

## **Translating experience**

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# Translating experience

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## ABSTRACT

This paper describes research investigating the significance of physical experience and materiality in creative digital visual art and design practice. Findings are presented from a recent phenomenological study, which indicates the ways in which memory of lived experience informs creative cognition and feeds the imagination.

The importance of physical engagement with the world, through the senses, enables emotional expression to be made in artworks that can be perceived by both artist and audience. Digital creativity support tools have been found, in this research, to lack interfaces that facilitate the translation of these visual aesthetic qualities in the virtual representation.

Hand use and the sense of touch stimulate novel ideas and enable practitioners to break from fixated thinking when working with digital design tools. Examples of artworks are presented that illustrate ways in which artists, working with digital technology, make use of physical experience to inform visual ideas and innovate design solutions.

Case study research is described that illuminates the ways in which memory of physical bodily experience and the time related factors involved in making by hand are crucial within the creative process. Findings from this research are presented that reveal the importance of physical interaction with the world when working creatively with digital design tools.

## Keywords

Physicality, hand use, creativity, art, craft, design

## 1. INTRODUCTION

Memory of physical experience informs creative cognition and inspires the imagination (Treadaway 2004). Most artists and designers are keenly aware of the significance of stimulating their imagination through experiencing new places, images and ideas; the artist's sketchbook is frequently the repository for visual memory prompts using photography, sketches, collaged ephemera and descriptive words. Memory of lived experience contains a wealth of visceral information that excites the emotions and affects the remembering and decision making processes that occur within creative cognition (Rose 2003; Norman 2005). The ability to remember is directly linked to the fundamental need to forget some of what we experience. Information supplied to the brain through the senses is so complex that it must be clustered and blended through associative thought (Fauconnier and Turner 1999). The body becomes desensitized to repeated stimulation and only notices changes in degree; only novel or emotionally laden experience is retained though a process of perceptual redundancy (Gombrich 1984). Artists frequently use visual prompts in the form of sketches photographs and artifacts to stimulate memories, juxtapose and associate ideas in order to inspire imagination.

Remembered physical experience not only informs the development of visual representations but it also facilitates skilled use of tools and materials. Memory of physical bodily experience is essential in providing the practitioner with procedural knowledge with which to craft. Tacitly knowing how to use tools and which tools to select is fundamental in all making;

digital technology is no exception (McCullough 1996). Artists and designers find that input devices frequently lack the haptic and force feedback they would expect from conventional crafting tools (Shillito 2004). This often leads to dissatisfaction and frustration that inhibits the creative process and disrupts *flow*: the fully engaged hyper-state of immersion in creative thought (Csikszentmihalyi 1996). Practitioners often rely heavily on digital tools that lack fine sensitivity to pressure and gesture and note that the complex neuromuscular potential of fingers and thumbs is rarely exploited using current technology (Treadaway 2006).

Understanding how hand use influences creative thinking will inform the development of better digital creativity support tools (Shneiderman, Fischer et al. 2006). Physical making processes involve the working of a material and it is the physical characteristics and affordances of that material that inform the creative process. Expressions of material qualities, displayed as graphic images on computer screens, are often unconvincing as visual representations of physical objects. When output as digitally manufactured artifacts, these are frequently considered by their creators to be deficient in communicating emotional and aesthetic qualities (Treadaway 2006). Most artists strive to express *meaning* through their artworks; they aspire to elicit an emotional response from the viewer/audience by communicating a connection with the artist through the way the work is perceived or apprehended. The digital medium frequently mediates the experience of making a physical artwork; the artist is less *hands on* in the making process, less physically connected and may have little or no physical bodily contact with the artifact that is produced compared with traditional making processes. This has implications for the way the practitioner develops creative ideas and the communication of the aesthetic qualities perceived in the resulting artworks.

This is a significant point in history for studying how practitioners interact with computer technology; today's users are increasingly those who have grown up using digital devices in many aspects of their everyday lives. A new generation of art and design practitioners now work extensively with digital tools having had little or limited experience of using physical art materials to develop visual concepts. Older practitioners who have embraced the technology within their working processes are able to provide invaluable insights into the different characteristics of digital tools compared with traditional tools and how their use impacts upon creative practice.

