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# DIGITAL CRAFTING AND CRAFTING THE DIGITAL

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**KEYWORDS:** Digital imaging, craft, printed textile design

*This paper presents part of a recently completed doctoral research project investigating the impact of digital imaging technology on printed textile practice. It describes how digital technology is able to support the creative process at the generative stage of idea development through to the production and embellishment of the printed artefact. It focuses on the ways in which digital tools are being used to support creative craft practice and proposes areas for future research.*

*Previous studies investigating the use of digital technology indicate that digital ink-jet printing frees textile practitioners from the technical constraints of the printing process and facilitates new strategies in design production and craft making. Recent studies in the field of HCI (Human Computer Interaction) have demonstrated the importance of understanding the creative process in order to develop more effective digital tools. Research described in this paper investigates the ways in which digital technology is able to support creative thinking within printed textile practice. It illuminates the role of hand making in the digital crafting process and reveals the importance of human memory and physical experience in the development of creative cognition.*

*A strand of the project focusing on a textile craft practitioner is described. The selection of qualitative research methods, including case study and practical investigations, is explained, as is the concept of 'disciplined noticing' as a research methodology. Digitally printed artworks, created as a result of the practical investigations, are presented and their purpose within the research explained.*

*Findings from the research as a whole indicate that digital tools are able to support creative practice through the stimulation, communication and manipulation of visual concepts; digital communications technology also facilitates creative collaboration between practitioners. The findings reveal that making by hand informs creative thought and enables emotional content to be perceived in the resulting artwork. This is evidenced in hybrid practice in which digital techniques are combined with textile craft skills. Further research is required to elucidate the role that making by hand plays in creative cognition and the ways digital tools might be enhanced in the future to support this.*

## **Summary**

*The paper describes the impact of technological change on the crafting of printed textiles. It describes research into the ways in which digital tools are able to support creative printed textile practice and presents findings, arising from the study, which indicate the process of making by hand is fundamental to creative cognition.*

## INTRODUCTION

Technological developments, tools and processes have always provided the craft practitioner with the opportunity to extend their creative thinking; digital technology is no exception (Greenhalgh 2002).<sup>1</sup> For the craft practitioner new, more democratic, approaches to making and selling work are available via the Internet. Opportunities to access new materials and collaborate with other practitioners make diversification and hybridization of craft practice a possibility. How then does this impact on the craft practitioners approach to creative practice? How does the use of technology influence creative cognition and how are new working strategies being developed to exploit the potential of digital tools?

The research presented in this paper seeks to address these questions, drawing on selected strands of a recently completed doctoral project. The focus of this study has been an investigation into the ways in which textile practitioners use digital technology and its influence upon creative cognition.

### Digital technology and printed textile design

Digital production methods are radically changing the design and production of printed textiles (Ujii 2006). The latest generation of digital ink-jet printers is now able to compete commercially with analogue print production. New types of designs are reproducible on fabric and the computer's role in the process has evolved from that of pre-print production (colour separation and repeat generation) to a fully fledged design tool (Nicoll 2006). The digital process makes viable short run production as well as unique *one-off* images on fabric, manifesting wide colour gamut and visual effects impossible to achieve using traditional processes (Ujii 2006). Craft practitioners are able to access digital print bureaus on-line; there is no need to purchase costly equipment, rent workshop space or stock fabrics. The availability of such facilities makes possible the development of unique *one of a kind* fabric that can be utilized in garments or soft furnishings and products. The reduction in production constraints, including scale and repeat, now enable images to be engineered within pattern shapes and customized garments can be printed economically (Campbell and Parsons 2005). Creative possibilities for the designer-maker working on limited run, *one-off* art to wear or crafted textile product are enormous. The scope for selling '*value added*' crafted products has increased following market saturation and commoditisation of luxury brands. Collins (2005 p.13) contends that '*a renaissance is underway in the luxury crafts business as customers forsake designer brands*' and begin to commission designer-makers. Internet shopping and globalization have stimulated consumer desire for exclusivity, product differentiation and personalization (Fralix 2006).

