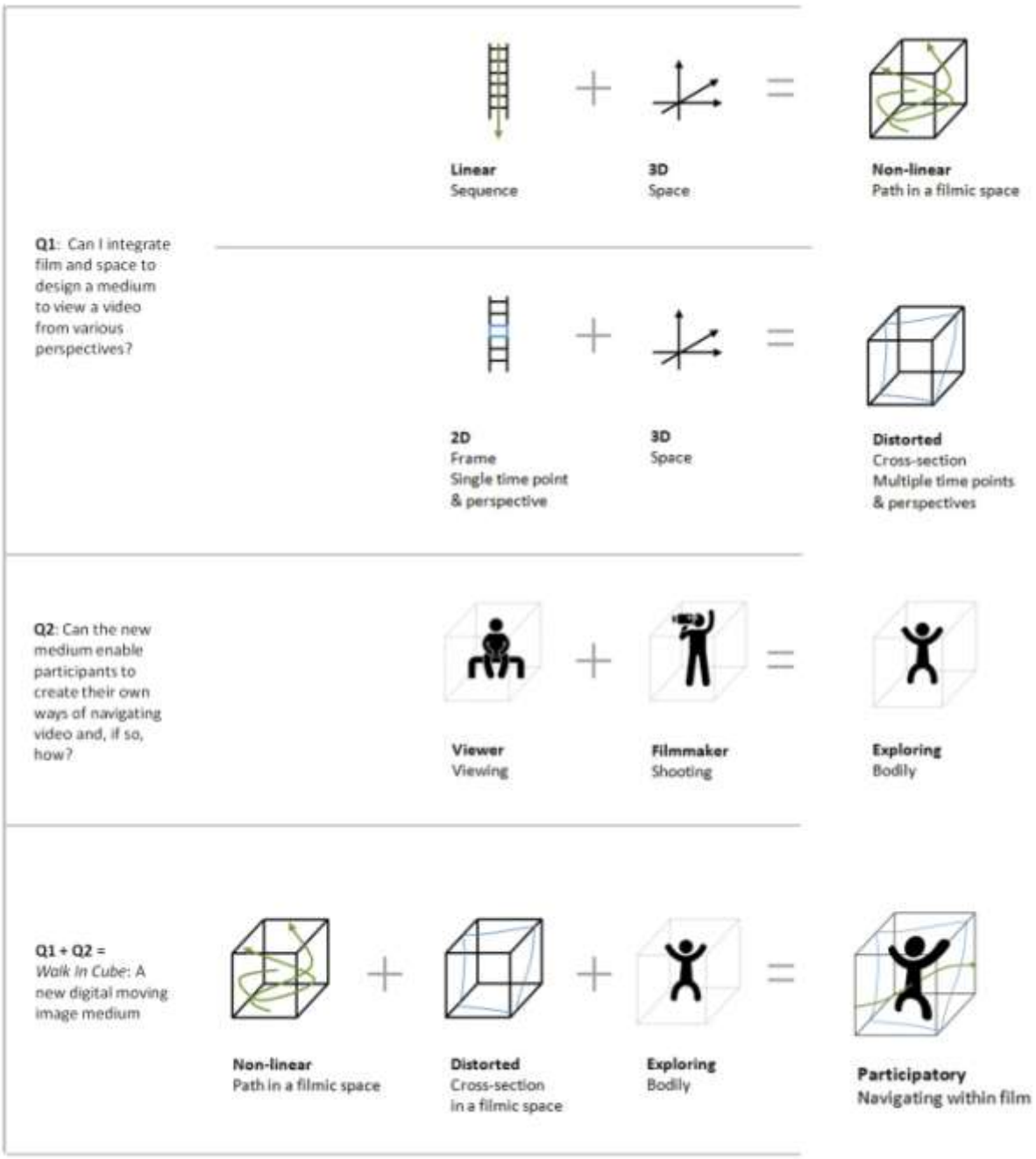


Figure 4.63: *Walk In Cube* enables the viewer to become a participant through integrating film and space

5 Evaluation

5.1 Introduction

In the previous Chapter, I presented the process through which I designed *Walk In Cube*, by integrating film, space and the participant. To answer my first research question, "Can I integrate film and space to design a medium to view a video from various perspectives?" I evaluate in this Chapter whether *Walk In Cube* met the aim outlined in the Contextual Review (Chapter 2), to enable participants to see new things and to make new ways of seeing possible. In this Evaluation Chapter, I examine the potential for generating new visual outputs with *Walk In Cube*, and assess whether the medium enables people to explore a video from new perspectives and see the video in new ways. To answer my second research question, "Can the new medium enable participants to create their own ways of navigating video and, if so, how?" I evaluate whether and how *Walk In Cube* is participatory, and how it may enable individuals to create their own ways of seeing and experience moving images by using their bodies.

For *Walk In Cube*, I draw upon the qualitative data from the semi-structured interviews with participants and the qualitative and quantitative data collected from the participants' questionnaires. I use an autoethnographic approach to describe my experience of designing *Walk In Cube* from the perspective of a designer.

The supporting videos can be accessed in the attached DVD.

5.2 Methods for evaluation

To collect the results and better understand participants' experiences of using *Walk In Cube*, I asked fifteen participants to prepare their own videos and experiment with them. I chose this method for three reasons:

1. First, regarding a medium, in reality, people should be able to input whatever they want and the subject should not be limited.

2. Second, since the original film was the individual participant's own video, I assumed that they would understand and be familiar with the content. Therefore, it would be easy

for them to compare the *Walk In Cube* output with the original video, and reflect on the creative and learning process.

3. Third, as was discussed in relation to input video subject matter above (Chapter 4, section 4.5.3.2), this widened the variety of the input subjects. Since the participants were from different social and cultural backgrounds with different interests, they could provide a range of videos that I had not previously tested.

I also asked a random sample of seven people at the Royal College of Art to join the experiment. They chose the videos to enter into *Walk In Cube* from a selection of seventeen videos, fifteen of them prepared by the previous participants. The total number of participants for this experiment was therefore twenty-two.

I asked the participants to use *Walk In Cube* three times each. After each iteration, the participants answered a set of questions directly from the questionnaire. As was discussed in Chapter 3, the questionnaire (see Appendix G) was designed to encourage participants to reflect in writing on their experience of *Walk In Cube* without my intervention. The first question enabled me to understand the participants' chosen subjects and why they chose them, and to familiarise each participant with the content of their chosen video, so that they could instantly recognise the difference between the input and the output video. The first iteration involved my own videos to prepare the participants for the interactive environment. The second question was designed to encourage them to reflect on their experience of using *Walk In Cube*. The second iteration enabled the participants to use their own video to see how it could be changed through *Walk In Cube*. Hence, the third question sought to identify their subsequent experience of the medium and specifically, the difference between the input and the output video. The third iteration encouraged the participants to try entering the cube from a different angle and also to apply what they had learnt in the second iteration to create their own video output. The fourth question, therefore, asked the participants to identify their methods to create the video, explain perceived differences between the input and output video, and document the relationship between the methods and the video output. I then asked the participants to evaluate their overall experience and, specifically, determine whether the medium made new ways of seeing possible. In short, the questionnaire covered the participant's general experience, what they had learnt and applied, what new things they had discovered in their video as a

result of using *Walk in Cube*, and how they evaluated described *Walk In Cube* as a medium.

A single participatory experiment session took between 60 and 90 minutes. Each video took four minutes to be loaded, during which time I discussed the experiment with the participants and talked with them about their experience of the previous iteration. The semi-structured interview method helped me to understand their thoughts correctly and systematically, and to clarify the points raised in their questionnaire responses. I audio recorded the conversations to ensure that they were fully documented for subsequent analysis. The video recording of experiments provided data for later observation between the screen and participants' movements, and to confirm my in-situ observations (Flick, 1992; Webb, Campbell, Schwartz and Sechrest, 2000).

Documentation included a questionnaire (Figure 5.1), my notes, audio recordings of the semi-structured interview, and photos and video recordings of the participatory experiments, showing participants' movement and the live visual output on the screen (Figure 5.2). In the following discussion, I present *verbatim* quotes from the questionnaire and semi-structured interviews, accompanied by non-edited scenes from the video recordings.

I employed thematic analysis to identify common themes and capture the intricacies of meaning within the rich textual data from semi-structured interviews (Guest, MacQueen and Namey, 2012). To interpret these meaningful parts to develop themes and thematic co-occurrence, I used keyword and sentence sorting (Berg, 1948; Figure 5.3; see Appendix K). I also used thematic networks to graphically display relationships between themes and the raw data (Attride-Stirling, 2001; Martin and Hanington, 2012). The basic themes in the networks are text segments derived directly from the textual data and are considered together with other basic themes to elaborate a fuller story. The organising themes are what Martin and Hanington (2012) define as "middle-order themes" and serve to organise basic themes into clusters, enabling me describe the characteristics of the medium. The global theme distills the overarching points from the participant's text and helped me highlight the participant's experience.

The findings from the textual data also helped me understand the participants' experience. I further synthesised the findings with the data captured from other methods for a holistic

evaluation and explained why particular themes are more useful for new knowledge contribution (Braun and Clarke, 2006). I presented data from scale questions for non-video subject-related questions to understand the common experience of body movement. See the Appendices for copies of the original questionnaires (Appendix G), results of scale questions (Appendix J), and the participant permission form to enable me to use the recorded photos and images (Appendix F). The non-cut video recordings can be viewed upon request from the author. I also used a comparative method to understand the relationship between inputs and outputs (Appendix H), and to identify patterns among the interconnected events.

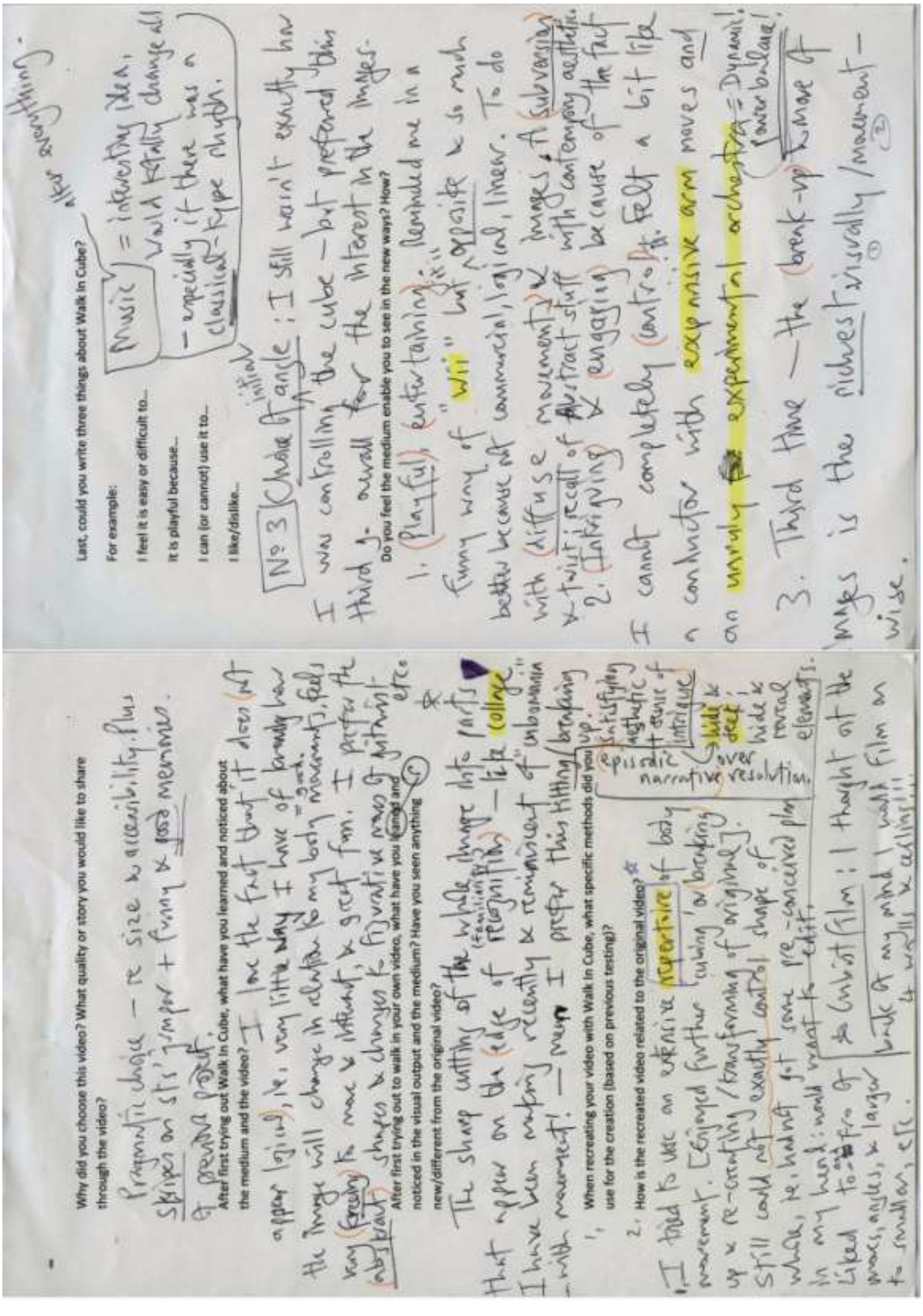


Figure 5.1: An example of a completed semi-structured questionnaire by participant 1

Figure 5.2: Photos showing participants' movement and the live visual output on the screen

Participant(s)	**About *Walk In Cube***
	Quality of the experience
2, 4, 5, 6, 7, 8, 11, 13, 14, 15 21, 22	Bodily Engaging
1, 2, 7, 10, 11, 13, 14, 15	Playful
1, 6, 2, 10, 11, 12, 5, 7,	Intuitive
4, 6, 9, 13	Dynamic
4, 14, 11	Disorientated
3, 7	Immersive
5, 12	Rhythmic
5, 7	Responsive
	Exploring
3, 4, 5, 6, 11	Unpredictable
1, 4, 6, 11, 13	Mix with control level
5, 6, 14, 15	Infinite of possibility
1, 5	Not logical
	Creating
1, 3, 4, 7, 13, 14, 22	Abstract
1, 3, 5, 12, 14, 21	Creative
5, 8, 13	Distortive, Entangle, Twisted
13, 14	Realistic
5, 15	Flashy
12	Deconstructive
10	Mix abstract and representational
6	Recognizable
4	Layered

Figure 5.3: Example of the key word and sentence sorting of the textual data from the *Walk In Cube* semi-structured questionnaire (see Appendix K for full documentation)

5.3 Seeing new things

To evaluate whether *Walk In Cube* meets the definition of a medium, I first discuss here whether I can integrate film and space to design a medium to view a video from various perspectives, and focus on the possibility of generating new visual outputs by integrating film and space. I begin by presenting the textual data and then synthesise these with the data retrieved from other methods (e.g. photos and video recordings). Below are a selection of pertinent, *verbatim* quotes from the semi-structured interviews and questionnaires, grouped into four thematic clusters.

1. Participants saw new things, such as patterns in the video using *Walk In Cube*:

"**Unpredictability** of the outcome, the apparent infinite variety of patterns that are possible to create. [...] revealing glimpse of the networking [of the original] all at once" (Participant 3).

"The *Walk In Cube* allows me to experience videos in a completely different way by making me **see things I would never have noticed** [...] because of their unusual position and shape" (Participant 11).

"See **new patterns** through finding and playing" (Participant 15).

2. Participants mentioned that the familiar parts in the video became unfamiliar:

"The sharp cutting of the whole image into parts that appear on the edge of recognition (**familiarity**) — like collage. [...] the break-up and movement of images is the richest, visually/movement wise. [...] to do diffuse movements and image, a subversion and twist; recall of abstract with contemporary aesthetic" (Participant 1).

"The video was sped up and reversed when I walked fast and backwards. The video cut in the original video has been revealed in different dimensions. The video is distorted from different **perspectives and the proportion of it has been changed**, so the familiar becomes unfamiliar" (Participant 5).

"The meaning and the feeling of the video has been **distorted**" (Participant 7).

3. Participants noted that the depth of the space in the video became conspicuous and layered, and tried to manipulate it:

“The **folding and manipulating of space** is very interesting and different. [...] Space is being rearranged” (Participant 2).

“It enhances parallax. **Depth becomes layered**. Foreground against background makes non-perspective” (Participant 4).

“The **depth** of the sky **can be manipulated**. Even they [the clouds] are abstracted, they remain recognizable. [...] The abstraction of the film form leads me to question the material nature of the cloud/sky [which is participant 6's video subject] in ways I hadn't considered previously” (Participant 6).

“The output video becomes more dynamic and animated because **2D video becomes 3D** or more [...] I started to notice the environment and the movement in the original video [...] The video becomes like a cave. I am curious what is inside” (Participant 9).

“The film **space has been re-imaged**, a mix of representational and abstract reality” (Participant 10).

“The **space has been expanded**. [...] The output video looks like as the input video is soaked in the water. [...] I see new visual possibilities. More than half of the output is different from the original video” (Participant 14).

4. Participants realised that the sequence of the original video can be remixed, and noticed that time and space are distorted simultaneously:

“Different frames of video are **entangled** and **twisted together**” (Participant 8).

“**New time line** has been **created**. I see a panoramic view of the original” (Participant 12).

“The speed of the video has changed by my body movement. [...] I cannot predict the output. I have to explore. [...] I like the new **combinations of the not connected part** in the original video” (Participant 13).

"I **link the different scenic image** as a special and new sequence. [...] The video becomes a tunnel" (Participant 21).

Each of the verbatim remarks can relate to more than one cluster and I use thematic networks to display the organisation of the verbatim remarks (Attride-Stirling, 2001; Martin and Hanington, 2012). Four organising themes emerged: (1) new possibility, (2) the familiar becomes the unfamiliar, (3) space rearranged and (4) time rearranged. I then grouped the four organising themes so that they formed a higher order premise. Therefore, the summary of the underlying text is that *Walk In Cube* enables participants to see new things and makes the familiar become unfamiliar by allowing them to rearrange the spatial and temporal relationship in the original video (Figure 5.4). The summary from the textual data helps me understand each participant's experience of seeing new things. In the following part, I further synthesise the findings with the data captured from other methods for a holistic evaluation.