Research described in this paper has been informed by findings from case studies of visual art practitioners who have had extensive experience of using both physical and digital tools in their creative practice. These findings provide new knowledge that illuminates the important role of physicality and materiality in creative cognition and digital practice.

### **1.1 Research Methodology**

Three examples of visual art practitioners who combine digital and traditional methods of working have been cited in this paper; a fine artist, a textile artist and a surface pattern designer who is also a researcher (and the author of this paper). The information provided is drawn from qualitative ethnographic case study data from three much larger studies that have been investigating how digital technology is impacting on creative practice. The data has been collected and analyzed using the research technique of *disciplined noticing* (Mason 2002). This process involves the detailed video documentation of working practice and includes interviews with artists who have been selected for their professional importance in the field and their relevance to the study. In addition, photographs, research journals and sketchbooks have been used to gather information and record the development of particular artworks. One of the studies cited in this paper also involved a series of practical investigations in which the artist, Alison F. Bell worked collaboratively with the artist-researcher. This process has enabled the researcher to actively experience and share empathically the creative processes in order to personally validate the claims made by the artist in the case study. Each stage in the investigation was video recorded and photographed for subsequent analysis.

## 2. MEMORY

### 2.1 Art practice informed by experience

Memories of physical experiences have been found to be fundamental to the creative digital practice of each of the artists cited in this paper. Ward in Smith (1995, pp.158) describes how every new idea is the product of remembered experience: '*we must always rely on some type of stored information when we develop any new idea*'. Wilson (1998) asserts the connection between hand and brain in developing imaginative thought. In the author's recent practice-based research these connections between remembered physical experience and the desire to make by hand, are embodied in the artworks that were produced. The investigations involved the generation of digital images based on specific thematic memories and reveal the ways in which metaphors that combine physical experiences are used to generate novel ideas and drive the creative process (Treadaway 2006).

#### Figure 1

**Panel – digitally printed silk. Size: 76cm x 155cm**

**Cathy Treadaway**

The artwork 'Panel' (Figure 1) was developed as part of 'Five Elements' a series of five digital prints exhibited in 'Digital Perceptions'<sup>1</sup>. The image blends a selection of remembered experiences of a location in China and explores memory through metonymy and metaphor. The title of the work 'Panel' suggests both cloth and wood and is able to express a memory capturing visual qualities of the carved and painted wooden doors, markets selling textiles, visits to a museum and the artist's emotional connection to the location, as well as the broader philosophical theme of the five artworks that comprise 'Five Elements'.

Sensory stimulation derived from visual, aural and haptic responses to the lived environment were shown to stimulate the imagination and enable new visual representations to be formed using digital technology. These responses were frequently poetic; directed by an intuitive reaction to remembered experience that was enhanced with emotion.

Collaborative investigations involving empathic art making were subsequently used to corroborate findings from this study and to interrogate the ways physical experience impacts on creative cognition and influences digital visual art practice (Treadaway 2007). A series of artworks were developed in which memory of specific time and locations were used to fuel the creative process. The practitioners involved in the investigations found that the mutual experience of physical engagement with the environment enabled a shared visual response to be made. It became possible to communicate a common visual language and to establish shared end goals and criteria for idea selection.

#### Figure 2

**Kilmory – digitally printed silk 120cm x200cm**

**Alison F. Bell and Cathy Treadaway**

The initial stage of the creative process involves *preparation* in which the senses are stimulated and ideas recorded (Sternberg 1988). Digital cameras, sketchbooks and journals were used to gather visual information and digital tools including computers running Adobe Photoshop® software, scanners and printers were used to develop imagery iteratively shared between the collaborating artists. The imagery was exchanged between practitioners in layers via websites and on hard storage media enabling a series of artworks to be produced for

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<sup>1</sup> 'Digital Perceptions': an international touring exhibition of digital textile artwork and conference June 2005 – 2007 supported by the Surface Design Association, Wales Arts International, Scottish Arts Council and the Missouri Arts Council, USA.

exhibition<sup>2</sup>. Analysis of the video recorded research data indicates the importance of physical experience in the development and refining of visual representations. The shared experience enabled an empathic response to be made to the physical situation, informing both the critical selection of ideas within the creative process and providing direction to the development of the work.