This is a significant moment for the craft practitioner as technological developments have coincided with accessibility to digital print production tools via the Internet. Practitioners can create digital images in the studio, upload or email them directly to a

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<sup>1</sup> 'As the physical realisation of scientific advance, technology has been present at every level of artistic invention, facilitating the physical construction of innumerable quantities of things, and being responsible for the development of entirely new forms of practice.' Greenhalgh, P. (2002). *The persistence of craft: the applied arts today*, London, A. & C. Black, pp. 7.

print bureau and receive the printed and processed fabrics by mail. Location and workshop space, equipment and manpower no longer constrain the printed textile practitioner's imagination (Nicoll 2006). For those wishing to print within their own studio space, small format digital textile ink-jet printers are available for sampling or production of limited quantities of fabric. Developments in pigment technology look set to eliminate the need for the steaming and post-printing treatments currently required in digital ink-jet textile printing (Fu 2006). This will make printed output onto fabric almost as straightforward as printing onto paper.

The facility to digitally translate sophisticated imagery directly onto cloth has implications that challenge and extend the possibilities that have previously been available to designer-makers or crafts practitioners (Ujii 2006). The speed and ease with which imagery can be printed onto fabric makes possible coloured and patterned substrates that can be further embellished using time intensive traditional craft techniques such as stitch, appliqué and beading etc. Digitally produced fabrics can be incorporated into work, such as patchwork and quilting, containing imagery more personal and appropriate than the sourced fabrics that were used previously (Treadaway 2004b). Analogue print and hand painting processes can be used to further decorate the digitally produced fabrics, enabling the practitioner to extend their visual language, add economic value and enhance personal expression.

### **Digital crafting**

For many textile practitioners it is the hands-on working with the print process that is important; the distributed nature of digital print divorces the maker from the work and denies the piece 'aura' that embodies the emotive content of the creator's touch.<sup>2</sup> Practitioners comment on the perceived flatness of the colours and lack of ownership or connection to their digitally printed product (Treadaway 2004a).<sup>3</sup> The perceived risk free environment of the computer, in which mistakes can be re-rendered and earlier versions reinstated, suggests that digital print is the product of '*workmanship of certainty*' (Pye, 1964); the product of a machine and industrial process. Nevertheless, every digital print has the potential to be unique and infinitely varied, the craftsman can reintroduce the element of *risk* in post-printing embellishment or can consider the very digital imaging process itself as both a tool and medium with which to craft (McCullough 1996). Some practitioners consider manipulation of the numeric code essential for controlling the crafting process and see their personal intervention as fundamental to the creative process (Carlisle 2004). It can be argued however, that software use itself *is* code manipulation, enabling the user to access the medium through graphical user interfaces (GUI) that respond to fluent use in just the same way as any skilled craftsperson using an appropriate tool for a creative task.

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<sup>2</sup> Walter Benjamin uses the term 'aura' to describe the emotive element that is lacking in the machine manufactured product. Benjamin, W. (1973). 'The Work of Art in the Age of Mechanical Reproduction'. Illuminations, Fontana/Collins.

<sup>3</sup> Treadaway, C. (2004). "Digital Imagination: the impact of digital imaging on printed textiles." Textile, the Journal of Cloth and Culture 2(3): 256-273.