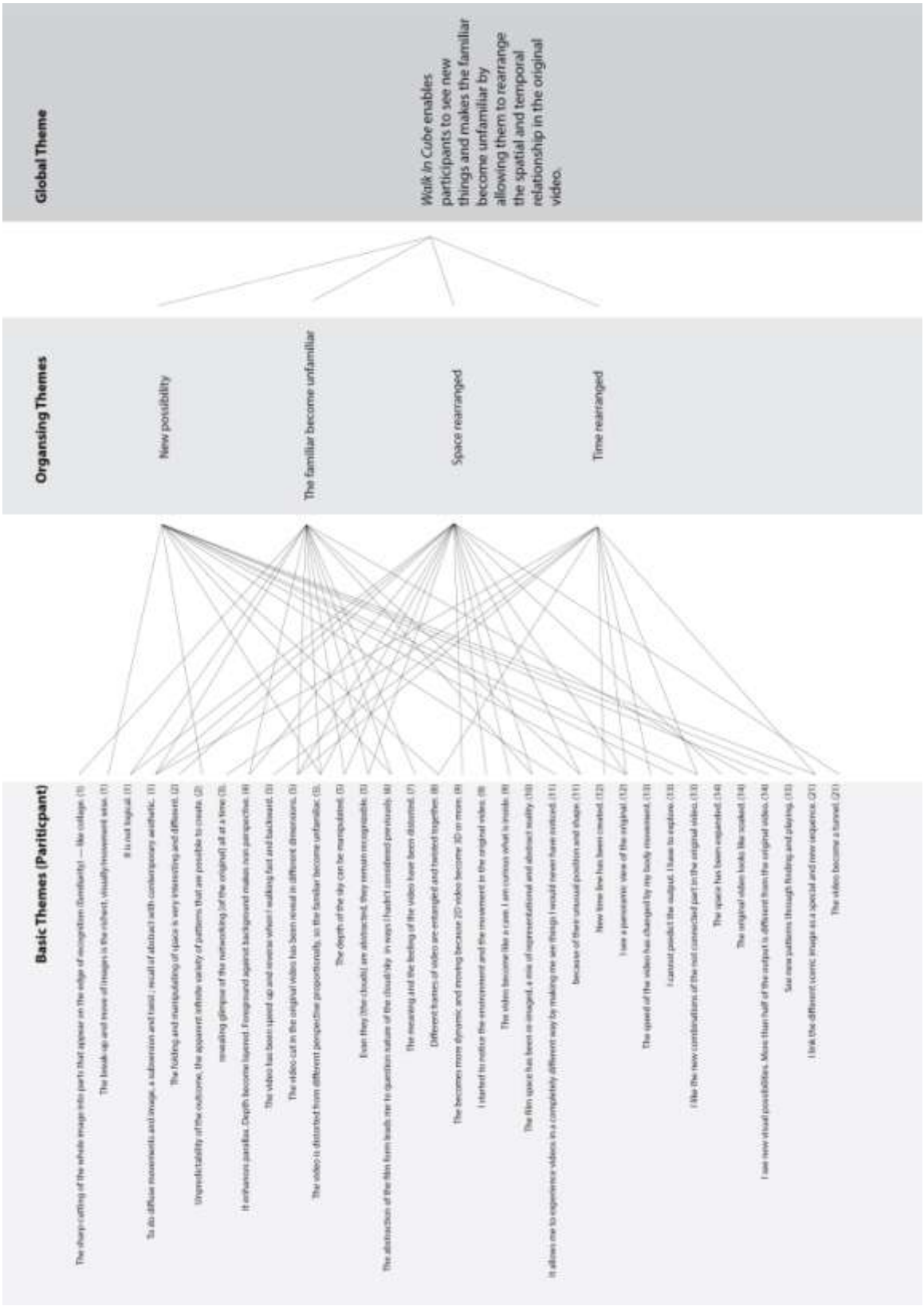


Figure 5.4: The thematic networks showing participants' experience of seeing new things

5.3.1 Body as frame: new possibilities

There are roughly 22,079,417 (180 [degree] x 180 [degree] x 618.48 [the average length of the line through the middle of the cube]) different cross-sections cutting from all perspectives of a cube, which is made up of 576 pixels on each side. Once two-dimensional frames have been released in a space (four corners of the frames do not need to be fixed on a plane) and become three-dimensional distortable cross-sections in the cube, *Walk In Cube* provides an opportunity to mix these 22,079,417 cross-sections by using human body movement. As a result, the participants could easily create unexpected patterns and movements by making a collage with all of the components throughout the video regardless of the components' previous temporal and spatial location in the original video.

The participants' bodies thereby served as the instrument to construct a new relationship with the deconstructed existing components and freed them to explore the video through creating their own new results. For example, an abstract animation, which was captured from *Asdfg* (Heemskerk and Paesmans, n.d.), contains three parts of various types of lines (Figure 5.5), which are mixed and generate unpredictable patterns. During the semi-structured interviews, Participants 5, 6, 14 and 15 said that *Walk In Cube* showed infinite visual possibilities. The mix between abstraction and representation creates endless possibilities and multiple interpretations (Figure 5.6 and 5.7). Participant 6 said that, "the way the image is abstracted changes dramatically based on the angle of the cube".

Figure 5.5: A video and image example of *Walk In Cube* with *Asdfg*

Figure 5.6: A collection of *Walk In Cube* frames of *Railings*

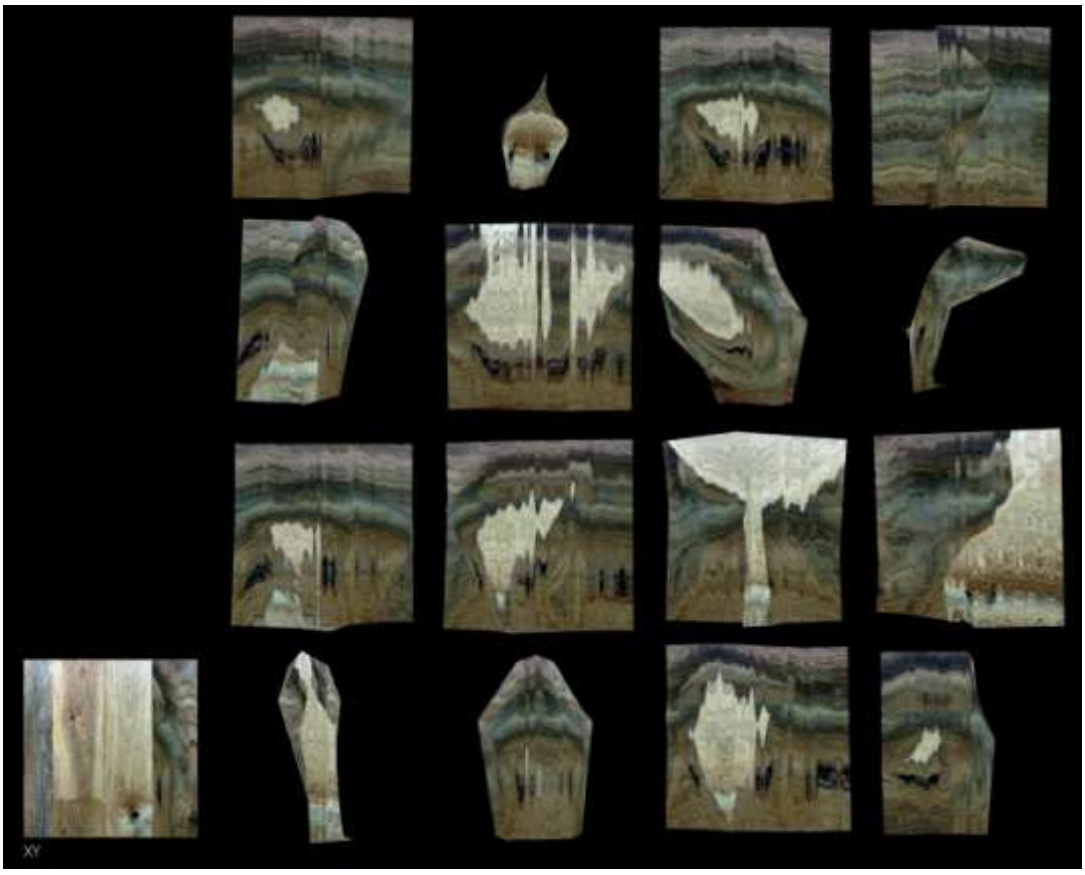


Figure 5.7: A collection of *Walk In Cube* frames of wood

In addition, the participants confirmed that *Walk In Cube* not only creates unexpected patterns but also new sequences. If they inputted a figurative animation with a simple background, the unpredictable combination of the patterns could lead to a new sequence (Figure 5.8). For instance, take a moving images output of people on the street bending towards the ground, something that does not exist in the original video (Figure 5.9): by simply bending their bodies into a slight curve, participants could form a three-dimensional frame that combines parts of different original frames. Consequently, characters that did not appear on the same frame in the original video appeared simultaneously. Moreover, any point on the human body can create a continuous line when moving and the cross-section created by the human body is always a continuous curvy frame, so when this frame moves, the changes between the recently-connected characters occur smoothly with the effect that the sequence is designed. As Participant 13 noted, "When I understand the time sequence, based on what I have learnt, I start to create a new output".

Another example of disrupting the recorded spatial and temporal relationship is that if the input video has cuts (break in time relationship), in video TY and XT, the cuts become the separation of the space in the projection. In *Walk In Cube*, practically speaking, participants will not be able to walk totally straight without any shaking of the body. For example, the cuts in the previous video could become a special visual language (Figure 5.10). Therefore, a cut becomes a line, which moves as the participant moves. In *Walk In Cube*, everything in the video becomes a malleable pattern, and there are no breaks of time in the output. Participant 3 said that he was surprised to get such a smooth video from a very disturbed and abstract input video, affirming that, "It provides a speculative illustration of what lies beyond the image". In short, when two-dimensional frames become three-dimensional distortable cross-sections, *Walk In Cube* not only connects recorded space, but also the recorded time.

Figure 5.8: A video example of *Walk In Cube* with a figurative animation

Figure 5.9: A video example of *Walk In Cube* with a street video

Figure 5.10: A video and an image example of *Walk In Cube* with an input video with cuts

5.3.2 Multiple perspectives: the familiar becomes unfamiliar

As I explained in Chapter 4, with *Cubic Film*, each frame of video TY and XT reveals multiple time points from the same single angle (shooting in the same direction). Further, through experimentation, the distortable three-dimensional frame in *Walk In Cube* reveals multiple time points and perspectives simultaneously.

As a result, the context of the video is much more noticeable because of the distortion, the unusual displacement, and the appearance/disappearance of the original content due to the participant's movement. For example, Participant 11 said that, "the stop sign in the video

has been distorted, and placed in the centre of the video, so becomes more noticeable" (Figure 5.11). Participant 10 highlighted the fact that she did not notice that her friend's cat had white feet until she "walked" into the video with *Walk In Cube*. Participant 7 said that he noticed that the carpet had a distinct blue pattern, which he was not aware of, even though it is always present in the original video (Figure 5.12). Participant 17 commented that, "I felt the stop sign becomes noticeable because it moved in and out repeatedly in the new video because of my movements. This is not directly related to the distortion of the original content." *Walk In Cube* thus makes the participant more aware of the video content – the previously neglected or ignored often becomes noticed for the first time because the familiar is presented in unfamiliar ways.

Figure 5.11: A video example of *Walk In Cube* with a video of driving on a road

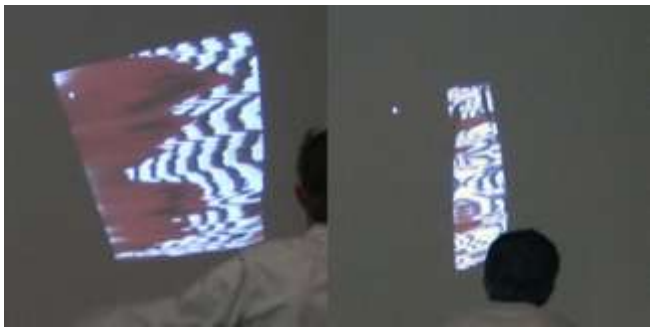


Figure 5.12: Frames of *Walk In Cube* with a video of a baby on a carpet

Participant 4 noted that, "The perspective is gone". For example, with a long shot video of a natural subject such as clouds in the sky (Figure 5.13), the depth of image was extensively manipulated by the participants. They felt that they could expand or reduce the space between the layers. This gave them a surreal experience in which they felt that the natural environment was changing in ways that they had not experienced before. Another example is that with a video of faces, the participants felt like they were walking into a house of mirrors (Figure 5.14). In summary, *Walk In Cube* revealed multiple time points and perspectives simultaneously, and led to a new experience of actively mixing of the figurative and the abstract as participants moved through the cube.

Figure 5.13 A video example of *Walk In Cube* with a long-shot video

Figure 5.14 A video example of *Walk In Cube* with a close-up shot

5.4 New ways of seeing

I have shown that *Walk In Cube* enables participants to see new things and that it makes the familiar become unfamiliar by allowing them to rearrange the spatial and temporal relationship in the original video through their body movement. To answer my second research question, "Can the new medium enable participants to create their own ways of navigating video and, if so, how?"I now evaluate whether *Walk In Cube* enables people to explore a video from new perspectives and see in *new* ways. I first present the textual data and then synthesise these with the data retrieved from other methods (scale questions and photos and video recordings). Below are a selection of clustered verbatim comments from the semi-structured interviews and questionnaires.

1. Participants considered the importance of their body movement to shape the video (see also Figure 5.15):

"It is like an **extensive repertoire of body movement**. I enjoyed further 'cubing' or breaking up and recreating/transforming the original video. [...] It is playful, not logical; intriguing, and dynamic because of the fact that I cannot completely control it" (Participant 1).

"It is very **playful** [...] like **origami** [...] it enables you to experience space and move in different ways — in a full body way [...]. It feels like I am **flying through** the space" (Participant 2).

"It is like a **wrapper blown against your body** and so by moving in the wind you can change its form. You can fold it, but not by the usual idea of folding with your hands but applying your whole body and moving (your arms)" (Participant 4).

"It [*Walk In Cube*] responds to the body or the **body respond to it**. You start to forget. [...] I not only see an image/film from different angles, but manipulate a set of images and the frame of them" (Participant 7).

"The way the image is abstracted changes dramatically based on the angle of entering the cube. [...] I not only **communicate** [change] with the content but also the frame [...] It [*Walk In Cube*] made me think of my body in terms of a **foldable surface**" (Participant 6).

"This is a new experience of manipulating a video. It is like moving **a sheet of paper**" (Participant 15).

2. Participants described their experience as exploratory, playful and recreational:

"It is an original and alternative way of visualizing video. It provides a **speculative illustration** of what lies beyond the image. There is an element of narration that invites you to discover the implications what an image is (video tend to be taken for granted these days)" (Participant 3).

"I have **no pre-determined** movements. [...] It is **playful** and accessible to everyone through the movement of their bodies. [...] I like using it [*Walk In Cube*] to **control** the onscreen environment" (Participant 10).

"I can play [the video] with my body backwards and forwards, **even in different directions**" (Participant 9).

"It feels more real than conventionally watching a video. I feel like I **literally walk into** the video. [...] I can find certain information at a specific 3D location in the space. [...] It is **playful** because you can 'play' a video, not just watching it" (Participant 13).

"I felt the forms and shapes I created motivated me to **experiment** with new bodily movement and rhythms" (Participant 18).

"I use my body to sculpt and modified the original video. As a professional video maker, it encourages me to **explore** new ways of creating videos" (Participant 12).

"I enjoyed participating in the abstracted animation. It feels like a dynamic process partly like **painting** and partly like swimming. It has a **relaxing** effect and potentially could be used for a kind of **creative therapy** or rehabilitation" (Participant 21).

3. Participants noted that the body controls the video:

"The shape of the subject changes with my body. It follows my movement and rhythm. My body is acting like a **remote controller**" (Participant 5).

"The most fascinating part is that transition of different plots [in the video] can be speeded up or slowed down by the speed of shift of (my) position. [...] Users can adjust or **control** the created video by movements instead of conventional device like keyboard etc [...] which can give users more feelings of involvements" (Participant 8).

"It is **playful** because you actually feel like an **active user** of the video rather than a passive viewer [...] It [*Walk In Cube*] is like a narrative story pool. An input story can be viewed in many perspectives" (Participant 11).

"It is easy to use my body to manipulate the image. I can '**draw**' or '**wipe**' to get new images" (Participant 14).

Each of the verbatim comments can relate to more than one cluster and I use thematic networks to display the organisation of the verbatim remarks (Attride-Stirling, 2001; Martin and Hanington, 2012). Three organising themes were evident: (1) engaging the full body, (2) exploratory, and (3) actively participatory. I then grouped the three organising themes so that they formed a higher order premise (Figure 5.16). Participants showed that *Walk In Cube* encourages them to explore both the video and their ways of using their full bodies to see in new ways.The textual data helped me to understand the participant's experience of exploring new ways of seeing. They showed that *Walk In Cube* encourages them to explore both the video and their body movement to view a video in new ways. In the following, I synthesise the findings with the data captured from scale questions and photos and video recordings.

Participant(s)	**Metaphor to describe *Walk In Cube***
	Frame
2, 6, 14, 15	Origami, sheet of paper
6, 7, 10	Object in object
4	Wrapper blown
14	Spider Net
	Space
11, 12	360 degree mirror
14	Under the water
4	Airport corridor
9	Cave
21	Tunnel
1	Repertoire of body movement
	Bodily Engaging
5, 8, 15	Bodily remote controller
2, 10	Avatar
6	Puppeteer
	Exploring
1	Hide and seek
	Creating
1, 14	Collage
4, 5	Alternative mirror

Figure 5.15: Metaphors for describing *Walk In Cube* (key word and sentence sorting of the textual data from the *Walk In Cube* semi-structured questionnaire)

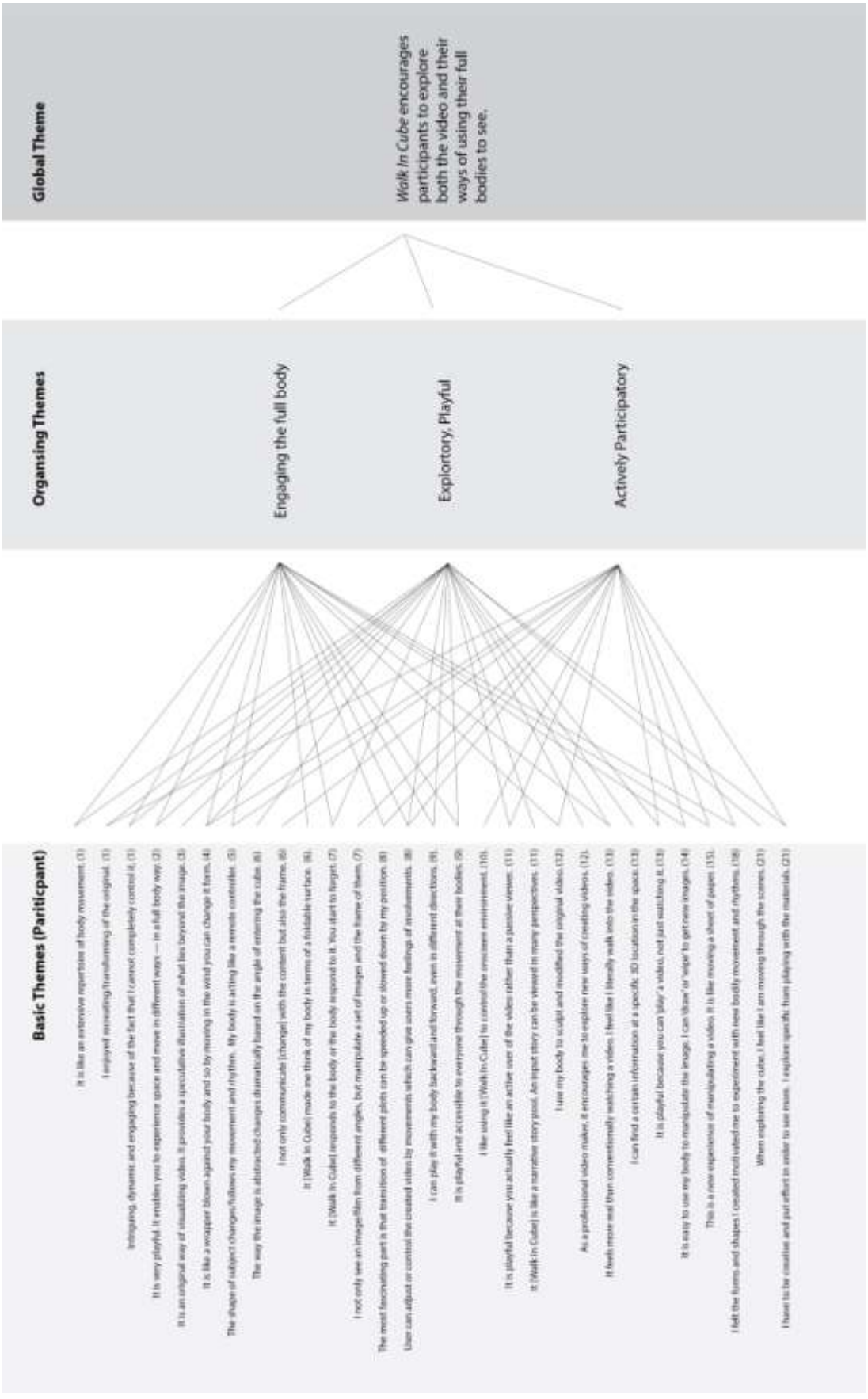


Figure 5.16: Thematic networks showing participants' experience of seeing in new ways

5.4.1 Non-linear path: exploratory

I introduced the Cubic Structure in the *Cubic Film* project above (see 4.5.2), and have evaluated the video TY and XT as sequence revealed through passing in a linear fashion through the Cubic Structure (see 4.5.2.3). When a video is transformed into a cube, all the information stored in the video has a three-dimensional location and the linear sequence become a three-dimensional non-linear path. As a result, the video selected by the participants can be considered to be the interior design of the cube through which they can navigate freely.