## **2.2 Crafting and memory of physicality**

The investigations described above incorporated both analogue and digital crafting processes. The sketchbook was fundamental to the collection and collation of initial visual ideas. Sketches produced on-site while the practitioners were physically immersed in the environment, were later perceived to be richer in conveying memory of the experience than the digital photographs taken at the same time and in the same location. The photographic images were unable to convey the emotional response of the practitioner; how it felt at that time and in that place. The sketches incorporated the muscular and gestured response of the body within the environment; the wet paper trapped the gritty sand, blown onto the sketch, resulting in textured marks that spontaneously captured the memory of physical sensation of sand on skin, wind on face and temperature of the location. The incongruity of the photographic representation compared to the physical sketch became the stimulus for the artwork 'Kilmory' (Figure 2).

The research findings indicate that practitioners find that physical sketchbooks continue to be vital in digital art and design practice. The physical property of the book and the ability to flick through quickly, at a glance, in a non-sequential manner, assists the recollection and assimilation of visual ideas. The physical action of cutting out images, sticking, manipulating and assembling photographs, sketches and ephemera within a physical book also provide a sense of bodily and mental satisfaction as well as time for reflection.

Research has found that art and design practitioners, who work with digital imaging technology, crave hand crafting processes and they frequently engage in such activities in order to stimulate new ideas and break out of fixed patterns of thinking (Treadaway 2006). The physical manipulation of materials and tools also stimulate new ideas through the sensory information they convey. Objects can act as carriers of memory through a variety of sensory properties: sight, smell, sound as well as touch. Each sensory prompt becomes capable of stimulating memory and building imagination through physical proximity or bodily contact.

## **2.3 Time**

Craft can be described as skillful making using tacit knowledge or *know how*; practical ability acquired by physical experience (Dormer 1994). Physical crafting is time intensive; the slowness of making frees the mind of the practitioner to reflect on the creative process and to develop new ideas (Harris 2005). Creativity takes time (Sternberg 1988) and hand making processes that are slow to perform facilitate thinking space in which ideas can be associated and refined. Findings from recent research investigating hand and digital craft processes have revealed the importance of time for reflection in order to develop new ideas (Hodes and Treadaway 2008). This research involved a case study which focused on the development of a series of new artworks for exhibition by the London based fine artist Charlotte Hodes. The research process documented the various stages in making the work through video recording, photography and the concurrent verbal reflection of the artist on her practice.

**Figure 3**  
**Papercut (detail) from 'Drawing Skirts' – digital and hand cut and paste**  
**Charlotte Hodes, photograph: Peter Abrahams**

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<sup>2</sup> The artworks produced during the research comprised a series of digitally printed silk panels which were exhibited in 'Recursions: material expressions of zeros and ones' Museum of Design, Atlanta, USA 2005, 'Digital Perceptions' Leedy-Voukos Gallery, Kansas City USA and Collins Gallery, Glasgow 2006