## METHODOLOGY

Malins and Press (2004) contend that it is not the use of a particular tool or technology that is important in the crafting of an object but rather the craft person's '*creative input or intention*' (Malins and Press 2004).<sup>4</sup> It is interest in this aspect of digital printed textiles that has been the focus of the study presented in this paper. Deeper understanding of the ways in which practitioners engage with digital tools and their impact upon creative processes will enable better technology to be developed (Shneiderman, Fischer et al. 2006). Observation and analysis of digital textile working methods will provide insight into creative strategies useful for educating future practitioners as well as helping to identify future areas for further research. Through video documentation it has been possible to record and reflect upon the craft process and the ways in which digital tools are able to support creative cognition. Edmonds et al. (2005) advocate the concept of '*the studio as laboratory*' when investigating creative processes, contending that it is impossible to observe creative action in a formal research environment<sup>5</sup>. Yin (2004) states the importance of observation of '*events within their real life contexts*' when interrogating human centered action. For this reason qualitative research methods were used to obtain data, including case study, formal interviews and a series of practical investigations. In order to increase validity of the data, three separate studies of printed textile practitioners were used to build the case, providing a chain of evidence for comparison and analysis. These were chosen (following advice from industry, academia and professional associations) to reflect the diversity of the field: a craft practitioner, designer and textile artist. Multiple sources of evidence were collected during the research, including audio and video recordings, interviews, research journals and still photography of artifacts.

The validity of verbal reports in accounting for cognitive processes is contentious<sup>6</sup> however, Ericsson and Simon (1993) propose that verbal reports concurrent with the action (talking aloud) or as retrospective verbal reports on tasks of very short duration (in which the subject makes no analysis of what is said) can provide '*rich data*' (Ericsson and Simon 1993). Schön (1987) advocates the use of reflective processes to obtain new knowledge about practice and to gain fresh insight from the familiar and new understanding from the routine. Using '*disciplined noticing*' (Mason 2002) and recording methods in which brief but vivid accounts of action are documented through video and audio recording, a body of research data was gathered for analysis. Following each case study interview, a task exercise was devised in which the researcher and practitioner could engage collaboratively. These practical

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<sup>4</sup> 'We would argue that what is important about the craft person's contribution to the making of an object is their *creative input or intention*.' Malins, J. and M. Press (2004). *Craft connexity: developing a sustainable model for future craft education*. Proceedings of Challenging Craft conference, Aberdeen: Gray's School of Art.

<sup>5</sup> Edmonds, E., et al. (2005). "*The studio as laboratory: Combining creative practice and digital technology research*." International Journal of Human-Computer Studies Vol. 63: pp 425-481.

<sup>6</sup> Behavioural psychologists disputed that verbal accounts can be relied upon as accurately reflecting the information that was retrieved at the time that the action occurred. Verbal protocol was frequently dismissed as '*variants of the discredited process of introspection*'. Nisbett and Wilson, 1977 cited in Ericsson, K. A. and H. A. Simon (1993). Protocol analysis : verbal reports as data. Cambridge, Mass.; London, MIT Press.

investigations provided opportunity to empathically test the initial findings from the case study and enable a reflective dialogue to take place. A body of collaborative digital printed textile artwork resulted from each investigation.

Data obtained from the case study and collaborative investigation, carried out with the textile craft practitioner, has informed the following section of this paper.

### **Case study**

Scottish textile artist, Alison F. Bell, was identified as a textile craft practitioner who had begun to incorporate digital print into her work after many years of working with traditional textile print technology and hand painting techniques. During the summer of 2003 she agreed to participate in the research and was interviewed and video recorded, during a field study visit to her studio in Lagg, on the Isle of Arran. Bell's craft practice has changed dramatically since she embraced digital technology, as have the visual qualities of the textiles she produces. Her previous work (*figure 1*) was influenced by the process of crafting with coloured dyes on silk; an unpredictable spontaneous technique that enabled her to capture qualities of hue and intensity but with little scope for adding detailed imagery or fine line work. Her early digital work explored using her home personal computer (PC) and printer to pattern small samples of fabric using a dye sublimation (heat transfer) process; she now digitally ink-jet prints much of her work using the bureau facility at Centre for Advanced Textiles (C.A.T.) at Glasgow School of Art (*figure 2*).

*(Insert figures 1 and 2 side by side here)*

### **Collecting, assimilating and manipulating ideas**

A period of *preparation* is widely considered to be an essential initial stage in the iterative processes that lead to creative thought (Smith, Ward et al. 1995; Amabile 1996). Visual research is fundamental during this phase, providing new ideas, fresh insights and spontaneous thinking. Digital tools were observed to provide Bell with the opportunity to collect, review and assimilate visual stimuli dynamically; assisting her to layer and collate visual material from a variety of sources in ways that would not have occurred in her previous non-digital practice. A still camera enabled detailed photographic imagery to be collected. Access to imagery from the Internet as well as scanned artefacts and images provided the raw visual data to influence ideas; the computer provided a means of ordering and reviewing this imagery so that it could be arranged and stored for later use. All three case study practitioners were observed to use digital tools in this way.