Participants 1 and 9 commented that *Walk In Cube* is akin to a 'hide and seek' game. Many people tried to identify content that they recognised in the original video (Figure 5.17). When the participants needed to find a pattern or an object in the previous video, they knew the pattern was somewhere in the cube and they moved around the cube to find it. Through quickly exploring by moving their body, they found a part of the pattern/object correctly. They then kept that part of their body static whilst moving the body to search for the other hidden parts of the pattern gradually until they were satisfied with the result. The participant thus divides the projection frame into parts, determines the parts and combines them into a whole. Participant 1 said that, "I always find something new or recognisable in breaks of the video". In other words, all the information in the cube has a three-dimensional spatial location, which the participant can search through by moving freely and access with their body movement part by part.

Using *Walk In Cube* to view a home video is a good example to illustrate the exploratory experience. Participant 13 noted that he had taken too many videos of his young daughter to actually be able to watch them all again. He said that, with *Walk In Cube*, he would look at those videos again because he could play with them. Participants 1, 2, 7, 11 and 21 also commented that they would revisit their home videos by using *Walk In Cube*. Participant 11 said that, "The *Walk In Cube* offers a refreshing way of accessing home videos for it allows the individual to go from being merely a 'viewer' to an 'active participator'. It also allows for us to access different aspects of our memory by seeing what is familiar at different angles." *Walk In Cube* thus encourages participants to explore the video on their own terms.

Figure 5.17: A video and image example of participants identifying content that they recognised in the original video

5.4.2 Engaging the full body

In Chapter 4, I showed that, through shooting a film, participants can re-explore a familiar subject in their own ways by seeing it from different perspectives as a result of their movement (*Hand Painted Film Plus*) and, moreover, hand movement during the shooting can be considered as a way to design the Cubic Structure (*Cubic Film*). Further experimentation through *Walk In Cube* extends the discussion of shooting with hand movement to whole body.

Participant 1 remarked that *Walk In Cube* is "an extensive repertoire of body movement", whilst Participant 2 commented that, "Learning how to move in the medium is like relearning how to use your body using a mirror." In other words, the body offers the tool for participants to explore and create.

The human body is a good tool through which to express ourselves. Participants 6, 12, 13 and 15 commented that they could project their personality through movement to make an object, such as text, move and create rhythm (Figure 5.18). We have seen that the cross-section of a cube creates perspective distortion of the video content. When adding movement, the sequence of the perspective also distorts. Consequently, if the video contains obvious volumes, the participant sees the volumes move smoothly, and they remain recognisable. Participant 6 said that, "I project my inner self onto an object";

participant 12 felt that, “The medium could reveal the characteristic of creator easily”; and Participant 13 remarked that, “*Walk In Cube* can be used to create edgy image advertising”. This finding resonates with David Gauntlett’s finding that “the individually crafted items are expressive of a personality, and of a presence in the world” (Gauntlett, 2011, p.162). Gauntlett further referred to Ivan Illich’s book *Tools for Conviviality* and claimed that, “The best tools are not merely ‘useful’ or ‘convenient’ additions to everyday life, but can unlock possibilities and enable creative expression, which are essential components of a satisfactory life” (Gauntlett, 2011, p.172).

Figure 5.18: A video of *Walk In Cube* with a text video

Furthermore, *Walk In Cube* offers participants an immersive environment that encourages the exploration of their body movement. Participants 6, 8 and 21 said that they felt that they had undertaken some form of physical exercise without feeling that they were actually exercising (Figure 5.19). This is because they needed to use their body movement to discover pattern, explore and create. By contrast, those participants who did not use their body to move energetically in the Cube did not agree that, by using the medium, they had undertaken physical exercise (Appendix I and J). Participant 1 said that, “The 24 second video becomes a world of absorption. I can play with the video for long time”. Participant 21 remarked that, “I realised after participating that it was quite a workout. But, while I was doing it, I was engaged in the experience and focused on learning and exploring the spaces”. Participant 18 commented that, “The device encouraged me to ‘dance’, which I never do”. Participant 11 felt that, “The *Walk In Cube* is certainly a solution to the sedentary manner in which we watch videos and allows for us to use parts of our body that we generally would not use on a daily basis”. In short, *Walk In Cube* provides a new filmic space and thus encourages participants to use and, in some cases, re-discover their body movement.

Figure 5.19: A collection of participants moving their bodies.
For participants with disabilities, see 5.4.3.

A video about entering a physical space serves as a good illustrative example to show how participants' body movements engage with the input video. Participants 2, 11, 13 and 14 commented that because the video is about entering a space which has a clear single vanishing point, such as walking through a path or driving on the road, they could feel strongly connected to the content of the video precisely through the movement of their bodies as if they are entering the space. For example, with a video that is about walking through a series of Japanese gates, in *Walk In Cube*, a participant will feel that they are passing through the gate, not just watching it (Figure 5.20). The distortion is like motion blur when moving fast. To take another example of a video of base-jumping (the activity of parachuting from a high fixed objects), the distortion applies to the ground, mimicking real base-jumping. Participant 2 said that, "Flying sequences are the best for that dreamlike but exhilarating feeling". Speed matters. For instance, a car coming from the opposite direction and passing by the participant would become very vivid because the car only moves when the participant moves, and its speed depends on their speed of movement. Participant 13 remarked that, "The speed of my body movement is important to what I see". Participant 11 said that, "I can guess what the abstract contents are when they are in motion". Participants therefore confirmed that *Walk In Cube* enables each participant to engage dynamically with the content of the video, especially video that is about entering a space.

Figure 5.20: A video example of *Walk In Cube* with a video of entering a space

5.4.3 The Body as a means to create

I have argued that participants can use their body movement to control the playback speed of a video, and explore and create new patterns. While *Walk In Cube* shows numerous new possibilities as discussed above, many participants mentioned different levels of control in their experience. Eight participants (1, 2, 5, 6, 7, 10, 11, 12) described their experience of using *Walk In Cube* as intuitive (see appendix K). I now offer further examples of postures that participants discovered for specific purposes. To triangulate the verbatim commentaries from semi-structured interviews and the video recordings, I have used the data from the structured questionnaire to collect participant's self-reports on specific body posture (see Appendices I and J).

Ten people 'strongly agreed' and six people 'agreed' that extending their bodies gave them a panoramic view of the video (Figure 5.21). Extending the body, for example by spreading the arms, extends the frame and enlarges the lens, so that participants can see more, which is useful to view the full sequence movement of an object.

Eleven people 'strongly agreed' and eight people 'agreed' that bending their bodies helped them distort the video and change the shape of the frame (Figure 5.22). For example, when along the original video sequence, bending their bodies forward mixes the time sequence and gives a tunnel shape to create a focus on a subject. Participant 7 said that, during the third iteration, instead of the video content, "I focused on playing the shape of the projection". Participant 6 felt that I was controlling them and that I "acted like a puppeteer". In other words, the output of *Walk In Cube* can be viewed as an object

(content) in an object (frame). *Walk In Cube* allows participants to manipulate both the content and the frame, whilst a conventional gaming environment allows a participant to control only their avatar, but not the environment. In short, participants are more able to manipulate the moving image results as a whole.

Eleven people 'strongly agreed' and five people 'agreed' that twisting their bodies gave extra dynamism to the video (Figure 5.23). Twisting creates difference upon all of the pixels between frames at once so it creates more significant movement than other postures.

Nine people 'strongly agreed' and eight people 'agreed' that folding their bodies creates breaks and produces parallels of the original sequence. For them, this was the best way to create a collage (Figure 5.24). The folding body folds the frame, which creates layers and disconnected space. Four participants said that using *Walk In Cube* is like creating "origami" (Figure 5.15 above; appendix K).

For participants with disabilities, as long as they can move parts of their body to create movement, such as arms, and their supporting equipment does not cover their bodies, they can also generate unexpected visual results. For example, after I folded away participant 16's wheelchair table, which was in-between his body and the kinetic sensor, he was able to play with *Walk In Cube* by moving his arms.

In short, *Walk In Cube* provides a new filmic space, encourages participants to re-discover the possibility of their body movements, and ultimately transforms the participant's understanding of the input video as well as of his/her body movements as a means to create new results from the video.

Figure 5.21: A collection of bending postures

Figure 5.22: A collection of extending postures

Figure 5.23: A collection of twisting postures

Figure 5.24: A collection of folding posture

5.5 Creating individual ways of seeing

In the previous sections, I showed that *Walk In Cube* enables viewers to create new information from the video; they are also engaged with the content and experience. To fully answer my second research question, I evaluate here whether *Walk In Cube* is wholly participatory and enables participants to create their own ways of seeing and experience moving images. During the third iteration, I asked participants to create a video to share with someone from their own input video and to identify their methods to create this video, explain the difference between the input and output, and the relationship between the methods and the video output. Below are a selection of verbatim comments from the semi-structured interviews and questionnaires.

1. Many participants entered the cube without a pre-conceived goal and they acknowledged their exploratory experience through creating what they saw:

"I had not got some pre-conceived plan in my head, but I **created episodic narrative**" (Participant 1).

"The medium offered an experience close to a **drawing** approach. [...] There was an element of narration that **invited me to discover** the implications of what an image is. [...] The created video is very different from the original" (Participant 3).

"I have **no pre-determined** movements. [...] It is interesting to see several cats up and down in one sight (these is one in the original video), when I change the direction of my body [...] *Walk In Cube* made me become a magician to zigzag the world" (Participant 9).

"When **exploring** the cube, I feel like I am moving through the scenes. [...] I have to be **creative** and put effort in order **to see more**. [...] I explore specific from playing with the materials" (Participant 21).

2. Participants highlighted their experience of creating and seeing new things through *Walk in Cube*:

"I like the mix of abstract and figurative in the last iteration, [I was] **taking** the characters from the original and **placing them in the weird landscape**" (Participant 4).

"The **sequence (story) has changed**. The recreated video is about a group of deer that killed a child (while the two characters, deer and a child, are in separate scenes in the original)" (Participant 5).

"I tried to find an unusual angle from which to begin. [...] I then used my arms to create interesting images [...] The **recreated video shows experience** of the earthquake on this area before" [the original video was of a car driving through an specific area] (Participant 11).

"It gives me **an original way to create**, and **frees me** from previous trained concept and skills. [...] The original video is disconnected images. With *Walk In Cube*, while the character become even more disconnected, I can create new rhythm from these disrupted signals" [participant 12 is a professional filmmaker and photographer] (Participant 12).

"The original space was stretched and duplicated. The **recreated video** has multiple vanishing point [there was only one vanishing point in the original] [...] I **felt like** I was driving through the space" (Participant 14).

3. Participants articulated their experience of learning (the content, their body and the environment) through iterations of using *Walk In Cube*:

"By identifying with the depicted video as a **sheet of paper** (in the **second iteration**), it was more intuitive to manipulate it." (Participant 2).

"The experience is an act of **question the original**" (Participant 6).

"I was preoccupied with the image itself **last iteration**, but I focused on manipulating the shape and scale of the video" [explored new ways of seeing during each iteration] (Participant 7).

"The order of frames can be mixed together **without bias**. Once users **get used to the system**, they can regenerate the video in their preferred way" (Participant 8).

"After two iterations, **I understood the time structure better**, and started to create interesting mix and parallax" (Participant 13).

4. Participants discussed their methods to create new results from the input video:

"Smooth movements, the full use of the waving arms and legs, **varying the position** of body in relation to the kinect detection - these all enabled me to **fold/unfold the space** in interesting ways" (Participant 2).

"I **played at folding** the image and pushing it forwards and backwards to compose images and create dynamic sequences" (Participant 6).

"I like using it to **control the onscreen environment**. [...] The different spatial zones within the original footage are separated dramatically by my movements" (Participant 10).

"I used my body **as a remote controller** [...] I can review my own dance movements" (Participant 15).

"When I **lean forward**, the image created feels like a tunnel into the next image. When **moving forward**, [...] the tunnel collapses, while it opens up when I move back" (Participant 20).

Each of the verbatim remarks can relate to more than one cluster and I use thematic networks to display the organisation of the verbatim remarks (Attride-Stirling, 2001; Martin and Hanington, 2012). Four organising themes emerged: (1) encouraging play and exploration (having fun without a specific goal), (2) creating and seeing new things (new outputs produced), (3) learning through iterations (recursive process) and (4) developing your own method (concepts addressed) (Figure 5.26). I concluded from the data that *Walk In Cube* encourages participants to develop their own ways of seeing by exploring new ways of using their bodies and spontaneously creating in their own ways things that they did not anticipate.

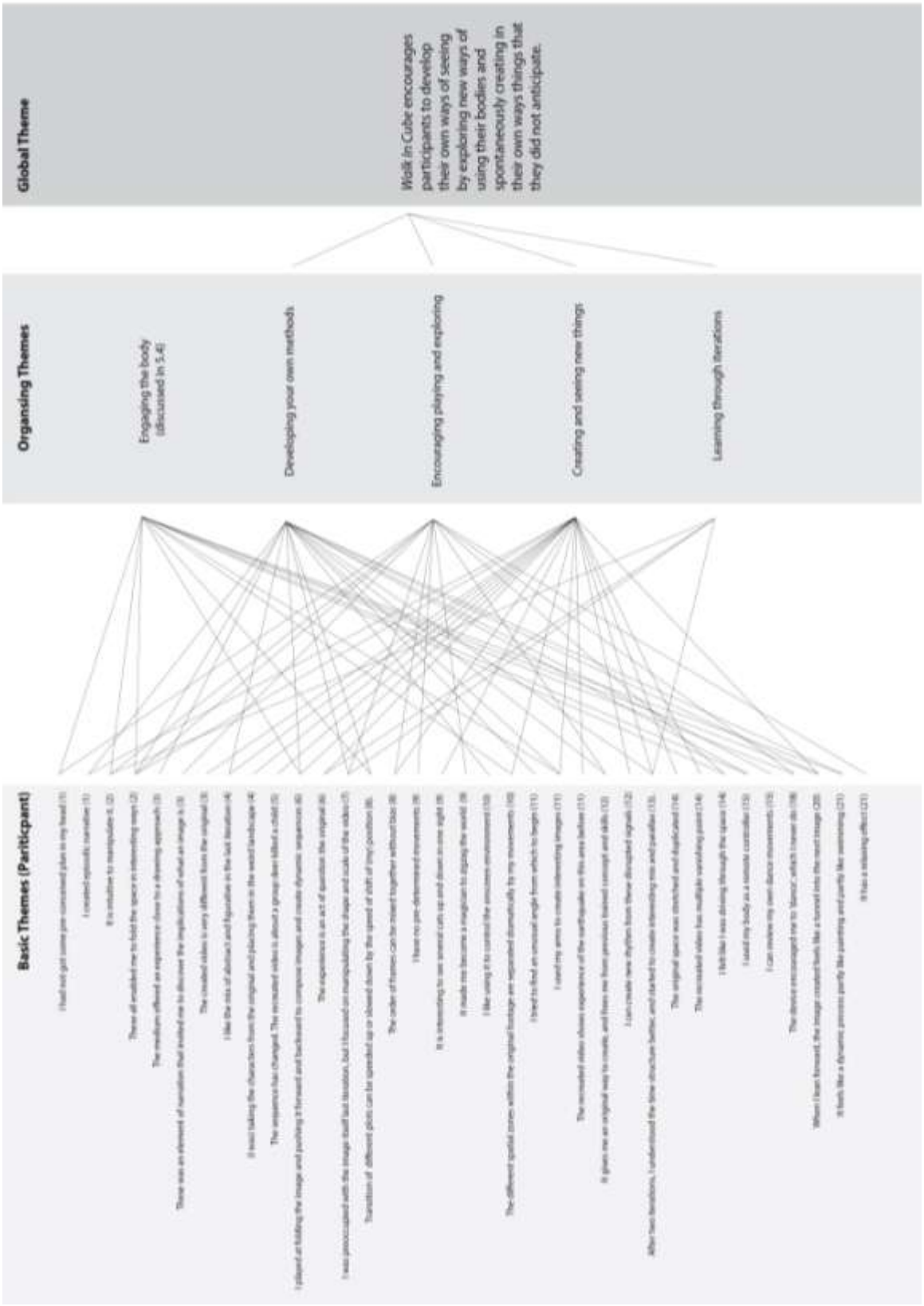


Figure 5.25: Thematic networks showing participant's experience using *Walk In Cube* to create

Figure 5.26: A collection of unique postures

Participants commented on their additional needs and the potential of *Walk In Cube*. Participant 4 said that she wanted a bigger space to walk through and a longer video to play. With the improvement of video card, depth sensor, and larger video recording format, this can be achieved. Participant 8 said that he hoped that the output could be less abstract. This can be achieved by setting limitations on the entering angle and also making the frame less curvy (closer to the two-dimensional screen). Participant 5 also said that it was hard to find the right path to play the video. This can be improved by giving the participants direct instruction, which I did not offer during the experiments because I wanted participants to discover and learn by themselves through the several iterations. As Participant 11 noted, "I have more control than I thought."