Hodes makes intricate *papercuts*: collages that are a product of her 'cut and paste' hybrid digital and hand craft process<sup>3</sup>; the work incorporates drawing, digital drawing, digital print and cut and paste collage (Figure 3). The physical cutting and collage provides Hodes with relief from the intensive decision making required in the earlier digital stages of her work. The video recorded research data however, reveals the complexity of the decisions that are in fact being made in her hand crafting processes: each tiny cut edge requires her to make a choice about which side of the line to cut, the characteristic of the line, straight or curved and how it works within the whole pattern. These decisions however, are made slowly and intuitively, as a result of a tacit understanding of the emerging cut pattern and how each element relates to the next; the work is touched, cut, moved, pressed and handled. By comparison the decisions required in the digital process are much faster and rely on memory: recall of menu structures and interpretation of graphic symbols. The digital process is human memory intensive requiring only restricted hand movement and with the exception of sight, little physical bodily acquired knowledge from the senses. Decisions made in the physical cutting process, by contrast, are informed through tactile sensing and muscular responses which are coordinated with vision and modified by perception. Much of this physical process is automatic and proceeds intuitively, without conscious thought, enabling the artist's mind to wander or consider alternative ideas outside the immediate locus of attention: the area being cut. Gladwell (2005) argues that productive decision making occurs when there is a balance between deliberate and instinctive thinking; that too much choice is detrimental and when too many options are offered the brain becomes paralyzed. This state is amplified when decisions are made rapidly, for example, when developing a graphic image using computer software.

The intricate time intensive craft process of cutting paper is physically demanding. Body position is crucial in the process, muscular pressure from the shoulder and elbow is exerted and both hands are used: the dominant hand to grip and exert pressure on the cutting tool and the non dominant hand to position and steady the material being cut. In contrast, drawing and painting are much quicker processes and the digital graphic equivalents even faster. Hodes' pre-digital artworks were executed in paint and the speed with which the work progressed inhibited her creative thinking: "*when I was painting I was working too quickly for myself.*" The collage process she now uses provides her with beneficial time to think. She states: "*my brain is going quicker than the cutting...the process has changed the way I think through an image.*"

The resistance of the material being cut, muscular tension and physical pressure is revealed in the characteristics of the drawn and cut line work, this provides an echo of the artist's physical bodily presence in the resulting artworks.

### **2.3 Craft and Digital tools**

Crafting processes involve direct engagement with a material. The physical properties and affordances of that substance require the practitioner to develop specific knowledge of how to work with it, based on empirical experience. This tacit knowledge of both material and tool use becomes combined in the act of crafting. Memory of the experience of crafting a physical material informs digital visual representations and provides the practitioner with an intuitive understanding of the creative potential and limitations of the digital craft. For example, in virtual draping for fashion, an understanding of the ways in which cloth handles and falls provides the digital designer greater awareness of the subtleties required in the virtual representation.

The expectation that digital tools will emulate those used in the physical world frequently leads to frustration with their haptic insensitivity and lack of bodily connection. Nevertheless, digital tools provide methods of creating graphic images that could not be replicated by hand due to their level of complexity, scale or precision. They also provide artists with access to

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<sup>3</sup> AHRC funded project involving case study research in which the development of Charlotte Hodes' artwork for the exhibition 'Drawing Skirts' has been video documented. Quotations by Hodes in this text have been taken directly from the video research data.

new digital processes such as digital printing and rapid prototyping. Those artists interviewed in this research that have embraced the technology within their practice, appreciate that digital tools provide their own distinctive characteristics that impact on the visual language of the work. Using digital input devices that appear similar to conventional artists' tools, (for example the graphics tablet and pen), may require the practitioner to relearn physical craft skills. The subtle differences experienced in using the electronic version, such as degree of pressure, angle or movement, calibration issues and dislocation of vision from the working of the hands must become tacitly remembered so that the crafting (drawing) process is fluid and intuitive. This, as with any physical tool, requires practice in order to gain virtuosity.

#### **2.4 Conveying emotion**

A handcrafted artifact is able to convey properties beyond its material constituents; it is a unique response to a material by the craftsman, often by hand. It may reference cultural tradition and process in its workmanship (Verhoeven 2007). The way in which its audience perceives the crafted artifact may be impossible to prescribe, however the maker frequently strives to communicate values, intentions and emotional content through the making process. The emotive qualities of an artwork or 'aura' are derived from the *workmanship of risk*<sup>4</sup> (Pye 1964) and are a unique acumination of creative responses to physical human interaction with the world (Treadaway 2004). Practitioners frequently note the 'flatness' of the digitally crafted product; CAD work is often described as looking the same, homogenous and without character<sup>5</sup> (Penfold 2007). The lack of adequate physical bodily interaction with digital creativity support tools is felt by art and design practitioners, interviewed in the research, to be responsible for the perceived deficit in emotional content of digitally produced artwork. Hodes' combines hand rendered drawing with digital line work in order to capture greater emotional weight. By scanning her drawings and then tracing over them, using a digital hand drawn line with a graphics tablet and pen, her intention is to simplify the physical drawing but retain the emotional essence of the expressive hand rendered drawing. Her perception is that drawing by hand using a pencil and paper enables the artist to express more emotion:

*"the hand drawn line on the computer doesn't need me to have a physical experience and so you don't imbue the drawing with the same emotional weight as you do when you are pencil drawing...the pencil embodies a different emotional weight."*

### **3.0 PHYSICAL EXPERIENCE**

The physical process of drawing is not confined to the action of pen on paper but encompasses the artist's desire to translate memory of physical experience through expressive mark making. Hodes uses drawings of her own body within her work and believes that her own experience of physically holding the pose informs the drawn representation she makes, *"as you are going into the position you sense the pose and the movement within that pose that you are going to draw."* When she draws the figure her intention is not simply to get everything in the right position but:

*"to embed a mood or feeling about the pose itself and give a sense of movement, sense of life, a caught moment...I really feel it physically – that sense of having your head tucked into your body. When you are drawing on the computer you don't have that kind of intimacy in what you are looking at, or in the pencil. The physical experience is so different even with the Wacom® tablet. Now I am drawing with the pencil I realize how gauche the Wacom® tablet is ...this feels more alive."*

The mediation of the computer in the process creates a lack of intimacy and physical connection and establishes emotional distance between the creator and the created work.

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<sup>4</sup> Pye [16] contrasts the safe machine made *workmanship of certainty* with the *workmanship of risk* in hand making when at any moment a mistake can be made and the work ruined.

<sup>5</sup> Matt Duckett founder of NICE states: *'I find if you stay on the computer too long, everything ends up looking the same'* [15].

Hodes describes feeling physically ill if hand rendered drawing or cutting goes badly whereas work on the computer is more impersonal: “*when it goes right on the computer you are just pleased to get it done; you don’t experience it as much.*” The lack of sensitivity of the digital drawing tools is one major contributory factor. Although input devices, such as graphics tablets and pens, are more sensitive than mice they still lack the huge range of pressure sensitivity, direction and angle of movement that is possible with a pencil or brush (Figure 4).

#### Figure 4

**Charlotte Hodes working with a Wacom® graphics tablet. Photograph: Peter Abrahams**

### 3.1 Touch

The importance of touch and manual sensitivity in Hodes creative practice is evident in the recorded research data. Considerable frustration is expressed with the limitations of the tablet and pen particularly when used as a tool to trace over a scanned hand drawn line. The fluidity of using a pencil and paper contrasts with the lack of precision and control of the digital equivalent; the process of digital drawing is less intuitive. The creative freedom experienced through sketching, hand drawing and cutting is not solely the result of physical muscular control of the implements used but is also informed by the sensory stimulation received through the body from touching surfaces and feeling material qualities. Appreciation of exactly how touch, manual dexterity and gesture inform creative thinking is limited. Recent studies in neurophysiology and psychology are illuminating the ways in which perception is modified by touch (Wing, Haggard et al. 1996). This research has identified that separate streams of sensory information are fed to the brain from visual stimulation (Wing, Haggard et al. 1996). These have been shown to enable both physical manipulative action and also the perception of objects. Prytherch (2002) links the sense of touch with sight and perception and asserts that both provide information to the brain in different ways. Haptic senses result from successive experiences in which substance is encoded; vision provides information concerning shape and location. Research by Goodale and Milner cited in Wing (1996) identifies how visual control of prehension informs perception and cognition in order to mediate physical action. These connections between *vision*, *touch* and *cognition* inevitably impact on perception of physical experience and influence imaginative thought (Wilson 1998). In the recorded research data Hodes comments on how restricted haptic sensitivity of digital tools influences her creative thinking. She finds the pen and tablet less intuitive to use than physical media; it is necessary to stop and start a line which ‘*interrupts the flow of your thinking and invites you to simplify the range of marks you choose to use*’. The physical awareness of friction that results from pencil drawing on paper is felt through the hands and influences the degree of pressure and speed of movement or flow of line. Both vision and touch inform the marks that are made in response to the physical surface. By comparison, Hodes notes the restricted sensitivity and force feedback from the electronic drawing tools. Nevertheless, there is a physical satisfaction derived from the smooth surface, restricted sensitivity and simplified marks that are produced and the artist finds that she incorporates these digital attributes and qualities to extend her creative practice creating imagery that fuses hand and digital craft.