The activities involved in collecting, ordering and assimilating visual data are responsible for stimulating embryonic ideas that remain imprecise and tacit (Martindale 1995). During this period of incubation, the facility to visualise, re-order, layer and manipulate imagery and colours using the computer was observed as being useful. During the field study interview, Bell was video recorded working on a piece of artwork based on a combination of sources of inspiration: an image from the Internet, a photograph from the shoreline of Arran and her own scanned painted fabrics. Her creative intention was to develop an image reflecting the concept that underlies much of her work – visually expressing the impressions, physical and metaphorical, that man has made on the environment. An image from the Internet was

manipulated and layered with photographic and scanned imagery; each element providing evidence of the importance of idea association at this early stage in the creative process. Bell stated that she regards the computer as a ‘melting pot’ in which she is able to make visual associations. She states:

*‘It’s like a doodle pad, I play with ideas; I play with colours. I do this for hours...I just sit and play, like a do with a sketchbook.’*

### **Visualisation**

The traditional sketchbook has taken on a different role within Bell’s digital practice and rather than existing as the primary source of collected visual ideas, it supplements the computer’s role as a depositary of collated imagery. Selected computer images are printed out and arranged within a physical book for ease of review. Other practitioners were also observed to use a physical sketchbook in conjunction with the computer. The physical satisfaction of sketching by hand, manually cutting and pasting, as well as being able to flick through and see several pages of imagery at a glance in the physical book, were regarded as important contributors to the creative thought process.

The type of imagery that is regarded as useful for stimulating idea development is affected by the detail that is reproducible on fabric using digital ink-jet printing techniques. In non-digital practice, Bell’s silk hand painting technique does not afford detail or precision. The craft process utilizes the wicking effect of the fibres to carry colour across the surface of the cloth; the digital process by comparison enables very fine detail in millions of colours. Although photographic imagery has always influenced Bell’s work, the ways in which this imagery is developed and translated has changed considerably. The facility to combine detail in digital work inevitably impacts on the selection of appropriate visual imagery and its refinement and manipulation (*figure 3*).

*(Insert figure 3 here)*

### **Spontaneity, play and flow**

The spontaneity of the wet hand-painted process contrasts sharply with the predictability of the digital technique in which the fabric output represents an accurate translation of the on-screen imagery. During the research interview, Bell states that that playfulness, serendipity and happy accident play an important role in her creative process. She has developed strategies in order to engineer a degree of unpredictability when using digital tools through the use of complex layers of imagery and playful exploitation of digital tools and software. The recorded case study interview captures a moment in the creation of an image when she unexpectedly reveals a bright red colour in a layer, using the eraser tool. The action is unplanned, fortuitous and gives rise to insight that enables the image to be successfully resolved. Her emotional response, recorded on the video, captures her delight:

*‘Oh look at that! Oh yes...oh yes...this is exciting...I love this... This is why I love digital technology because you get lovely surprises like this. Whoever says that computers are predictable need their heads looked at!’*