5.5.1 Recreational exploration and creation

I have shown that *Walk In Cube* enables viewers to compose new information from the video; they also engage with the content and experience. I consequently argue that *Walk In Cube* encourages viewers to explore and create new content recreationally. This argument links to play theory. For psychologists and ethnologists, 'play' is a voluntary, intrinsically motivated and actively engaged range of activities typically associated with recreational pleasure (Garvey, 1977). The National Institute for Play categorises play into seven types: attunement, body, object, social, imaginative, narrative, and transformative (The National Institute for Play, 2009). The last type, transformational play, is an

extension of John Dewey's idea of *transactivity*, namely that "every experience enacted and undergone modifies the one who acts and undergoes. […] For it is a somewhat different person who enters into them" (1963, p.35). It also emphasises that both knower and known constitute and are constituted through meaningful inquiry (Dewey, 1963; Dewey and Bentley, 1949).

Sasha Barab, Melissa Gresalfi, and Adam Ingram-Goble argue that transformational playing integrates *person*, *content*, and *context* to form a transactive system in which each of the three elements motivates and is motivated by the others (Barab, Gresalfi and Ingram-Goble, 2010). I further argue that *Walk In Cube* is a model of participation that involves intentionally leveraging the three interconnected elements of viewer (person), input video (content), and medium (context). In *Walk In Cube*, the viewer is responsible for making choices that advance the navigation within the video. The chosen input video by participants fills the cube with the content of their interests ripe for exploring. *Walk In Cube* as a medium provides a context that is modifiable through participants' choices and their body movements, thus illuminating the consequences of their decisions. Therefore, *Walk In Cube* serves as a perfect example of transformational play: the participants transcend what is known (their body movements and chosen input video) in the current state to form new moving image results as well as ideas for experimenting with their body movements, and shape and re-shape them (Kelley and Littman, 2004).

5.5.2 How can *Walk In Cube* enable participants to create their own ways of navigating video?

As discussed in Chapter 2, there are three main stages in parametric design: setting parameters, forming a parametric model by deciding the relationship between parameters, and flowing data through the parametric model (Woodbury, 2010). *Walk In Cube* enables participants to create their own ways of seeing: in this research, I only set the initial parameters and invited participants to join the rest of the parametric design stages by deciding their own content (the input video) and their own ways to interact with it (using their bodies).

The parameters that I set for *Walk In Cube* are: the size of the cube, its dividing unit and, most importantly, the frame formed by the participant's body. I determined the relationship (dependencies) between the projection frame and each participant's body to

ensure that the frame can move and the shape of the frame can change with the participants' movements (in previous projects, such as expanded cinema, participants have been involved in the creation of the content but rarely in the process of forming the shape of a frame – see, for example, Lis Rhodes' *Light Music* [1975]).

If a participant only wants to explore within the cube, he/she often moves his/her whole body and the movements generate numerical data through a depth sensor creating a sequence of different frames. He/she explores new ways of seeing (new body postures) and thus creates new things. If a participant has "a need" (Christopher, 1966, p.1), such as finding/retrieving/manipulating an object in the input video or creating a certain pattern, he/she often moves his/her limbs, head, trunk separately, and fixes his/her body part by part gradually until he/she is satisfied with the result. The participant thus divides the projection frame into parts, determines the parts and combines them into a whole. This paradigm is similar to the divide-and-conquer strategy used in algorithm design to limit interactions among the constituent parts reducing the effort to fulfill a need. In short, whether or not participants have some more prescribed goal in mind, they are able to create new things and thus construct new ways of seeing (Figure 5.27).

All of the stages in parametric design are usually completed by designers. However, with *Walk In Cube*, the participant actively chooses the input data (both the video and the body movement), makes a decision about their objective(s) for using the medium, and decides on a strategy to meet the objective(s). I also integrated participants into the shooting-related structural re-construction (i.e. the size and shape of the camera lens determined by their bodies) and thus the final shooting process and moving image experience needed their contributions to be initiated and completed. *Walk In Cube* therefore serves as a tool to capture each participant's decisions in an audible, editable and re-executable form.

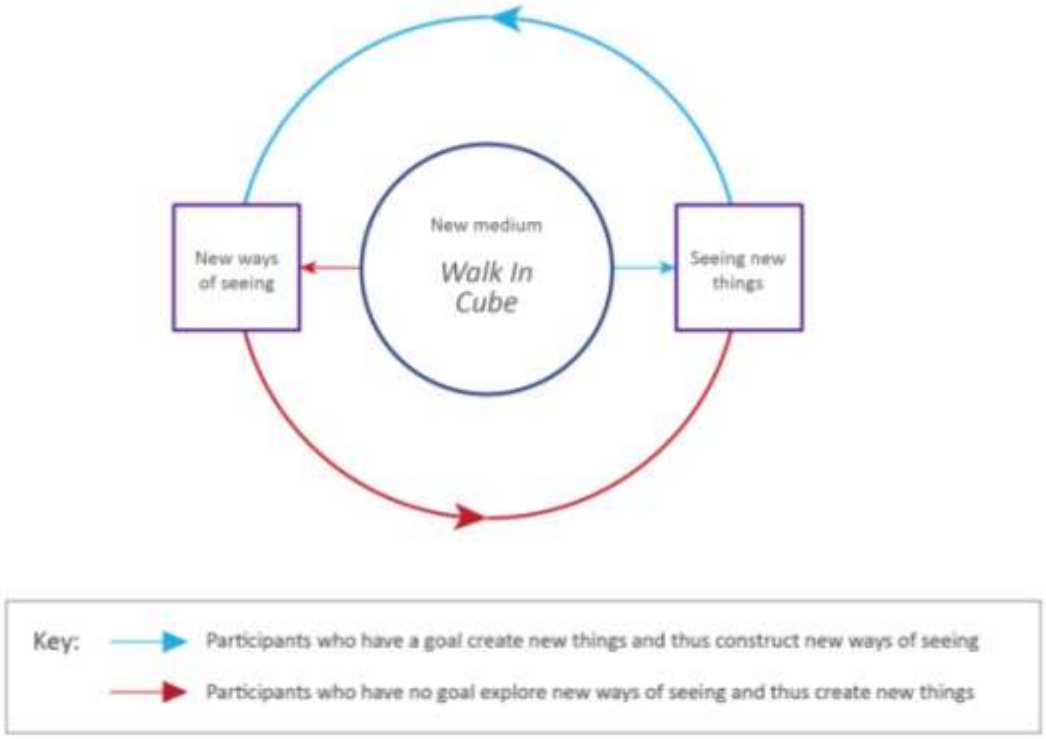


Figure 5.27: The cycle of seeing new things and new ways of seeing

5.6 Summary

Walk In Cube encourages participants to use their full body. Through iterations, participants used what they had learned to achieve something more complex. Ken Robinson has discussed the idea of, "creating a climate of possibility: […] if you do that, people will rise to it and achieve things that you completely did not anticipate, and couldn't have expected" (Robinson, 2013). *Walk In Cube* creates a 'Cube' of possibility that encourages participants to explore by moving their body to spontaneously create unpredictable ways of seeing and thus discover new things.

In conclusion, Walk In Cube gives individual choice and individual control to viewers; it requires them to take on the role of a protagonist who must make choices that have the potential to transform a video. This consequently leads to new experience, one which undermines linearity, parallels fields, such as architecture and sculpture, and echoes the cubist 'method' or approach that reveals a simultaneity of angles and perspectives. Ultimately, this engagement transforms the participants' understanding of the content and leads to insights about how his/her body movements become a means to composite new things from the chosen video.

6. Conclusion

In this thesis, I have discussed the research and development of a digital moving image medium through integrating experimental film and transmedia storytelling. I synthesized the knowledge that helped to define my approach in the first part of this thesis. In the second part, I examined the development of the medium through a project-reflection iterative method. In the third part, I evaluated the final *Walk In Cube* project. In this concluding chapter, I explain how the five projects address the research aims and questions that motivated this project.

The initial proposal was to design a digital moving image medium through integrating experimental film and transmedia storytelling.

The first part of this proposal shows that the research that was aimed at designing a digital moving image medium. Therefore, I began Chapter 2 with a brief historical review, tracing developments from photography to digital media to explain that a new medium makes new ways of seeing possible, and vice versa. I then argued that designing a new medium is not the same as designing interaction because the former focuses on the framework into which participants can put their own content and interact in their own way, and does not limit what and how the participants want to reflect.

The second part of the initial proposal indicated the general research and methodological approach. In Chapter 4, I presented my first project, *To Be Different*, which compared abstract film and transmedia storytelling in line with my initial research proposal to design a digital moving image medium through integrating experimental film and transmedia storytelling. I found that: (1) while abstract films generally have a beginning and an end, transmedia storytelling has a multi-entry structure because of its interconnection between the online and physical space; (2) whereas abstract film originally focuses on authorship, transmedia storytelling involves collaborative problem solving. Based on the findings, the initial proposal evolved into two research questions: (1) can I integrate film and space to design a medium to view a video from various perspectives? (2) If yes, can the new medium enable participants to create their own ways of navigating video and, if so, how?

Can I integrate film and space to design a medium to view a video from various perspectives?

To answer the first question, in Chapter 2 I discussed film and space separately as a medium to show that they are both closely associated with movement but in different ways. I presented four studies which offered previous examples showing how film and space have been combined: transmedia storytelling, expanded cinema, parametric design, and the slit-scan technique. I selected these four because they all: (1) generate new results from the integration of film and space; and (2) are rooted in different fields — storytelling, film, space and photography — and show a unique approach to the move from analogue to digital. I therefore discussed how each approach generates unique results and participatory experiences.

In Chapter 4, I introduced my third project, *Hand Painted Film Plus*, through which I deconstructed the film strip and gained a deeper understanding of frame and sequence, and reconstructed film strip through the transformation between linear film strip, two-dimensional image, and three-dimensional space. I found that forming a space through layering frames was technically much more straightforward than layering through connecting the inputted content by the participants, and thus all existing videos could be transformed into cuboids. As a result of this development, I built project four, *Cubic Film*, which integrated film and space. In creating *Cubic Film*, I chose to form a perfect cube in order to interrogate the cube equally from all perspectives. I analysed the inputs and outputs in order to understand the process of deconstructing the input video and reconstructing the output: how the recorded time and space was disrupted, and what new information and aesthetic was revealed through the process. This understanding helped me to integrate viewers into the creative process to see new information in the fifth project, *Walk In Cube*, and to answer the second research question.

Can the new medium enable participants to create their own ways of navigating video and, if so, how?

In Chapter 2, I explained that experimental filmmakers have explored how holding a camera affects the visual output. I also showed that expanded cinema uses the projection space successfully to involve the audience with the creation of the output content. Moreover, transmedia storytelling allows participants to be both the creator and the

viewer. I also showed that the slit-scan technique has been applied to interaction, but argued that the technique also limits the participants' control on the subject and their interaction. Last, I explained that there are three main stages in parametric design: setting parameters, forming a parametric model by deciding the relationship between parameters, and flowing data through the parametric model. I argued that, if some stages in parametric design can be completed by participants, it is possible to allow participants to have control over the content carried by a digital medium completely and thereby to become both creator and viewer.

In Chapter 4, I reflected on my second project, *Grid 9*, to explore the difference between drawing and using a digital interface for participants, especially in terms of their expression and reflection. As a result, I sought to integrate into my final project the intuitiveness of the participant's body movement with the generative power of the digital interface. In the third project, *Hand Painted Film Plus*, I explored using the camera as a brush, and discussed the relative movement between the moving body and the filmed subject. I found that the dialogue between body movement and the form of the subject created unexpected organic results.

With the *Cubic Film*, I saw how the organic results from hand movement could be combined with the *Cubic Film* system. I found that shooting becomes the process of cubing the reality. Through holding the camera, the creator is deciding not only which objects or events will be in the cube, but also where they will be placed in the cube. In other words, the shooting process can be considered a means to design the interior space of the cube. *Walk In Cube* allowed me to continue this exploration of — and discussion about — the relative movements between subject and human body, with the subject as the inputted video.

I connected my discussion about the relative movements between the subject and the human body with the previous exploration in *Cubic Film* of the deconstructing and reconstructing process of the input video. I experimented with ways to involve the viewer with both processes by linking the projection frame with the participant's whole body. This led me to create a medium which allows the participant's movement to control both the projection frame and sequence. As a result, the participant deconstructs the input and reconstructs the pixels simultaneously, and thereby becomes both the creator and viewer.

Walk In Cube makes possible a new way of seeing the recorded visual data and shows that navigating within the cube leads to new experience. A participant can use his/her body to revisit and recreate the recorded moving images. When revisiting the recorded data, the cube is like a room which is structured interiorly by the input video selected by the participant. The latter then chooses an angle to enter the room and physically travels through it, non-linearly. If a participant only wants to explore within the cube, his/her body movements generate numerical data through a depth sensor to create a sequence of different frames. If a participant has a clear goal, such as retrieving an object or creating a certain pattern, he/she often moves his/her body parts separately (dividing the projection frame), and fixes them gradually (determines the parts) until he/she is satisfied with the result (combining the parts into a whole).

With *Walk In Cube*, the participants can transcend what is known (their body movements and chosen input video) in the current state to form new moving image outputs and ideas of using their body movement, and shape and re-shape them. The flexibility of the body forms a three-dimensional frame intuitively. The constant movement of the limbs generates many outputs and controls the digital adjustable lens, which the participant can use to frame and create images from what has been deconstructed. The body also serves as a remote controller to move the sequence forwards and backwards; a new path in the cube means a new sequence of the outputs.

Moreover, *Walk In Cube* enables the viewers to become active participants. The participant actively chooses the input data, determines the objectives, and explores strategies to meet the objectives. The participant views something already existing through 'shooting' it with his/her body, and discovers its detail through creating it. *Walk In Cube* therefore serves as a tool to encourage the participants' understanding and captures their creative decisions through the exploration.

In conclusion, *Walk In Cube* gives individual choice and individual control to viewers leading to new experience that undermines linearity, paralleling fields such as architecture and sculpture. It also allows them to view from all possible perspectives, and consequently transforms the participants' understanding of the content as well as understanding of the potential role of body movements as means to composite new information from the selected video.

6.1 Recommendations

6.1.1 Practice

With the development of technology, many digital tools are created to facilitate the exchange of information. As a result, information is not limited to those who control the organisation of information, but is now a social asset. As David Weinberger explains, "editors are more powerful than reporters, and communication syndicates are more powerful then editors because they can decide what to bring to the surface and what to ignore" (Weinberger, 2008, p.89). The control of power has been challenged. A good example of this shift in power is the recent exhibition, *Rain Room*, at the Barbican Centre in London (Barbican Centre, 2012), which invited people to experience what it is like to control the rain: "Visitors can choose to simply watch the spectacle or find their way carefully through the rain, putting their trust in the work to the test" (Random International, 2012). Companies, such as Google and eBay, also now embrace this trend towards increased self-empowerment by providing platforms that motivate mass participation (Brand and Rocchi, 2011).

As more and more digital data is being generated, collected and shared, many design practices, such as data visualization, platform design and interface design aim to reveal information from these data (Smart Geometry, 2011). While all these design practices encourage the assemblage of media (such as sound, text, video) and the sharing of the created content, they impose a 'seeing' structure onto the audience. As Lanier has argued, digital media can suffer from "lock-in mode" (i.e. older software shaping/limiting how newer software is created) and de-emphasise the human (i.e. a person becoming a source of digital fragments to be crowd sourced by others) (Lanier, 2011, p.10).

In contrast, I argue that designing a new medium through integrating previous media helps to make the seeing of new things possible. I started with experimental film, which enabled me to investigate film through form and structure. As Hamlyn explains, "In narrative movies, form is to a major extent predetermined by a combination of the demands of the screenplay, genre and grammatical conventions" (Hamlyn, 2003, p.viii). Unlike media made through the assemblage of previous media, such as online platforms, my research involves an integrative approach. Through the process, the structure of previous media must be changed in order to be merged, collage-like, into a single entity.

As a result, the necessary structural changes of the previous medium for integration introduces new ways of structuring the seeing, and thus, based on the new structure, makes the exploration of new ways of seeing and seeing new things possible.

Furthermore, I argue that medium design needs to be addressed by researchers and practitioners more thoroughly. As my research has shown, a medium does not limit what and how participants want to reflect. During the restructuring of previous media, I integrated participants into the structure construction and because of that, the final structure needed their contributions in order to be completed, the input data, their objectives, and a strategy to meet the objectives. Without these contributions, the participants' experience of *Walk In Cube* would be limited. For example, while both 'Seene' (a phone app which enables people to capture, share and discover 3D photos easily and instantly; Obvious Engineering, 2013) and holography (Hariharan, 2002) incorporate space with existing media, enabling viewers to explore content from angles, they do not allow them to construct their ways of seeing through actively creating the subject. *Walk In Cube* requires the participant to make more decisions than is the case with interaction design. This decision-making creates unique results even when the input video is the same because every participant has a different body and ways of moving; therefore the results of their participation will always be different. The unpredictable results encourage exploration and unexpected creations using the recorded digital data. As Weinberger argues, "Messiness is a [digital] virtue" (Weinberger, 2008). I argue that medium design deserves more attention than it has received hitherto because a good outcome encourages creative usage of the miscellaneous digital information and celebrates individuality.

Lastly, experimental film can be a good reference for digital design that produces time-based events. While the latest technology can facilitate an event, the essence of the moving image is still worthy of consideration when designing digital moving image experience. For example, while the pixel is the smallest unit in a digital medium, the frame is still the unit of meaning to the viewer. In Chapter 2, I noted that Alvaro Cassinelli and Camille Utterback (Cassinelli, 2005 and Utterback, 2002) used volumetric video to alter the relationship between the audience and the projection. However, both artists focused on building the relationship between the participants and the pixel, rather than the frame. Therefore, their outputs were not a complete moving image output and the

projection frame was considered through the design. On the other hand, the frame, rather than the pixel, is always at the centre of my research: that is the preoccupation that lead to the concept that the frame can be linked to the body and ultimately made *Walk In Cube* possible.

6.1.2 Research

I used interdisciplinary materials, which necessitated an interdisciplinary approach. This approach suits design research because it does not rule out the demanding requirements of a complex design problem. As Roger Martin has argued, "More salient features make for a messier problem. But integrative thinkers don't mind the mess. In fact, they welcome it, because the mess assures them that they haven't edited out features necessary to the contemplation of the problems as a whole" (Martin, 2007).

While the adoption of an interdisciplinary approach to investigate a digital medium as a medium might not be easily understood by the academic/general reader due to the non-linear process, it has enabled me to see new possibilities for design solutions and to help explain the outputs from a new perspective. For example, while Eddie Elliot's *Video Streamers* was one of the first works to research how slit-scan techniques could be applied to digital media (Elliott, 1993), it did not include discussion of the shooting event and the hand movement. So for instance, Tania Ruiz Gutierrez has undertaken a thorough assessment of spatiotemporal imaging, and used spatial-temporal objects to analyse previous slit-scan photography and visually related work but has not created new moving image media (Gutierrez, 2004). Sequence is therefore not the focus of Gutierrez's research. For example, in terms of explaining the outputs, there was no existing research to explain video TY and XT thoroughly (Vanvolsem, 2011). On the other hand, drawing upon my original training as an architect, I could look at the *Cubic Film* as a structure and explain the video TY and XT as a playground from an architectural perspective, and the 'look-alike world' as a Cubic Structure.