Harris (2005) contends that those practitioners that have learnt haptic skills, such as textile handcrafting, have a more acute sense of touch and are more likely to feel constrained by the lack of sensory stimuli inherent in digital crafting. This appears to be confirmed by recent research involving human touch and ceramic surface at the Royal College of Art, London, which suggests that craft practitioners have a greater sensitivity to haptic stimulation (Kemske 2007). This research has found that tactile surface qualities are perceived differently across the body and a range of stimuli such as temperature, pain, pressure, vibration, light touch and texture activate a variety of different nerve cells in the brain. The propensity of the body to

acquire tactile sensory information through the whole body, not just the hands, indicates the rich information flow concerning experience in the physical world that informs cognition. This tactile information is mediated by visual perception, providing both information into the body and expressive output from the body, back into the physical world.

#### 4.0 DISCUSSION

Artists are increasingly integrating digital technology within their creative practice in order to access the expanding potential of digital output devices for making their artworks. Ink-jet printers, laser cutters, computer assisted machinery, rapid prototyping technology, screen based media, portable and embedded information appliances are being used to create, communicate and present artworks. For many visual art practitioners increased interaction with computers in their creative practice inevitably means there is less opportunity to engage in working with physical materials and traditional tools. Future generations of artists and designers, who have grown up using computers and working digitally, are likely to have less traditional craft skills. Their perceptions of creative practice will be different as will their expectations of the technology used to support their art making. Findings from the case studies presented in this paper are important since they provide a unique opportunity to reflect on the implications of using traditional tools and physical materials within the creative process by practitioners experienced in using *both* digital and analogue working methods. These reflections may also give insight into how the technology might be improved in order to enhance user experience and provide greater support to the creative process in the future.

The case study material presented in this paper indicates that memory of physical engagement with the world is crucial for creative cognition. It assists the development and selection of new ideas and provides physical bodily knowledge that can convey emotion and express meaning in an artwork. In the case study data informed by the authors own art practice cited in section 2.1 and substantiated through collaborative investigations with other practitioners (for example in the instance cited in sections 2.1 and 2.2) it is clear that that multi-sensory information, acquired through physical experience, informs the development of visual concepts and impacts upon the making process through the development of tacit knowledge in both tool use and understanding of material properties.

The case study on Hodes (section 2.3) provides an example of an artist who integrates traditional hand crafting and digital processes in order to create her work. Her creative process has developed in such a way so as to exploit the potential of the expressive qualities generated through hand rendering as well as those attributes of digital technology that facilitate the creation of visual representations that would be difficult if not impossible to achieve by any other means due to their complexity and detail.

The data from this study reveals how emotional content can be translated from artist to artifact through physical making and can be perceived in the resulting artwork. The research video documents her reflections on drawing, making comparisons between using a pencil compared with graphics tablet and pen, and cutting, using a knife in contrast with digital 'cut and paste' on the computer. The findings reveal that the physical activities produce characteristics perceivable in the artwork that can convey emotion and meaning for the artist. This occurs as a result of the physical bodily responses of muscles on material, which leave a trace of the artist's physical connection with the artwork through a hand cut edge or the intensity of a line. The spontaneous and risky nature of physical manipulation of materials contributes to the evidence of the artist's touch in the artwork. Random inconsistencies and mistakes provide characteristics of humanity lacking in machine produced work.