Playfulness and the need for freedom from external constraints have been shown to enhance creative thinking (Amabile 1996). Digital design tools that enable previous renditions of an image to be reinstated and copies to be made and saved, were shown to reduce anxiety about ruining successful developing visual concepts. Multiple copies containing variations in scale, colour and technique can be stored for subsequent manipulation and development. The speed with which it is possible to generate and manipulate multiple digital images makes analysis of the work and critical selection between images of paramount importance. Bell comments during the recording: *'The thing is not to overdo it.'* Decisions concerning the selection of particular marks, colours or imagery, judgements about their success or appropriateness are dependent on subjective discrimination based on the artist's prior experience, tacit knowledge and emotional reaction. The overall scheme for the final artefact provides Bell with a confidence to select appropriate tools and colours when working digitally. Although not clearly defined, she carries a malleable virtual image in her imagination, which is flexible enough to accommodate the surprises in the creative process but structured sufficiently to form a framework for judgement. The computer enables the rapid visualisation of these nebulous ideas; however, without the tacit knowledge that is able to inform these discriminatory decisions, the digital process would be unproductive. To avoid experiencing overload or confusion in idea generation and to assist critical review, Bell advocates saving the work and returning to it following a period of reflection. Although knowing when to stop is essential, the ability to save multiple copies and to step backwards and 'undo' provides a much less risky environment in which to work. Research has shown that the reduction of risk in the creative process enhances creative thinking (Amabile 1996). Nevertheless, opportunity to alter an image at any stage in its development increases the mental burden of critical selection. Creative decisions are often difficult to change when hand rendering, due to the time invested in making the work. Mistakes have to be incorporated or the artwork abandoned; fewer decisions are required and the pace of decision making is slower.

Knowledge of software and difficulties with colour management were shown in this research to be the greatest impediments to fluid creative thinking. Freedom from the constraints of working with a tool, in order to flow effortlessly with the creative intention held in the imagination, is the ultimate goal of every practitioner. The development of tacit knowledge in tool use is fundamental in the creative arts; physical and mental procedures are required to shift to background cognition so that the imagination can be exploited. Raskin (2000) and McCullough (1996) both propose that fluidity in the use of software is essential if the operator is to be able to focus on the task in hand. Interfaces that are quick to learn and place less cognitive burden on the practitioner promote greater likelihood that a state of 'flow' will be reached (Csikszentmihalyi 1996). Analysis of the research data indicates that artists working with commercial software develop 'coping strategies' that provide them with fluency; these involve tactics such as learning a restricted number of functions rather than the whole software package. The primary goal of computer use for creative practitioners is to develop visual concepts and so there is only marginal interest in learning the tricks and gismos of an all singing and dancing software package. The difficulties posed by colour communication, between devices and printed output, cause frustration to the practitioner who is without access to sophisticated colour calibration and management tools. The research found that empirical methods of adjustment were



used, along with the manual post-printing application of additional colour through dye and stitch.

### **Hand use**

The relationship between making by hand and creative cognition is evident throughout this research. Each practitioner involved in the case study stressed the importance of hand crafting and rendering within their individual practice. Bell was observed to incorporate scanned hand painted fabrics in her digital artwork, to provide the spontaneity of line and colour she considers to be lacking in the digital medium. She perceived her early digital work to be impersonal and '*lacking the creator's touch*' and this has influenced the subsequent development of post-printing embellishment of digitally printed fabrics using hand paint, stitch and appliqué. Other practitioners involved in the case study use hand rendering to help refine and develop visual concepts or to stimulate alternative visual approaches when digital ideas become fixed and repetitive. There was unanimity, amongst the practitioners interviewed, that physical manipulation of materials and tactile stimulation were able to substantially excite and modify imaginative thought.

Anthropologists contend that making by hand is an innate human capacity and that hand use directly influences kinaesthetic and language skills (Wilson 1998; Dissanayake 2000). It is the combination of kinaesthetic and tactile information supplied from hand to brain, blended with sensory information from the visual system that enables imaginative thought to occur (Wilson 1998). The sense of touch is linked to perception and heightened awareness can be acquired through repeated stimulation of haptic senses (Prytherch 2002). Those practitioners who have learnt handcrafting skills and to whom touch is important are therefore, more likely to feel constrained by the lack of sensory stimuli in digital crafting (Harris 2005). Practitioners involved in the research commented on the ways in which digital tools and peripheral devices did not exploit the complex neuromuscular potential of fingers and thumbs nor the hand-eye coordination or force feedback common to most manipulative activity.