To ensure the synthesis of the disciplines, not only providing multiple perspectives but also resolving conflicts and achieving a holistic view of the subject (Holbrook, 2012), I re-examined and updated the built relationship between projects, precedents and theories after each research cycle. This was necessary because each project relates to different approaches and the latter can transfer and link to projects in different ways. Most

importantly, through this process, I refined my research questions, developed a new perspective on the research questions, and enhanced their integration iteratively.

In short, the interdisciplinary approach ensures that a complex problem is treated holistically. By using this methodological approach, the researcher and designer can then find a creative resolution to the tensions between the individual parts. That said, the complexity of an interdisciplinary approach and the iterations of project-reflection can be hard to follow for some readers. Structuring the thesis through the research journey is necessary to ensure clarity. However, this does not mean reinventing a structure which rules out the errors through the research journey and tells the story based solely on the successes. On the other hand, addressing both what worked well and what did not gives a true reflection of the research journey.

6.2 Further research

The *Walk In Cube* project is ongoing. It is a way of helping us begin to understand a participatory medium for viewing recorded video, and a new approach to understanding the relationship between design and a medium as a whole.

I suggest that, to understand the impact and potential of *Walk In Cube* longer-term, more on-site participatory experiments could be undertaken (e.g. in a school or in a domestic setting) to develop and understand better the medium. This is necessary in terms of product development, to finalise the design before it is introduced to a wider audience. For example, with the advanced capacity today of computing power, it will soon be possible to load a feature movie or a live video and explore the latter with *Walk In Cube* in the home; multiple participants can use *Walk In Cube* simultaneously and co-create their experience in a group setting such as a school. To understand the moving image outputs, further research and development on its aesthetics could also be undertaken. For example, the new aesthetics discussed in Chapter 4 can be analysed further by focusing on the pictorial value and considering how the latter can be applied to other fields, such as textile design. The comparative information revealed in the outputs discussed in Chapter 4 can also be analysed further to suggest future digital design, such as adding hyperlinks into the cube for jumping between data three-dimensionally, to facilitate more effective reading of the information. Last, my research experimented with the transfer of information from one- to three-dimensions. New types of input, such as three-

dimensional information captured from a depth sensor or a digital textual database, rather than video (as well as the opposite transformation), could be explored in more detail to lead to the next iteration and prototype of the *Cubic Film* and *Walk In Cube*.

In conclusion, future research on designing a digital medium would benefit from this project as a useful resource and a starting point to help define the detailed integration of particular proposals within specific contexts. Reading information from collected digital data is becoming more and more important. My research shows that an integrative journey to design a new digital moving image medium that offers individual choice and control to viewers leads to a new non-linear experience. It allows participants to creatively see the digital visual information from all possible perspectives, and consequently transforms the participants' understanding of the content as well as their body movements as means to composite new information.

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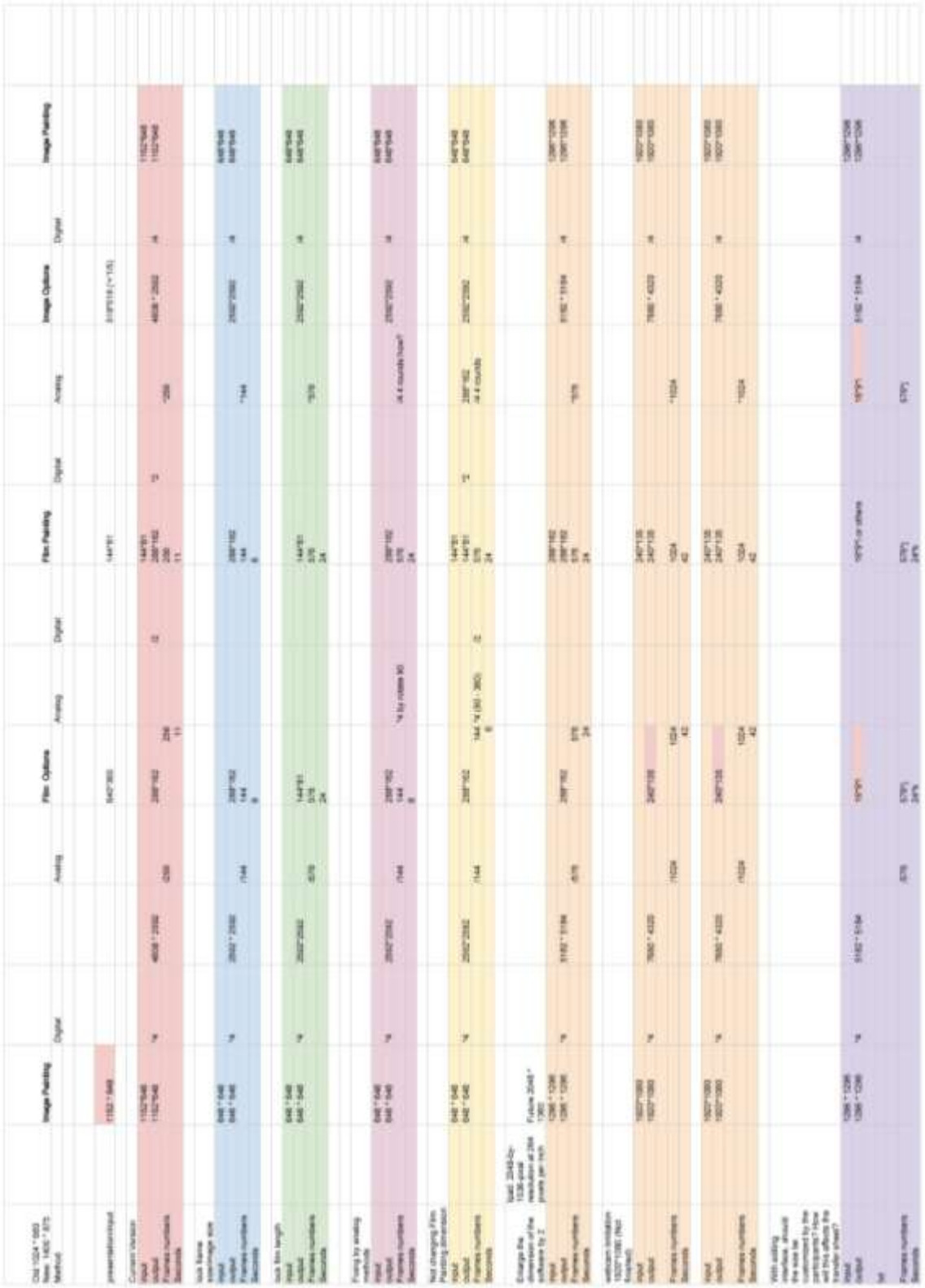
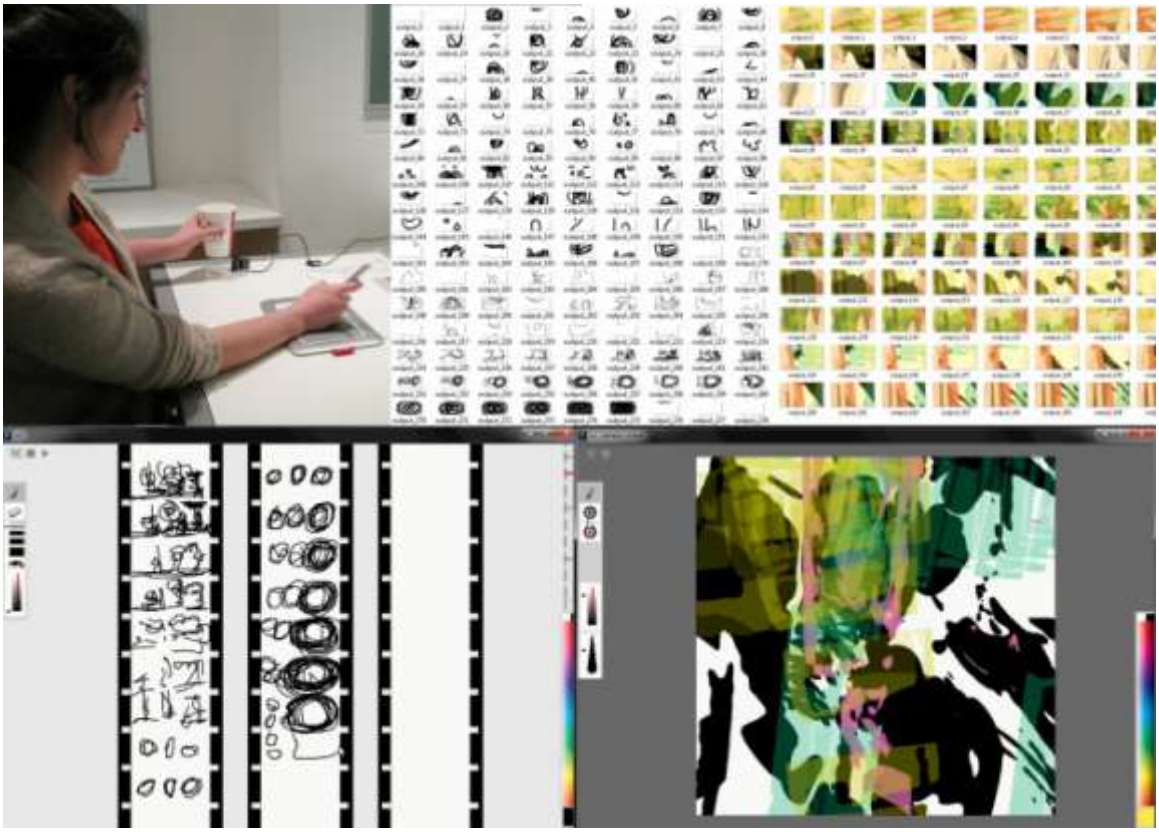
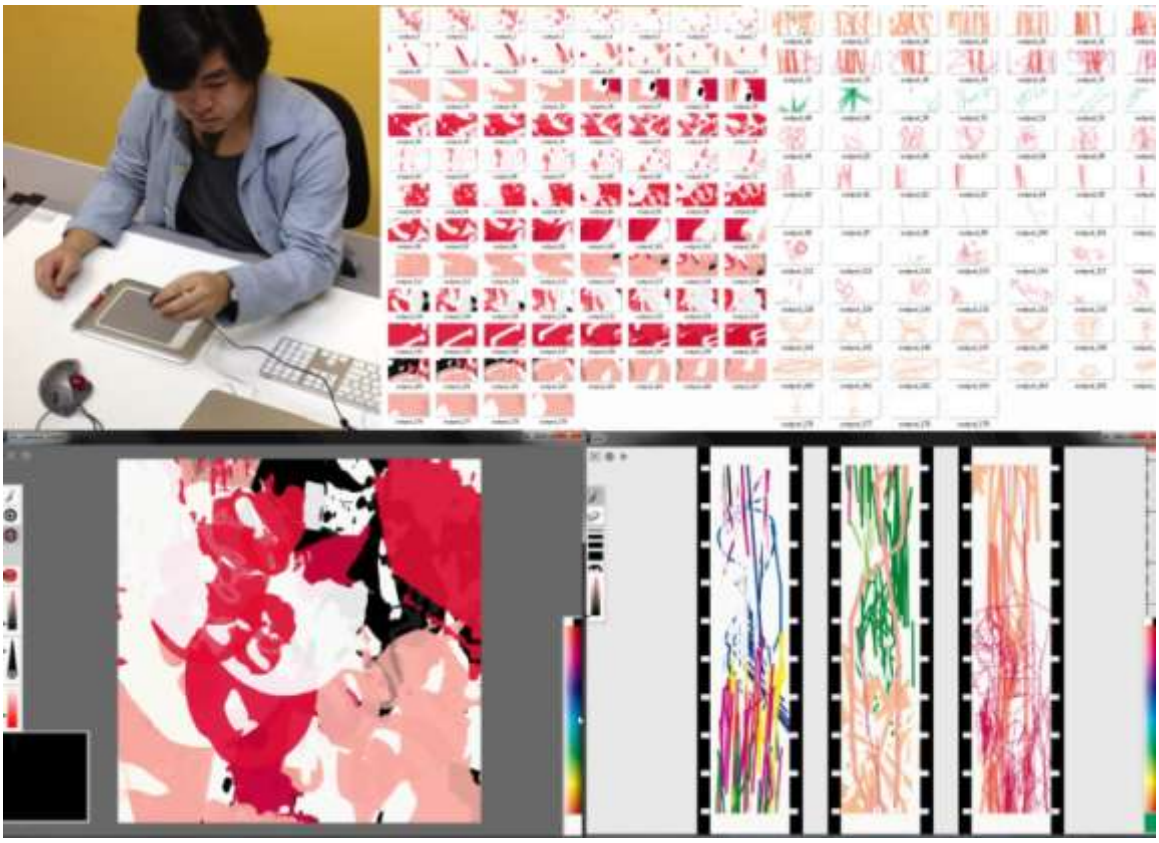
Appendix

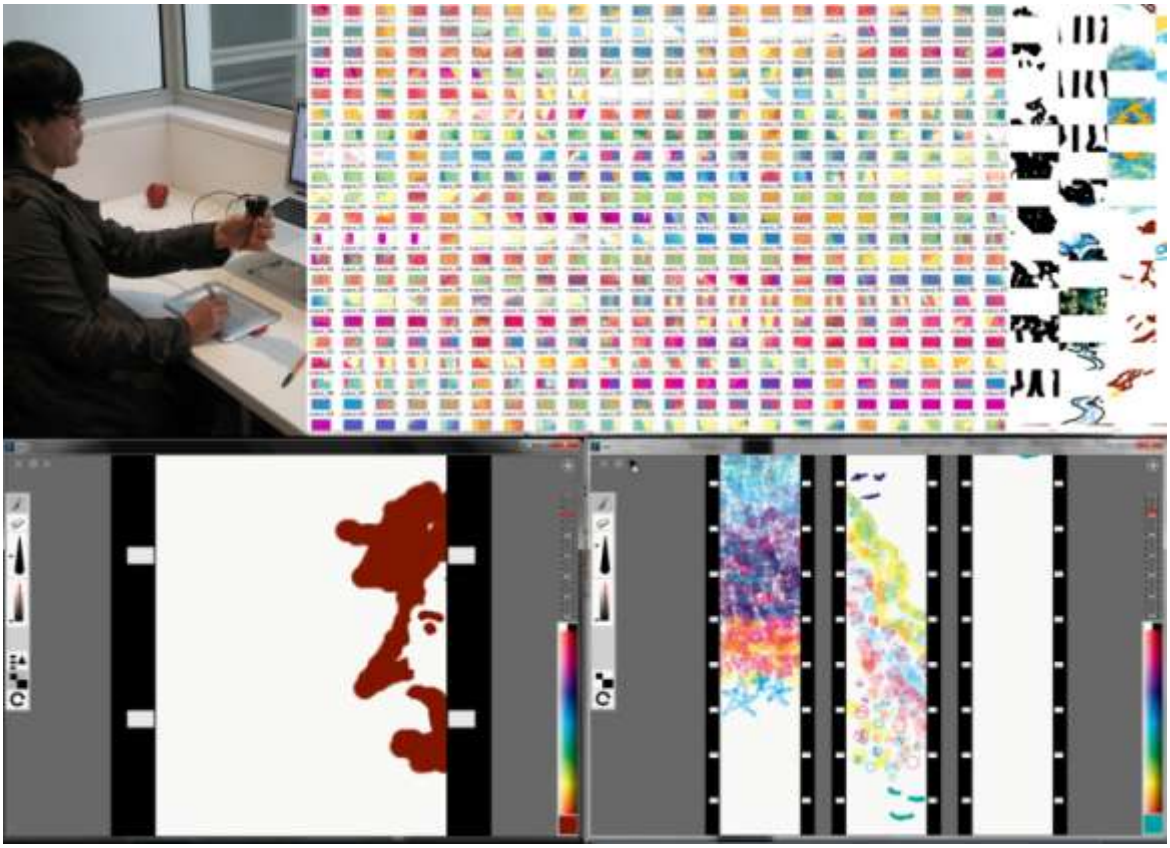
Appendix A: Dimension transformation between image and film



Appendix B: Participants 1, 3 and 4 and their *Hand Painted Film Plus* outputs





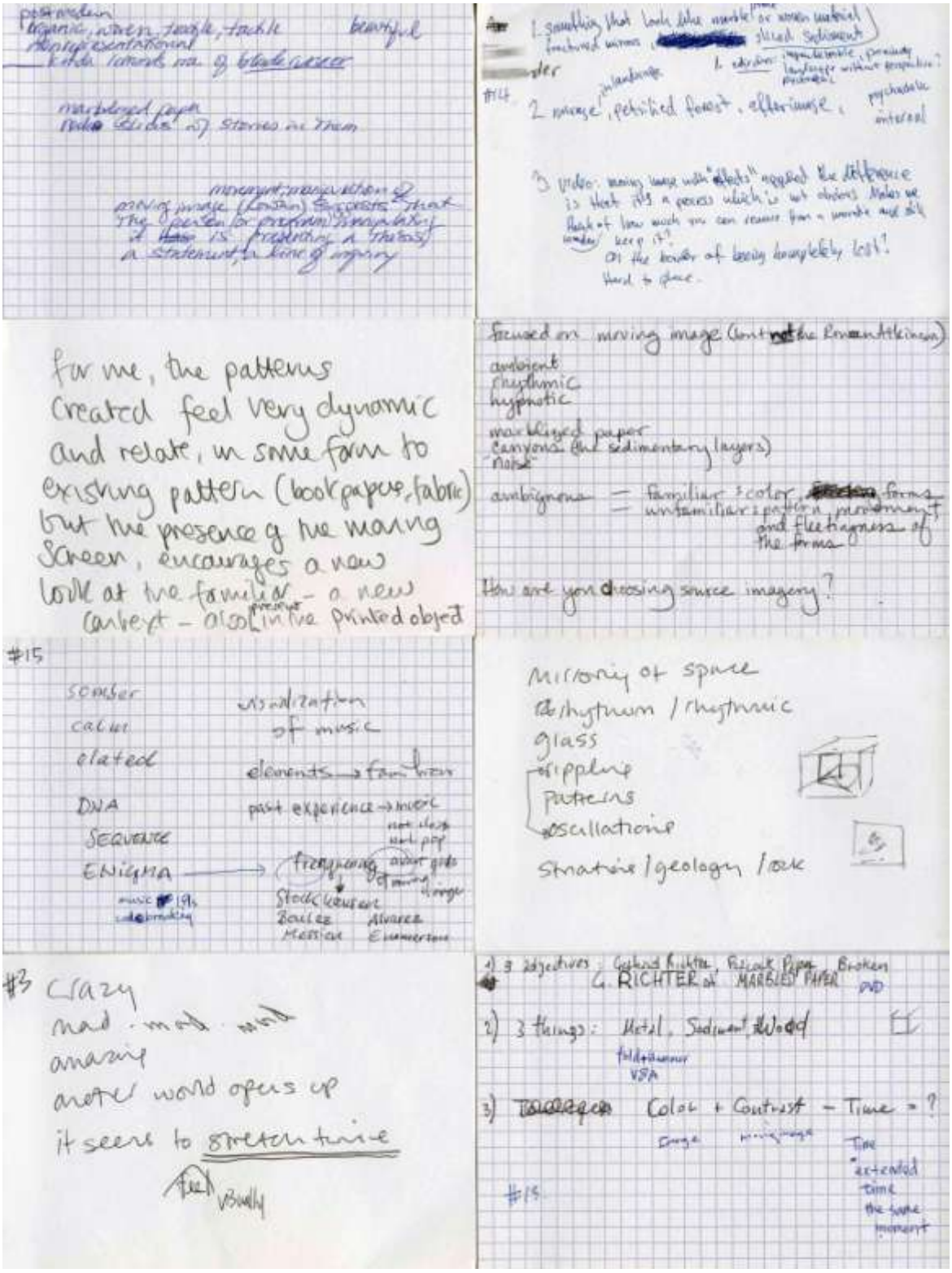


Appendix C: Semi-structured interview and questionnaire on *Cubic Film* outputs from the RCA Research Exhibition, London (2013) and the Digital Futures event at the V&A Museum, London (2012)

I asked each participant or visitor three questions and had a conversation with them to understand how they interpreted the output and the distortion.