The collaborative practical investigations described in section 2.2 of this paper indicate how collaborative art making is enriched through the sharing of physical experiences and sensing of the physical properties of objects. Hobson (2002) explains the importance of mutual experience, action and expressions in our ability to perceive and communicate emotion and its significance in the development of imaginative thought. Our bodies react through muscles and

nerves to our experiences and these are communicated both verbally and non-verbally. Social interactions and individual responses to physical experience inform the artist's imagination and define how materials and tools are manipulated in the making process. Crafting skills utilize the bodily acquired knowledge of the world unique to an individual's experience and through the process of *making* practitioners are able to imbue materials with emotional content that is a personal expression of its creator.

The findings presented in this paper indicate that that making by hand, touch and manipulative activities, have a significant impact on creative thinking and imagination (Treadaway 2006). The development of haptic interfaces which are more responsive to the senses, gesture and touch will inevitably enhance the users' ability to translate physical experience into digital imagery. According to Carrigy, whose practice based art research at NCAD Dublin is investigating the integration of sensors in wearable technology:

*'Computing is getting physical and interfaces are getting more tangible. The digital process is merging with the material world, connecting to it through sensors and interfaces that convert analogue to digital and back again'* (Carrigy 2007 pp.301).

Tangible interfaces that provide more intuitive interactions with digital systems are already available, although economically prohibitive for many practitioners. Haptic tools, such as the PHANTOM® Desktop™ device, provide tactile information to their users in the form of force-feedback. Although they remain relatively inefficient at conveying the rich sensory experience of the hands and fingers, they are able to offer a more intuitive means of interacting with 3D design software through the physical to digital application of force and pressure. There are other haptic input / output (I/O) devices such as haptic mice, joysticks and touch pads that have been developed for the computer games industry. Much games software, however, does not support haptic input, resulting in little investment in the technology; production of usable commercially available haptic devices lags well behind academic research. Developments in sensing technology and haptic interfaces will provide greater potential to translate physical experience into digital format, resulting in tools that will better support creative practice and stimulate the imagination.

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**8. FIGURES:**

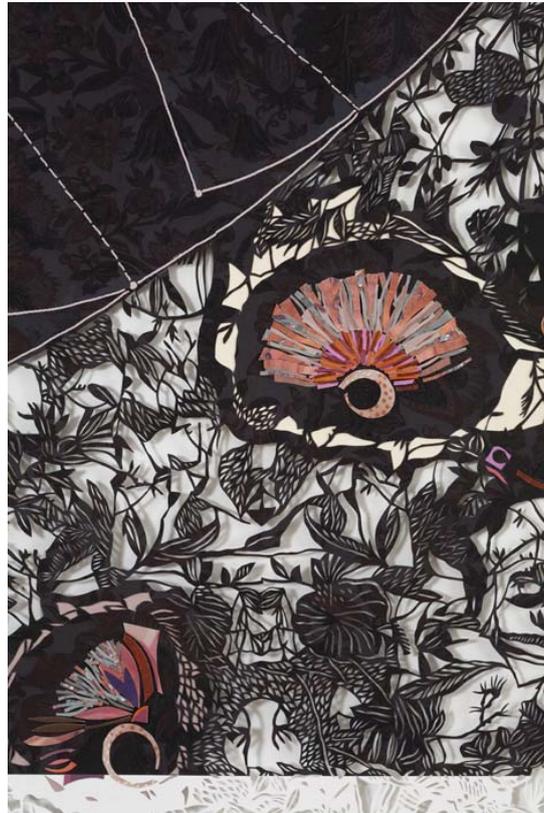
1. Figure 1 *Panel* – digitally printed silk. Size: 76cm x 155cm



2. Figure 2 *Kilmory* – digitally printed silk 120cm x 200cm Alison F. Bell and



3. Figure 3 Papercut (detail) from '*Drawing Skirts*' – digital and hand cut and paste. Charlotte Hodes, photograph: Peter Abrahams



4. Figure 4 Charlotte Hodes working with a Wacom® graphics tablet. Photograph: Peter Abrahams