### **COLLABORATIVE INVESTIGATION**

The previous sections have identified issues emerging from the case study concerning creative use of digital tools by printed textile practitioners. Following the field study interview with Alison Bell, three practical investigations were undertaken. These provided the researcher with the opportunity to empathically examine how digital tools are able to support and facilitate the creative process and assess how working collaboratively, in a distributed environment, influences creative strategies. Visual stimulation for the investigations came from material collected during the field study. Photographs, sketches and notes were collected in a research journal and combined with video documentation to create a digital resource to fuel ideas. A framework for the development of the work was agreed prior to its commencement, to outline the parameters, facilitating selection of appropriate ideas and defining the strategy for the collaborative process. It was agreed that layers of imagery would be developed iteratively with subsequent additions made by practitioner and researcher in turn, with the intention of creating a digital image to be printed onto fabric using digital ink-jet printing. It was agreed that the theme for the work would be a shared memory of the shoreline of Arran, Scotland; the source of visual inspiration for much of Bell's

previous work. The development of the project was documented through the use of video and research journal by the researcher and email and telephone feedback was provided by Bell. A questionnaire, completed at the conclusion of the project as a whole, provided additional information from the three practitioners involved in the wider research and was used to inform the findings.

Three digitally printed textile artworks arising from the field study with Alison Bell were developed during the first investigation (*figure 4*). These textiles were exhibited in: 'Recursions: material expressions of zeros and ones' at the Museum of Design, Atlanta (2005) and 'Digital Perceptions,' the Collins Gallery, Glasgow (2005/6). (*Insert figure 4 here*)

### **Memory and experience**

Recent studies in neuroscience indicate the importance of memory in the development of creative thought (Rose 2003). Ward (1995) contends that memory plays a key role in creative cognition, stating that '*we must always rely on some type of stored information when we develop any new idea.*' For the visual artist and craft practitioner this knowledge contains a mix of procedural memory (how to do something) with memory of lived experience; intelligence acquired through the senses. The investigation drew from the shared memory experience of the researcher and practitioner and the collaborative nature of the research made available a collective visual memory to be utilised in the creative process. The wealth of sensory stimulus that is provided by daily experience requires compression so that it can be successfully stored and retrieved. Fauconnier and Turner (1999) contend that this occurs through a process of conceptual blending and perceptual redundancy in which visual cues are clustered and only novel or enhanced sensory stimulation is perceived and retained. Creative ideas are generated from the rekindling and association of previous remembered experience. Research into perception and neural activity indicates that visual mental imagery relies on *picture like* rather than *verbal* representations (Slotnick, Thompson et al. 2005). Throughout the investigation the digital facility to collect store, assimilate and manipulate visual images was found to fuel imagination, reviving memory and stimulating associative thought. The collaborative process also provided unilateral introduction of fresh visual imagery into the emergent image, keeping ideas fresh and invigorating the creative process.

### **Communication**

Three digital images were developed during the investigation with Bell; each one based on memory of the time and location of the visit. The first image *Kilmory* (*figure 5 and detail figure 6*) was initiated by the researcher and evolved from ideas stimulated by a photograph of the shoreline and a watercolour sketch. The photograph was unable to convey the memory of the physical experience as accurately as the hand rendered sketch. This formed the starting point for the work which combined photographic imagery with scanned hand rendered artwork and electronic paint. Using Adobe Photoshop® the image was developed in stages, saved onto a CD and mailed between the researcher and practitioner. The initial intention was to send images over the Internet but the large file size and slow speed of the available Internet connection at the time of the project (2003-4) prohibited this. Subsequent investigations, in the wider research, explored file transfer methods and the use of

websites for image data transfer in distributed creative collaborations (Treadaway 2006b). Throughout the investigation regular contact was made between researcher and practitioner via email and telephone conversations and the work in progress was documented using video recording and photography.