1. Three adjectives
2. Three related things
3. What is new to you?

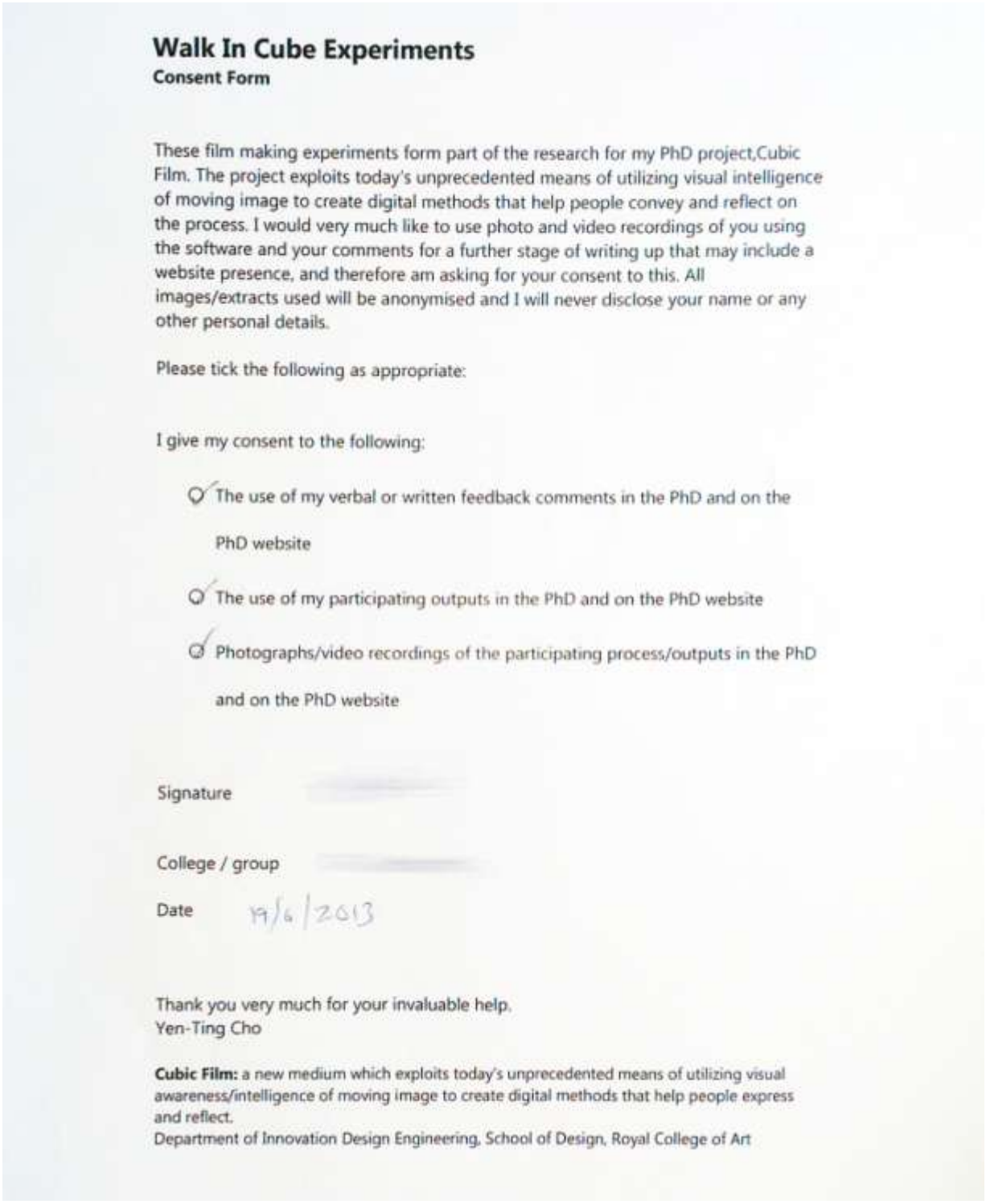
Appendix D: Copies of participants' answers to the *Cubic Film* semi-structured interview and questionnaire



Appendix E: Chart showing participants' responses to the *Cubic Film* semi-structured interview and questionnaire

	Three Adjectives				The Related Things				What is new to you?			
01 Nil Jean	Organic	Texture	Beautiful		Nature	landscape	art history convention, distortion of the original		see process in the image	from nature	self reflection	self-contained process and content (windy)
02 Salt	abstract	floating	waving		Gerhard Richard	forest	skye of isle		texture (hand feeling)	3D in image	people moving in the image	
03 Fan	waveing	hot	floating		Desert	cloth	the skin of tree		floating rymthmic			
04 Thee	Texture or pattern								glitch	interesting video clips		
05 Annlin	repeatitive	wavy	dynamic		house	sound wave	stone texture		digital but has life	similar to painting	texture	
06 Amanda	rhythmic	absorbing	light		sound	oil based book paper	fabric		the patterns created feel very dynamic and relate in some form to existing pattern (book paper, fabric)	but the presence of the moving screen encaurages a new look at	the familiar - a new context - also the present in the printed object	
07 Victor	continuous	flow			side of book	rain drops on	Lamination	cross eye arts	Beyond the limit of time	New Index (image)	3D Layer recording	
08 Harriet	tantalising	kaleidossopic	intriguing		texture klint	painting tiles	windows of building wallpaper	apartment wires	not shocking different	computure blips	in between displines (art and craft, textile and photography) familiar and	
09 Eunice	emotional	transforming	peaceful		ripples	Polar light	fog		perspective	pattern trace		
10 Agnes	Nature	Emotional	Sound		forest	landscape	ocean		movement			
11 Joseph Ho	Temporal	enbodiment	liminal		montage	feather	water		space (in & out) 2.0	skin of sculpture		
12 Tingyu	Natural	Enviromental	Fluid		water	snake skin	Sedimentary Rock		inbetween (nature & digital)			
13 Paolo	Gerhaed Richter	Paper	Broken DVD		Metal (Hammer +	Sediment	Wood		color + contrast - time = ?	Extended Time		
14 Emma	impenetrable	proximity	landscape without perspective	psychadelic	marble/stone mirage in	woven material petrified forest	afterimage sediment		Video: processing which is not obvious	remove from narrative and still keep it?	on the border of being completely lost	
15 Friedemann	somber	calm	elated		DNA sequence	Enigma music 19s			visualization of music	elements	past experience	Stockhausen Boulez
16 Meg	ambient	rhythmic	hypnotic		marblized paper	canyons	noise		familar: color forms	unfamiliar: pattern, movement, and the fleetingness of the forms	How are you choosing source imagery	
17 Sarah	postmodern nonrepresentational	organic beautiful	woven		blade runner	marbalized paper	rock		Mr Bean, the manipulation suggests,	it is a presenting a thesis, or statement	a line of inquiry	
18 Meg's mate	flowing	transitory	superficial		impressionistie	evolution(organic)						
19 Amy					calligraphy elements				Process VS result. knowing the process (how it's made) is essential to my understanding of the work.	It's also a word play between this "process 過程" and computer	"processing"--they went through both. If process out of date?	

Appendix F: Consent form for reproducing recorded photos and images



Walk In Cube Experiments

Consent Form

These film making experiments form part of the research for my PhD project,Cubic Film. The project exploits today's unprecedented means of utilizing visual intelligence of moving image to create digital methods that help people convey and reflect on the process. I would very much like to use photo and video recordings of you using the software and your comments for a further stage of writing up that may include a website presence, and therefore am asking for your consent to this. All images/extracts used will be anonymised and I will never disclose your name or any other personal details.

Please tick the following as appropriate:

I give my consent to the following:

- ☑ The use of my verbal or written feedback comments in the PhD and on the PhD website
- ☑ The use of my participating outputs in the PhD and on the PhD website
- ☑ Photographs/video recordings of the participating process/outputs in the PhD and on the PhD website

Signature

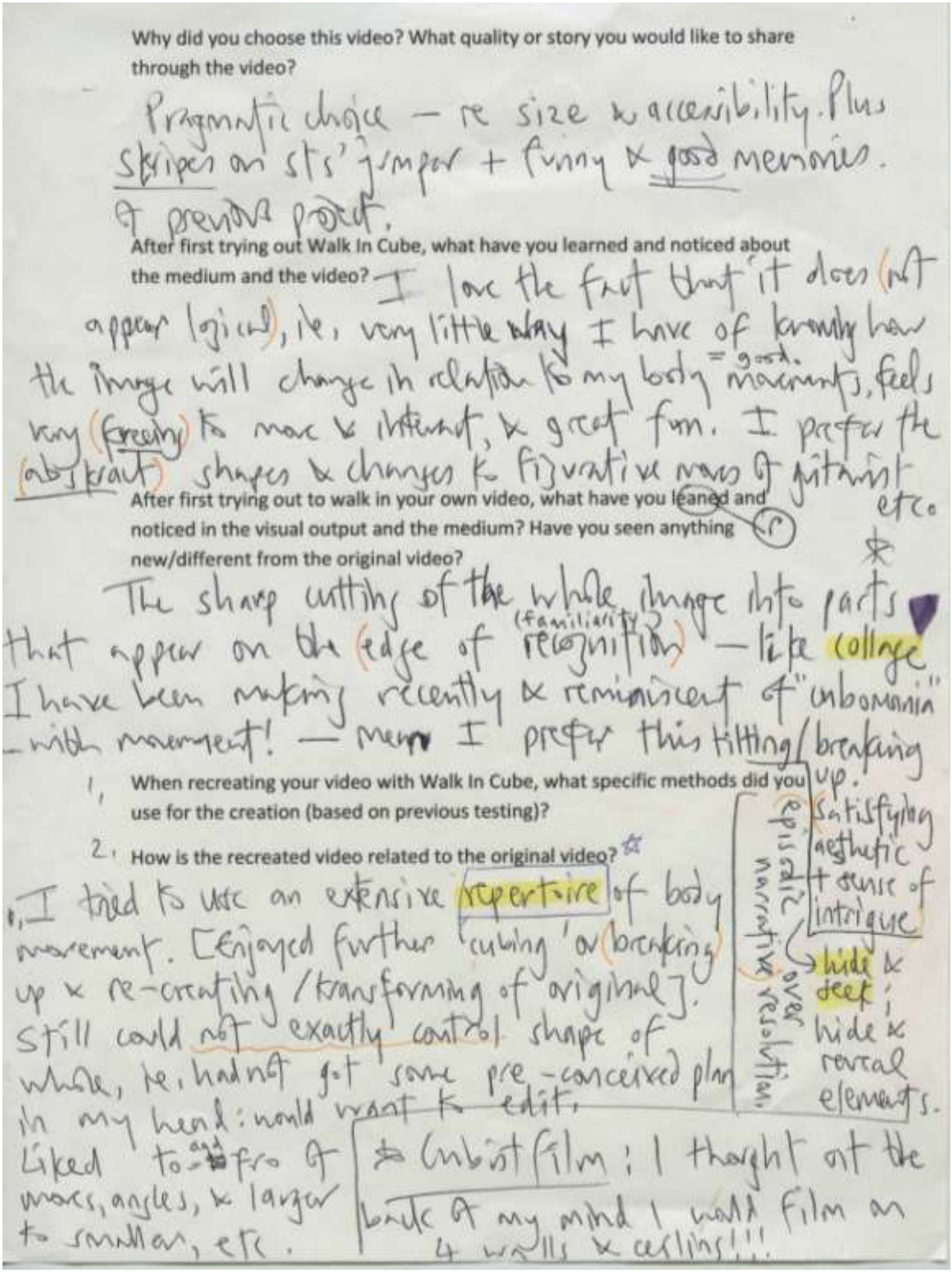
College / group

Date 19/6/2013

Thank you very much for your invaluable help.
Yen-Ting Cho

Cubic Film: a new medium which exploits today's unprecedented means of utilizing visual awareness/intelligence of moving image to create digital methods that help people express and reflect.
Department of Innovation Design Engineering, School of Design, Royal College of Art

Appendix G: Responses from participant 1, 2, 3, 6, 8 and 11 to the *Walk In Cube* semi-structured questionnaire



Why did you choose this video? What quality or story you would like to share through the video?

Pragmatic choice – re size & accessibility. Plus stripes on sts' jumper + funny & good memories of previous project.

After first trying out Walk In Cube, what have you learned and noticed about the medium and the video? I love the fact that it does (not appear logical), ie, very little way I have of knowing how the image will change in relation to my body movements, feels very (freeing) to move & interact, & great fun. I prefer the (abstract) shapes & changes to figurative ones of guitarist etc. = good.

After first trying out to walk in your own video, what have you leaned and noticed in the visual output and the medium? Have you seen anything new/different from the original video?

The sharp cutting of the whole image into parts that appear on the (edge of recognition (familiarity)) – like (collage) I have been making recently & reminiscent of "unbomania" – with movement! – mmm I prefer this (slitting/breaking up.) (satisfying aesthetic + sense of intrigue)

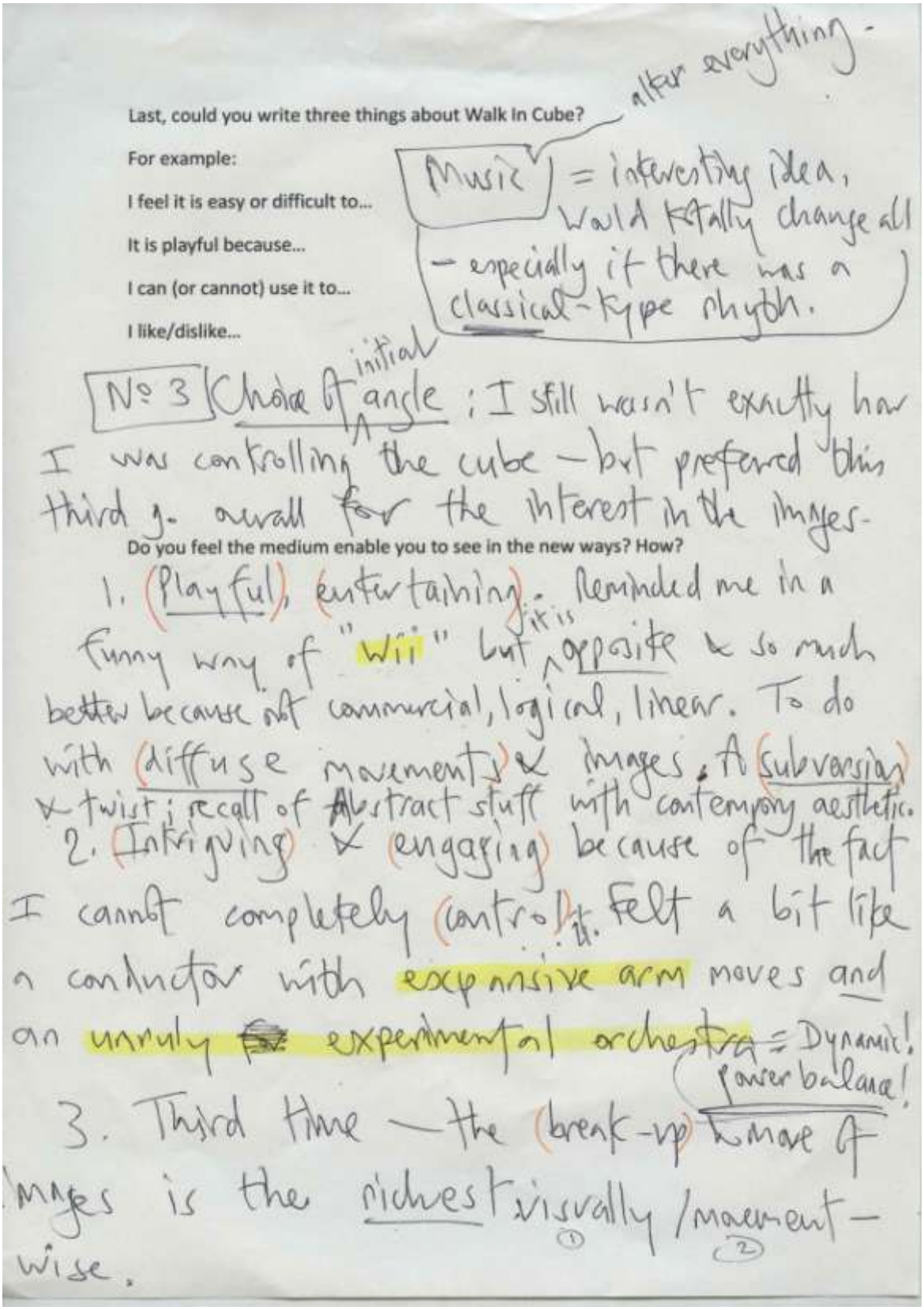
1, When recreating your video with Walk In Cube, what specific methods did you use for the creation (based on previous testing)?

2. How is the recreated video related to the original video?

1, I tried to use an extensive (repertoire) of body movement. [Enjoyed further 'cubing' or breaking up & re-creating / transforming of original]. Still could not exactly control shape of whole, ie, had not got some pre-conceived plan in my head: would want to edit. Liked to go fro of macro, angles, & larger to smaller, etc.

(episodic narrative over resolution.) → hide & deep; hide & reveal elements.

☆ Cubist film; I thought at the back of my mind I could film on 4 walls & ceiling!!!



Last, could you write three things about Walk In Cube?

For example:

I feel it is easy or difficult to...

It is playful because...

I can (or cannot) use it to...

I like/dislike...

after everything -

Music = interesting idea, would totally change all - especially if there was a classical-type rhyth.

No 3 Choice of initial angle ; I still wasn't exactly how I was controlling the cube - but prefered this third g. overall for the interest in the images.

Do you feel the medium enable you to see in the new ways? How?

1. (Playful), (entertaining). Reminded me in a funny way of "Wii" but it is opposite & so much better because not commercial, logical, linear. To do with (diffuse movement) & images, A (subversion) & twist; recall of abstract stuff with contempory aesthetic.

2. (Intriguing) & (engaging) because of the fact I cannot completely (control) it. Felt a bit like a conductor with expansive arm moves and an unruly experimental orchestra = Dynamic! power balance!

3. Third time - the (break-up) & move of images is the richest visually (1) / movement-wise (2).

Why did you choose this video? What quality or story you would like to share through the video?

This video depicts the practice of Base-jumping. As a relatively new sport it is as close to flying as you can get. I love the dreamlike almost abstract quality of the video.