### **Leadership, authorship and appropriation**

The second image created during the investigation, *Dawn*, was initiated by Bell. This used the colour and light of the early morning shoreline as a source of inspiration. The third image *Pladda* was initiated by the researcher. In the post-investigation evaluation, the practitioner noted a '*marginal*' preference to respond to a visual idea initiated by the researcher however, she did not consider that initiating the image provided her with any greater sense of personal ownership of the piece. The research as a whole found that, in each of the collaborative investigations, authorship of the collaborative artworks was not an issue but was considered to be an expression of shared experience. Bell responded on the questionnaire:

*'Ownership is not an issue. I thought it might be before we started, but this never happened. This is a shared experience of memory, full of empathy and pleasure.'*

Nevertheless, the researcher experienced a sense of responsibility for the image development and felt the need to take the lead in the process in order to orchestrate the project. As each layer of imagery was developed it was considered essential to *hold back* and leave space in the image for the collaborators response. Agreeing the stage at which the work was to be considered complete and ready to be printed proved difficult initially. The original framework for the project specified that a prescribed number of layers would be created for each image. In reality the first image became over complex and began to move away from the identified *memory* theme. It was decided that the work had gone beyond the best expression of the shared memory and so an earlier rendition, that was considered the most appropriate representation of the theme, was selected to be printed. The collaborative and empathic experience illuminated the decision-making process and highlighted the importance of a constraining framework to limit thinking and direct the selection of appropriate ideas. The investigations revealed the potential of collaborative distributed digital working processes to stimulate creative practice.

### **FINDINGS AND FUTURE RESEARCH**

Findings from the research as a whole indicate that digital technology is able to support creative thinking at the generative stage of idea development. The facility to visualize, collate and manipulate imagery with ease, its communication via the Internet and on digital storage media, assists associative thinking and idea development crucial for stimulating the imagination. Cameras and scanners provide raw material for rekindling memory. The ease and rapidity with which visual concepts can be developed and manipulated aids the proliferation of ideas.

Communicability of digital files enables visual concepts to be shared and developed collaboratively, in co-located or distributed environments. Limited run, bespoke or *one off* textiles can be produced without the need for sophisticated and costly textile printing equipment; there are many benefits of the integration of digital technology into designer-maker craft practice.

Development of effective digital tools requires deeper understanding of the ways in which this technology impacts upon creative cognition and is able to support the process of crafting. This research has identified ways in which visual representations are generated, modified, presented and communicated using digital technology. Sensory stimulation has been found to be integral to creative cognition, motivating the intention that drives intelligent making. Practitioners have demonstrated through the research that hand-making informs practice, providing tactile sensory information that feeds imagination, breaks fixed thought patterns and provides the emotional expression considered deficient in the output from digital technology (Treadaway 2006a). Practitioners find digital input devices frequently disrupt creative flow and hinder expression, as a result of their haptic insensitivity. *A priori* development of hand rendered scanned imagery or post-printing embellishment, using textile crafting techniques, are methods used by practitioners to overcome these difficulties and increase their emotional connection with the work. These findings indicate the need for development of enhanced haptic interfaces that exploit the neuromuscular connection between hand and brain in order to harness the creative potential of hands and fingers.

Future multi-disciplinary research, arising from this study, will interrogate the impact of haptic sensory stimulation and dexterity on creative cognition, to inform the design of enhanced digital tools to support craft practice.

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## 1. Figures

*Figure 1* –Early textile work, Alison F. Bell. ‘Arran’ Hand painted silk. Size: approx 48” x 20”





*Figure 2* - Early digital print, Alison F. Bell. Digital ink-jet printing on silk with post-printing hand application of colour, Size: 60" x 12"



Figure 3 – Alison F. Bell: digital practice: 'Ladies3' Painted digitally p[rinted, stitched textile panel, 25 x 26cms



*Figure 4 – ‘Kilmory’, ‘Dawn’ and ‘Pladda’, digitally printed textiles exhibited in ‘Material expressions of zeros and ones’, Museum of Design, Atlanta, USA 2005*



*Figure 5 – ‘Kilmory’, collaborative investigation, digital print on silk satin 120cm x 200cm*



*Figure 6 – 'Kilmory' (detail from digital file) indicating layering of photographic, scanned and drawn imagery.*