After first trying out Walk In Cube, what have you learned and noticed about the medium and the video?

Firstly the video is really suitable for this medium. Abstract in itself the depiction of people ('flying') / base-jumping inspires you to use your whole body in using / manipulating the medium. The medium is fairly intuitive, although a little disorientating at first. It is like a large piece of origami paper you use your whole body to fold. Space is being rearranged.

After first trying out to walk in your own video, what have you leaned and noticed in the visual output and the medium? Have you seen anything new/different from the original video?

Learning how to move in the medium is like learning how to move using a mirror - much like dancers use mirrors - you learn how to use your body, + in doing so, become really aware of your own body. The video becomes an avatar, or a cyber physical vessel for your own consciousness. You have an out-of-body experience whilst still being aware of your own body

When recreating your video with Walk In Cube, what specific methods did you use for the creation (based on previous testing)?

How is the recreated video related to the original video?

By identifying with the depicted space/video as a sheet of paper, it was easier + (more intuitive) to manipulate it. Smooth varied movements, the full use of body waving arms, legs + torso, varying the position of body in relation to the kinect detector - these all enabled me to fold the space in interesting ways.

Last, could you write three things about Walk In Cube?

For example:

I feel it is easy or difficult to...

It is playful because...

I can (or cannot) use it to...

I like/dislike...

Walk in Cube is really interesting - it enables you to experience space + move in different ways - in a "full body way"
It is very (playful) by allowing your body to fully manipulate space.
It does have some problems with connecting the body + projection.

Do you feel the medium enable you to see in the new ways? How?

Yes. It enables you to bodily feel the medium - to fully and ~~also~~ viscerally connect / experience it.
The folding - manipulation of space is very interesting + different.

Why did you choose this video? What quality or story you would like to share through the video?

- It is an attempt to materialize the interface.
- self-contained object

After first trying out Walk In Cube, what have you learned and noticed about the medium and the video?

- the video is easy to identify and a valuable point to move around.
- medium turn representation into an abstraction
- Orphée (Cocteau) reference

After first trying out to walk in your own video, what have you leaned and noticed in the visual output and the medium? Have you seen anything new/different from the original video?

- the possibility to create multiple surfaces within the cube
- (unpredictability) of the outcome, the apparent infinite variety of patterns that are possible to create
- strong aestheticisation power of the medium.

When recreating your video with Walk In Cube, what specific methods did you use for the creation (based on previous testing)?

How is the recreated video related to the original video?

- I focused on the visual outcome of the medium
- It is a very (immersive) experience, the body is forgotten
- The medium offers an experience close to (drawing approach)
  ① first the lines of the cube led me to think of the spaces between the image and the cube
  ② without the borders of the cube, I focus on the image 'from within'
- the recreated video is very different from the original.

Last, could you write three things about Walk In Cube?

For example:

I feel it is easy or difficult to... yes

It is playful because... yes it is but the creative potential of the medium as an artistic tool is more important

I can (or cannot) use it to... yes

I like/~~dislike~~...

Do you feel the medium enable you to see in the new ways? How?

Yes, it is an original, alternative way of visualising video, it provides a speculative illustration of what lies beyond the image. There is an element of narration that invites you to discover the implications of what an image is. (video tends to be taken for granted these days)

Why did you choose this video? What quality or story you would like to share through the video?

Clouds in sky is one of the subjects of my own artistic research. I thought it would be interesting to see what happens. I am interested in how the film evokes a short passage of time in layers of clouds at differing distances.

After first trying out Walk In Cube, what have you learned and noticed about the medium and the video?

The corners of the image correspond to my hands and feet.

It made me think of my body in terms of a (foldable surface).

After first trying out to walk in your own video, what have you leaned and noticed in the visual output and the medium? Have you seen anything new/different from the original video?

Yes, the clouds seem to work well in this medium. Even they are abstracted they remain (recognizable).

The way the image is abstracted changes dramatically based on the angle of the cube. From the first angle, I felt more as if I were manipulating the film in linear time, while from the second angle I was more interested in the changing shape of the film.

When recreating your video with Walk In Cube, what specific methods did you use for the creation (based on previous testing)?

How is the recreated video related to the original video?

I first tested what my hand/feet movements would do from the new angle. I found the orientation at which the film would appear as close as possible to its original form. Then I played at folding the image and pushing it forward and backward to compose images and to create (dynamic) sequences.

video

The recreated video still looks like clouds in the sky, but the abstraction of the film form leads me to question the material nature of the cloud/sky in ways I hadn't considered previously. I found the experience to be an act of questioning the original.

3D but no volume

Last, could you write three things about Walk In Cube?

For example:

I feel it is easy ~~or difficult~~ to... use.

It is playful because... no matter how much I experiment with it, I am always surprised at its response.

I can ~~(or cannot)~~ use it to... make art!!!

I like/~~dislike~~... it very much.

Do you feel the medium enable you to see in the new ways? How?

Yes, it helped me to consider the interdimensionality of a medium (film) that is otherwise fairly conventional and well understood. I could spend a long time thinking about this...

Why did you choose this video? What quality or story you would like to share through the video?

The video is related to the travel guide of Kyoto, my favorite city.

I'd like to share the beautiful scenery in that city.

After first trying out Walk In Cube, what have you learned and noticed about the medium and the video?

It seems there've some range restrictions.

The movements of the cube is pretty cool, but I've got no clues about what the cube is intended for.

After first trying out to walk in your own video, what have you leaned and noticed in the visual output and the medium? Have you seen anything new/different from the original video?

Different frames of movies/video are (entangled & twisted) together. The rotation of video clips can be adjusted by gestures movements.

But it's a bit hard to know the ~~surface~~ of cube is belongs to which frame.

When recreating your video with Walk In Cube, what specific methods did you use for the creation (based on previous testing)?

How is the recreated video related to the original video?

I've tried to bound my (arms) to distore the generated video. The most ~~fascinating~~ part is, in certain frames of the video, the transition of ~~different~~ ~~pose~~ can be speeded up or slowed down by shift of position. Speed of

Compared to original video, the newly created video can be fully controlled by users, which can give users more feelings of (involvements).

Last, could you write three things about Walk In Cube?

For example:

① I feel it is easy or difficult to... easy the control of cube by arms difficult to shift the cube in the positions we like.

② It is playful because...

③ I can (or cannot) use it to... users can adjust or control the created video by movements, instead of conventional devices, like keyboard etc.

④ I like/dislike...

⑤ advertisements, or incorporation into user interfaces of machine.

④ I favor the part of video progress shifted determined by Do you feel the medium enable you to see in the new ways? How? shift of bodies

1° The order of frames can be (mixed) together instantly without (lack instantly) Once users get used to the system, they can (re-generate the video in their preferable way.) relaxing

2° the control of video clipping or special effects can be done by human body movements, which enable users enjoying the process of making their own unique videos.

Why did you choose this video? What quality or story you would like to share through the video?

I chose this video because it depicts my home town, Lyttelton, New Zealand, which was struck by a devastating earthquake in 2011. This video shows historic footage of the Time-ball Station, which was my favourite building, but was destroyed by the earthquake.

After first trying out Walk In Cube, what have you learned and noticed about the medium and the video? It took me a while to figure out how to control the medium, but after moving for a while I realised that ~~I don't have~~ I had more control than I expected. A very simple thing I noticed about my video was how dark it was!

After first trying out to walk in your own video, what have you leaned and noticed in the visual output and the medium? Have you seen anything new/different from the original video?

I learnt a lot more about how to control the medium, such as being able to move forward and backwards or seeing both the beginning and the end. I was also able to make more interesting patterns and explore the video. mix

When recreating your video with Walk In Cube, what specific methods did you use for the creation (based on previous testing)?

How is the recreated video related to the original video?

At first, I tried to find an unusual angle from which to begin. I started by turning the video so that it was rotated 90° to the right. I then used my arms to create interesting images and trying to see it from three different angles. The recreated video I feel really shows experiences of the earthquakes on this area.

Last, could you write three things about Walk In Cube?

For example:

I feel it is easy or difficult to...

It is playful because...

I can (or cannot) use it to...

I like/dislike...

"part of" video recording

- It is "playful" because you actually feel like an "active" user of the video rather than a passive viewer
- The Walk In Cube allows me to experience videos in a completely different way by making me see things I would never have noticed.
- While at first it is "disorientating," it does not take long to work out how to use it.

Do you feel the medium enable you to see in the new ways? How?

- Yes, ~~mostly~~ by allowing me to see from different angles, which then in turn makes us look for different things.

white car & stop sign (unusual position) looking for noticing new things

Appendix H: Comparative chart showing the relationship between *Walk In Cube* inputs and outputs

Group Type	Participant	Video Content	Abstract level	Time	Space	Movement	scenes	Content Type	Entering Angle	Angle note	Note
Demonstrating	Guitar	A men playing guitar	1	2	Single Character/backgroun static	little/specific	1	Animation/Edited			Encrypted the key moment
	Harriet 1	A man eating a candy paper	1	3	Single Character/backgroun static	little/specific	1	Indoor event/Raw			break sequence and patterns
People in space	Claudia 4	a busy morning street in front of a shop	1	3	structured space/layers	static	1	Outdoor /Raw	face		breaking sequence, patterns, Manipulate the layers of the space, Play the foreground/background
Animal in space	Jieun 9	cat jumping	1	2	Single Character/backgroun static	fast movement	4	Home /Raw	close to x		See sequence/aware the context
Entering a space	WeiDan 14	Entring a misty space	2	3	divided space	slow mvoement	5	Animation/Edited	Corner or face are fine		Still entering/different direction
	Josephine 11	driving through her home town	1	3	Through a path	fast movement	1	Outdoor Culture/Raw	close to x, space opens up		Aware the context\Experience linked
	Chih Hao 8	Walking through a path in Kyoto	1	3	Through a path	slow movement	3	Outdoor /Raw	close to x		still feel the same space/but collaged, Create Multi Enters
	Ying 2	base jumping	2	3	Open (entering) space	Entering the space (shaking)	1	Outdoor Sport /Raw	close to x / face		mimicking the experience,Change the diraction
observing a space	Cathy 10	Tree in wind	2	2	layers	fast movement	1	Outdoor /Raw	Both, face (volume), Edge (Stretch)		layers space, Create patterns
Foreground/Backgr most closed	Meg 6	clouds moving slowly in the sky	2	2	layers	slow movement	1	Outdoor /Raw	Both, face (volume), Edge (Stretch)	Edge is the best!	Manipulate the layers of the sky/ Cloud is a round trip
Close Shot (face)	Jamie 7	baby's face (home video)	1	2	Single Character/backgroun static	slow/little	1	Home /Raw	close to x > 主角 y z > display movement		find the baby's face and play with the distortion
Foreground/Backgr most sperated	Yuchang 13	daughter running (home video)	1	3	Single Character/moving background	fast movement		Outdoor baby/Raw	y, x, edge		the movement has been represented/distorted
People moving in white background	Chinwei 15	dance	1	3	Single Character/backgroun static	very fast movements	1	Indoor Event/Raw	close to x/corner	Spectrum	too messy/ abstract pattern
	Yeun 12	body movements	2	2	Single Character/backgroun static	slow movement	15+	AD / Edited	all	Spectrum	recreate the movement/showdow now is part of the subject/cocreate/Well mixed abstract and figurative
Abstract Animation	Nils 3	Abstract patterns	3	1 Distru	abstract 2D patterns	shaking (no camera)	3	Animation/Both	Corner is better		Create unexpected patterns
Narrative Animation	Anntin 5	Animation about birth	2	2	motiple characters morphing	geometric	2	Animation/Edited	corner		creating new sequence and story
	WeiDan 14	Entring a misty space	2	3	divided space	slow mvoement	5	Animation/Edited	Corner or face are fine		Recreate the story
Text	IDE	Three words appeal on the screen in sequence I D E	1	3	Three Characters/backgrou static	little	3	Text/Edited	Both (simple, so not confusing) Angle is more exciting		Combinations of the three words, and distortion of the words/Hide and seeks

I: Structured questionnaire for collecting participants' self-reports on specific body postures

WIC Participatory Experiment

Based on your experience, how much do you identify with each of the following scenarios (i.e the future applications) and findings?

Strongly agree = 5;
Agree = 4;
Neither agree nor disagree = 3;
Disagree = 2 ;
Strongly disagree = 1

* Required

Posture

1. **1-1 Posture : Extending** *
   Extending your body gives you a panoramic view of the video, which is usually useful to view the sequence movement of an object, or to make a collage by spanning through scenes.
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

2. **1-2 Posture : Bending** *
   Bending your body helps you distort the video and change the shape of the frame. For example, when along the original video sequence, bending your body forward mixes the sequence and gives you a tunnel shape to circle the leading character.
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

3. **1-3 Posture : Twisting** *
   Twisting your body gives extra dynamism to the video.
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

4. **1-4 Posture : Folding** *
   Folding your body creates breaks and produces parallels of the original sequence. It is the best way to create a collage.
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

5. **1-5 Posture : Exercising** *
   You feel that you have done exercise without feeling that you are actually exercising.
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

6. **Comments**

Appendix J: Results of the structured questionnaire which collected participants' self-reports on specific body postures

	A	B	C	D	E	F	G	H
1			1-1 :	1-2 :	1-3 :	1-4 :	1-5 :	
2								
3	Participant with their own videos							
4	7/19/2013 0:56:07		4	4	5	4	4	
5	7/19/2013 9:56:04		4	5	4	4	5	
6	7/19/2013 10:25:27		4	5	5	4	4	
7	7/19/2013 16:23:14		3	4	5	4	3	
8	7/19/2013 16:45:36		5	4	4	5	5	
9	7/20/2013 14:58:32		5	4	5	5	4	
10	7/22/2013 16:07:20		4	4	5	4	1	
11	7/22/2013 18:30:37		3	4	3	5	2	
12	7/23/2013 8:43:27		5	5	5	5	5	
13	7/23/2013 16:42:05		5	5	5	5	5	
14	7/24/2013 0:21:13		5	5	4	2	5	
15	7/30/2013 12:39:19		5	5	5	5	5	
16	8/2/2013 17:45:15		3	4	3	4	2	
17	8/3/2013 7:55:01		5	5	5	4	3	
18	Sub-Average		4.285	4.5	4.5	4.285	3.785	
19								
20	Random Participants							
21	7/21/2013 10:27:45		5	5	3	4	4	
22	7/22/2013 17:46:21		5	5	5	3	3	
23	7/25/2013 3:23:20		3	3	3	3	5	
24	7/30/2013 4:46:59		5	5	4	5	5	
25	8/3/2013 1:25:05		4	4	5	5	5	
26	8/11/2013 11:00:59		4	5	4	5	5	
27	Sub-Average		4.333	4.5	4	4.166	4.5	
28								
29	**Sum (Score)**							
30	Strongly Disagree		0	0	0	0	1	
31	Disgree		0	0	0	1	2	
32	Neither agree nor disagree		4	1	4	2	3	
33	Agree		6	8	5	8	4	
34	Strongly Agree		10	11	11	9	10	
35	**%**							
36	Strongly Disagree		0	0	0	0	5	
37	Disgree		0	0	0	5	10	
38	Neither agree nor disagree		20	5	20	10	15	
39	Agree		30	40	25	40	20	
40	Strongly Agree		50	55	55	45	50	
41								
42								
43	**Total score**		86	90	87	85	80	
44	**Average**		4.3	4.5	4.35	4.25	4	
45								

Appendix K: Key word and sentence sorting of the textual data from the *Walk In Cube* semi-structured questionnaire

About Walk In Cube

	Bodily Experience
2, 4, 5, 6, 7, 8, 11, 13, 14, 15 21, 22	Bodily Engaging
1, 2, 7, 10, 11, 13, 14, 15	Playful
1, 6, 2, 10, 11, 12, 5, 7,	Intuitive
4, 6, 9, 13	Dynamic
4, 14, 11	Disorientated
3, 7	Immersive
5, 12	Rhythmic
5, 7	Responsive
	Exploring
3, 4, 5, 6, 11	Unpredictable
1, 4, 6, 11, 13	Mix with control level
5, 6, 14, 15	Infinite of possibility
1, 5	Not logical
	Creating
1, 3, 4, 7, 13, 14, 22	Abstract
1, 3, 5, 12, 14, 21	Creative
5, 8, 13	Distortive, Entangle, Twisted
13, 14	Realistic
5, 15	Flashy
12	Deconstructive
10	Mix abstract and representational
6	Recognizable
4	Layered

What In Cube does

	Exploring
1, 9	Hide and reveal
4, 8	Mix of abstract and figurative
11, 13	Personal experience related
3	Reveal glimpse of the networking not one at a time
1	Cut of the whole image into part that appear on the edge of recognition
1	Turn representation into an abstraction
3	Provide speculative illustration of the lies beyond the image
5	Distort image
12	Deconstruct image
1	Diffuse movements
	Bodily Experience
2, 6, 10	Enhance the awareness of your own body
2, 4, 14	Use your "whole" body
3, 10	Immersive (forgot your own body)
2	Empowers the physical self
2	Make participant relearn
14	Expend your senses
	Creating (Space)
4, 5, 6, 10	Changes the depth in the video
21	Create multiple surfaces within the cube
4	Lost perspective (Fore ground against the background)
12	Panoramic view
	Creating (Time)
4, 13, 21	Enhances parallax
1, 14	breaks with narrative content
4	Take characters from the original and place them in the weird landscape
7	Distorted the meaning/feeling of the video
10	Change the atmosphere of video
12	Change the time axis
9	Give dynamism of time

Metaphor to describe Walk In Cube

Frame

2, 6, 14, 15	Origami, sheet of paper
6, 7, 10	Object in object
4	Wrapper blown
14	Spider Net

Space

11, 12	360 degree mirror
14	Under the water
4	Airport corridor
9	Cave
21	Tunnel
1	Repertoire of body movement

Bodily Engaging

5, 8, 15	Bodily remote controller
2, 10	Avatar
6	Puppeteer

Exploring

1	Hide and seek

Creating

1, 14	Collage
4, 5	Alternative mirror

I used Walk In Cube to

Exploring

11, 9, 7	Aware of the context of the video
7, 11	Explore hidden information in the context
13	Play what I have found in the video
4	Exploring surface and time
13	Find data because the information now has a specific 3D location
15	Review my own body poster and find new ones

Create (Space)

2, 6, 10	Manipulate space in the video
3, 14	Draw with my body
6, 11	Composite an image
1, 14	Collage
7,13	Manipulate the shape of the video
1,5	Break image
7	Play with scale, color, form
8	Create recognizable pattern

Create (Sequence)

4, 5, 12	Create new story
1, 21	Create episodic narrative
11, 13	Mix the beginning and end of the video
12, 21	Create new rhythm
12	Sculpt and modified the video
12	Create new meaning from the original video
9	Create new video by body movements

Bodily Engaging

6, 8, 21	Do exercise
8, 9, 15	Control a video by body movements
4, 5	Move forward/back forward the video

Seeing in new way

Hide and Seek (Aware the context)

3, 7, 15 I move much slower and more delicate than usual to see the image carefully and look for information/patterns

7, 9, 11 Aware of the context and notice new objects

9, 13 Aware the movement in the original video

Exploring

7, 15 Look at the film from different angle

3, 13 Video is now taken for granted (24 second video become a world of form absorption).

9 I can now see several cats in one sight (only one cat in the previous video)

8 User can adjust or control the created video by movement instead of conventional device

6 It makes me to question the material nature of the cloud/sky (participant's subject)

12 New relationship between the video and audience

Creating

3, 14 The recreated video is very different from the original

1,12 It helps me to reconstruct the deconstructed information in my own way

12 It gives me a original way to create, free me from previous trained concept and skills

For the future

4 More space to walk through

5 Hard to find the right path the play the video

12 It would be interesting to hear sound

8 When rotate it is hard to know the face of the cube is belongs to which frame

13 Less abstract

My experience

Exploring

2, 4, 5, 21 A process of relearning (object, interaction, orientation etc)

1, 3, 13 24 second video become a world of form absorption. I can play with it for long time.

5, 8, 13 The speed of my body movement is important.

7 It was fun to make the figurative video abstract - make it crazy - it's a fun and playful experience.

7 It responds to the body and the body responds to it.

11 I have more control then I thought.

Seeing in a new way

1, 5 Always find something new in breaks of the video

2 There is an element of narration that invite you to discover the implication of what an image is.

6 The experience is an act of question the original.

5 Video has been rearranged, so I see new (not logic, awkward) story. New story board.

5 The cut in the original video is illustrated in new dimension

6 Make me considering the interdimentalonlity of film

Creating

2, 6 I project my inner self onto an object

13, 8 When I understand the time sequence, based on what I have learned, I start to create an output

3 The medium offers an experience close to a drawing approach.

12 The medium could reveal the characteristic of creator easily (movement and relationship with the original video

8 The order of frames can be mixed together without bias.

9 Make me become a magician to zigzag the world.

Abstract

6 The way the image is abstracted changes dramatically based on the angle of the cube.

13 I can guess the abstract contents when they are in motion.

Space

11, 14 It is like Driving through a space.

4 The perspective is gone.

13 Walking into the video

Personal Experience Linked

11 I feel really shows experience of the earthquake on this area.

13 It makes me remember the shooting processing of the video.

Appendix L: Structured questionnaire for collecting participants' shared experiences

WIC Participatory Experiment

Based on your experience and the visual information, how much do you identify with each of the following scenarios (i.e the future applications) and findings?

Strongly agree = 5;
Agree = 4;
Neither agree nor disagree = 3;
Disagree = 2 ;
Strongly disagree = 1

* Required

Play with Home Video

1. **1-1 Play with Home Video : Entering a Space** *
   With a video that is about entering a space which has a clear single vanishing point, such as walking through a path or driving on the road, by moving your body you can feel strongly connected to the content of the video as you are entering the space. For example, a car coming from the opposite direction and passing by you would become very vivid because the car only moves when you move, and its speed depends on your speed of movement.
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

2. **1-2 Play with Home Video : Entering a Space** *
   The context of the video will be much more noticeable because it appears/disappears due to your movement, the distortion of original content, and the position change. For example, the traffic 'stop' sign on the side of the road can be moulded and moved to the centre of the screen because of your movement.
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

3. **1-3 Play with Home Video : A Long Shot** *
   With a long shot video of a natural subject, such as clouds, you can use your body to manipulate the patterns which feel like you can expand or reduce the space between the layers. This gives you a surreal experience in which you feel the natural environment is changing in a way which you have never experienced before.
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

4. **1-4 Play with Home Video : A Close-Up** *
With a video of your face, it will feel that you are walking into a house of mirrors. Moreover, you can use your body movement to create new distortion mixing the figurative and the abstract.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

5. **1-5 Play with Home Video : Sum Up** *
To sum up, with Walk In Cube, you are more likely to revisit your home video.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

6. **Comments**

_____

_____

_____

_____

_____

To Create

7. **2-1 To Create : Background Removed** *
With the video where its subject is moving with white/removed background, all parts of the moving subject, whether in the foreground or background in the original video, become the leading subject in the output. For example, the shadow of a dancer in the video can be part of the leading subject in the Walk In Cube.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

8. **2-2 To Create : The Cuts** *
The cuts in the original video become readable and a special visual language of their own.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

9. **2-3 To Create : Abstract Animation** *
If you input an abstract 2D animation and you choose a corner to enter the cube, with your body movements, you can easily create unexpected patterns and movements by making a collage with all the components throughout the video regardless of the original video sequence.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

10. **2-4 To Create : Figurative Animation** *
If you input a figurative animation with a simple background, the unpredictable combination of the patterns can lead to a new sequence.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

11. **2-5 To Create : Text** *
You can project your personality through movement to make an object, such as text, move and create rhythm.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

12. **Comments**

_____

_____

_____

_____

_____

Hide and Seek Game

13. **3-1 Hide and Seek Game : Find a Pattern** *

You need to find an assigned pattern or an object in the video. You know the pattern is somewhere in the cube and you move around the cube to find it. Through quickly exploring by moving your body, you have found a part of the pattern/object correctly. You then keep that part of your body static while moving other parts of the body to search for the other hidden parts of the pattern. Once you have found the identical pattern or object, you find your body is twisted. Now, the game level is complete and you know the next level might require more complex body posture.

Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

14. **3-2 Hide and Seek Game : Find an Event** *

If the information you need to find is a sequence or an action, for example, a man playing guitar, firstly, you move your body to find the man holding a guitar. Secondly, you keep the same posture, but walk forwards/backwards to see what exactly the man is moving. You then notice he is strumming and fretting on his guitar.

Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

15. **Comments**

_____

_____

_____

_____

_____

Appendix M: Results of the structured questionnaire for collecting participants' shared experiences

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1			1-1 :	1-2 :	1-3 :	1-4 :	1-5 :		2-1 :	2-2 :	2-3 :	2-4 :	2-5 :		3-1 :	3-2 :	
2																	
3	Participant with their own videos																
4	7/19/2013 0:56:07		5	4	3	3	5		4	4	5	3	4		4	4	
5	7/19/2013 9:56:04		5	4	5	4	4		5	4	4	4	4		4	3	
6	7/19/2013 10:25:27		4	4	4	3	5		3	4	5	4	4		4	4	
7	7/19/2013 16:23:14		4	3	4	5	3		4	4	4	5	4		3	3	
8	7/19/2013 16:45:36		4	3	5	4	5		3	4	4	4	5		4	4	
9	7/20/2013 14:58:32		5	4	3	2	3		3	5	4	4	5		4	3	
10	7/22/2013 16:07:20		3	4	4	4	4		4	3	5	4	3		5	5	
11	7/22/2013 18:30:37		4	5	3	4	2		3	2	5	4	4		3	4	
12	7/23/2013 8:43:27		5	5	5	3	3		4	5	5	4	4		4	4	
13	7/23/2013 16:42:05		5	5	5	4	5		3	4	4	3	5		5	5	
14	7/24/2013 0:21:13		3	2	5	5	5		4	3	5	5	3		5	3	
15	7/30/2013 12:39:19		5	4	5	4	4		5	5	5	5	4		4	4	
16	8/2/2013 17:45:15		3	4	4	4	5		4	5	5	4	4		2	4	
17	8/3/2013 7:55:01		5	3	5	5	4		5	5	4	4	3		5	5	
18	Sub-Average		4.285	3.857	4.285	3.857	4.071		3.857	4.071	4.571	4.071	4		4	3.928	
19																	
20	Random Participants																
21	7/21/2013 10:27:45		5	3	5	5	5		5	5	5	5	5		5	4	
22	7/22/2013 17:46:21		3	3	3	3	4		3	3	5	5	3		3	5	
23	7/25/2013 3:23:20		3	5	5	4	4		4	4	5	5	4		3	4	
24	7/30/2013 4:46:59		5	5	5	5	5		5	5	5	4	5		5	5	
25	8/3/2013 1:25:05		5	4	4	5	4		4	3	5	3	4		4	2	
26	8/11/2013 11:00:59		4	3	5	2	3		3	3	5	4	3		4	3	
27	Sub-Average		4.166	3.833	4.5	4	4.166		4	3.833	5	4.333	4		4	3.833	
28																	
29	**Sum (Score)**																
30	Strongly Disagree		0	0	0	0	0		0	0	0	0	0		0	0	
31	Disgree		0	1	0	2	1		0	1	0	0	0		1	1	
32	Neither agree nor disagree		5	5	4	4	4		7	5	0	3	5		4	5	
33	Agree		5	9	5	8	7		8	7	6	11	10		9	9	
34	Strongly Agree		10	5	11	6	8		5	7	14	6	5		6	5	
35	**%**																
36	Strongly Disagree		0	0	0	0	0		0	0	0	0	0		0	0	
37	Disgree		0	5	0	10	5		0	5	0	0	0		5	5	
38	Neither agree nor disagree		25	25	20	20	20		35	25	0	15	25		20	25	
39	Agree		25	45	25	40	35		40	35	30	55	50		45	45	
40	Strongly Agree		50	25	55	30	40		25	35	70	30	25		30	25	
41																	
42																	
43	**Total score**		85	78	87	78	82		78	80	94	83	80		80	78	
44	**Average**		4.25	3.9	4.35	3.9	4.1		3.9	4	4.7	4.15	4		4	3.9	
45																	

Appendix N: Cubic system

Project Name	Real World	+		=	Video	+		=	Project 4: Cubic Film	+		=	Project 5: Walk In Cube
Technical			**Point of view**				**Cube**				**Movement Tracking**		
Abstraction of Abstraction	Reality		Select		Recorded Realtiy		Abstract		Watching Abstract Reality				Experice the abstract Reality
Filmmaker's decision	Seeing the world		Framing > sequence + content				Cubing > Sequence				Spacing > shape of cross-section and the link between it and the audience		
Reletive Movement	RM 1 subject/environment		RM 2 Shooter/Camera		AM 1 = RM 1 + RM 2		AM 2 = Re-sequence A1		AM 3 = reveal/emphasize the RM in AM1		RM 3 Audience/cube to resequence cubic film + x		AM 4 = RM 3 + RM 2 or AM 2
Tiime/Space	Real Time/Space		Real Time/Space		Recorded Time/Space		Retrospective Time/Space		Distorted recorded Time/Space		Real Time/Space		Real Time/Space distorted the recorded Time/Space
Film Events			Event of shooting Hand Movement				Event of Printing / Cube printer		Media Matters to viewing the mix RM		Event of Projection		Frame Skin and Shape
Audience	Seeing the world				Sequence + Content				Ambiguity		Exploring		Creating
Craft VS Digital	Physical		Hand movement + Digital recorded		Digitally saved		Digital Transformation		Digital Presented		Body movement + Digital Tracking		Digital Presented

Appendix O: SmartGeometry 2011 report

Introduction

SmartGeometry 2011 consisted four-day workshop, one-day talkshop and one-day symposium. This year the topic was "Building the Invisible." Vast streams of data offer a rich resource for designers. User data, energy calculations, embedded sensing, material and structural simulation allows design to be situated and responsive.

The sg2011 workshop was organized around Clusters. Clusters were hubs of expertise. They comprised of people, knowledge, tools, materials and machines. The cluster in the workshop, which I joined, was named Reflected Environment. The primary objective of this cluster was to work with the occupancy and behavioral data in a given space using the SmartGeometry workshop space as a test bed. This cluster looked to reveal characteristics of the currents and mechanisms of occupant engagement that would otherwise go unnoticed, mapping the heat, electricity consumption, noise levels, temperature and air quality, online activity and motion of the workshop participants through the use of pre-wired sensors.

The Talkshop contained four sessions: Data by Design, which examine data as a raw material; Form follows Data investigates how data is informing design; Performative Data looked into the fading distinction between physical and virtual realms; The Data Promise analyzed some of the processes that transform data into design into data as design and data start to inhabit the same information saturated ecosphere. Following this year's challenge, Building the Invisible: Incorporating Real World Data into Digital Design, during the symposium, invited keynote speakers showcased major projects around the globe that exemplify the way data informs design. The discussion combined with presentations of the outcome of the four-day workshops. The conference was a unique opportunity to hear insights into the challenges ahead for the discipline.

What I did

The first day of workshop I installed electricity meter to power sockets used by each cluster. Enistic, which specialize in energy manager technology, helping people to understand their financial spend and energy use and carbon emissions, provided these meters. Then, I studied the Enistic website to see what kinds of data I can output from its

website and how I can use these data to generate information. I tried two ways, generating diagrams using the embedded function from the website, and using Processing to parse the data into a tsv file and create my own visualization on the second day.

On the third day and fourth day, I started to process video from the thermal video camera. I use Processing to image process the frames of the video, and identify white areas which indicate the source of heat, usually from human bodies and laptop. I then built a three dimensional model to Illustrate body movement in space through time. The z-axis represented the timeline. Finally, I analyzed how electricity consumption of each cluster would match the body movements in the space.

How this experience contribute to my research

First, I might apply similar techniques my cluster used to obtain information from my site. My cluster used many types of equipment, such as thermal video camera and electricity meter, and online survey to get both objective and subjective data. As I mentioned in the previous paragraphs, I experimented various way to processing the thermal video in the workshop, and all these techniques and video processing can be used to analyze my site and participants'' body movement as well. Secondly, there were ten clusters and each of them experimented with various methods, and materials. The variety inspired me with new ideas; meanwhile confirmed some my previous ideas. For example, one of the clusters tested knitting technique with sensing. The method can be applied to my idea of creating a wearable computing to help people find their in a huge exhibition space.

In terms of programming skills, I learned to use Enistic website and process thermal video. The most important gaining was that I used Processing to import data from the processed from thermal video and build a three-dimensional models. Although, some software could do this, only with Processing, the model could later be used as an interface for my future project. Finally, I experienced how collaboration with people from many different backgrounds could work on a project together. This experience solidified my ideas and belief that how my projects will be conducted. Also, through conference, with speakers from world leading firm, such as IBM, UNStudio, and SOM, I learned how collaboration between programmer and designers could work in the industrial world and from their practice experience, how this new trend, design with data, could really change both the current design method and outcome.

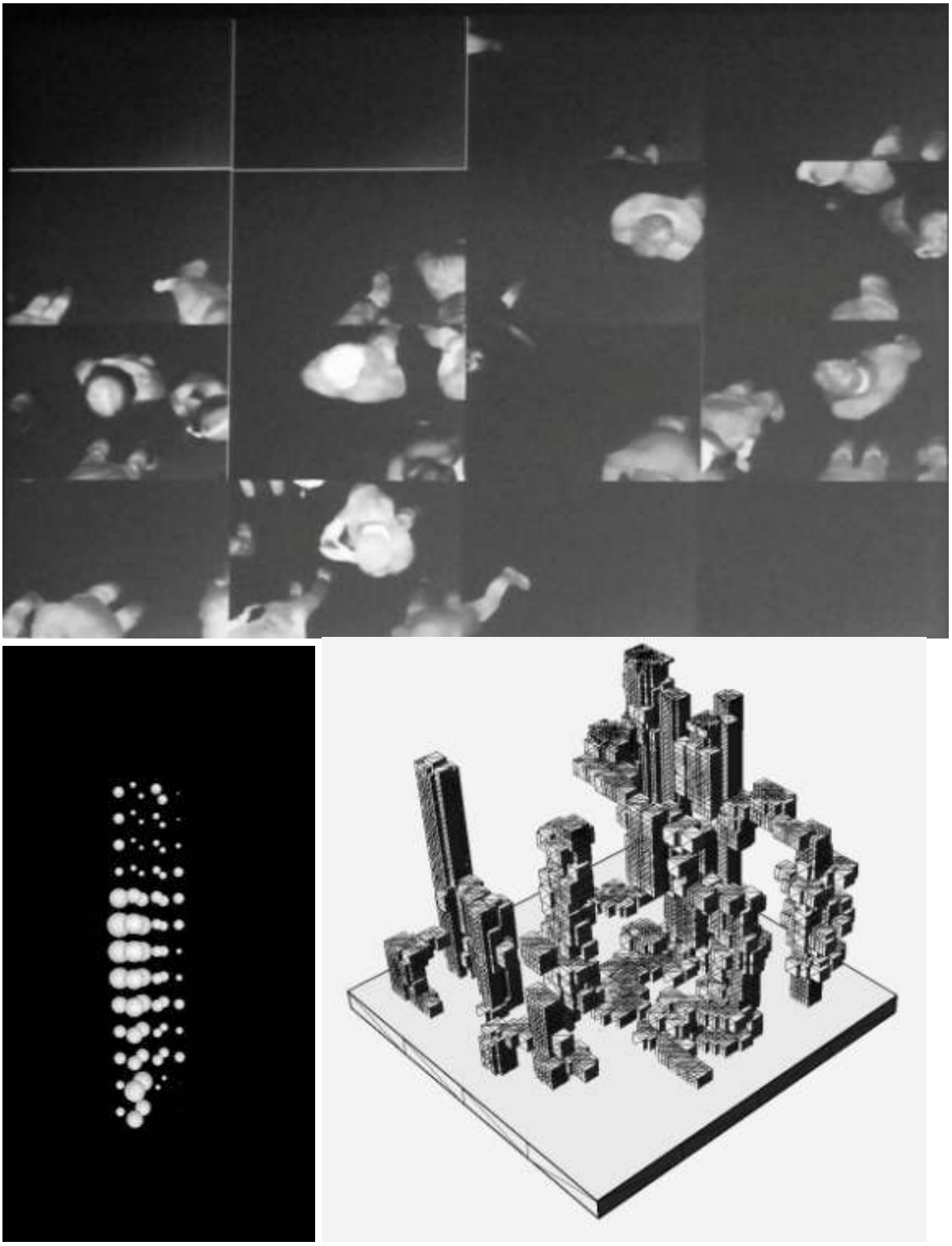


Figure M-1: My models for 3D printing, based on the thermal video

Figure M-2: Final installation of my cluster

Figure M-3: Final installation of other clusters

Appendix P: An example of an input and re-sequenced outputs

1	16	6	21	11
14	4	19	9	24
2	17	7	22	12
15	5	20	10	25
3	18	8	23	13

21	20	19	18	17
22	7	6	5	16
23	8	1	4	15
24	9	2	3	14
25	10	11	12	13

1	6	11	16	21
2	7	12	17	22
3	8	13	18	23
4	9	14	19	24
5	10	15	20	25

1	3	11	13	22
5	9	15	24	20
7	17	25	18	8
19	23	16	10	6
21	14	12	4	2

1	2	4	7	11
3	5	8	12	16
6	9	13	17	20
10	14	18	21	23
15	19	22	24	25

1	6	7	8	9
2	10	14	15	16
3	11	17	20	21
4	12	18	22	24
5	13	19	23	25

1	5	9	13	2
16	17	21	18	6
12	24	25	22	10
8	20	23	19	14
4	15	11	7	3

10	11	12	13	14
25	2	9	8	15
24	3	1	7	16
23	4	5	6	17
22	21	20	19	18

1	10	11	20	21
2	9	12	19	22
3	8	13	18	23
4	7	14	17	24
5	6	15	16	25

11	23	10	22	9
24	4	16	3	21
12	17	1	15	8
25	5	14	2	20
13	18	6	19	7

4	7	12	15	9
2	10	14	15	17
6	25	1	20	3
21	18	5	22	24
8	16	19	23	11

Input Drawn Film