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Digital Creativity: The Impact of Digital Imaging Technology on the Creative Practice of Printed Textile and Surface Pattern Design

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ABSTRACT

The development of digital imaging technology for printed textile and surface pattern design has been driven by its use as a production tool rather than as a design medium. It has been successfully deployed by industry for the reduction of cycle times in product development, prototyping and communication but its full potential in the creative domain has yet to be realized. This paper contends that it is possible to unlock the potential for innovation when digital imaging technology is embraced as meta-media containing a wealth of embedded knowledge and skills in virtual space.

The initial phase of phenomenological research into the creative use of digital imaging by surface pattern and textile practitioners being undertaken at University of Wales Institute Cardiff has revealed that creative expression is being enhanced through an evolving visual language, development of new craft techniques and the possibilities that it provides for collaboration and communication. On going empirical research described in the paper illustrates how creative practice can be explored through a sharing of imagination in virtual space and the resulting material artifact is a phenomena of both individual and shared expressive responses.

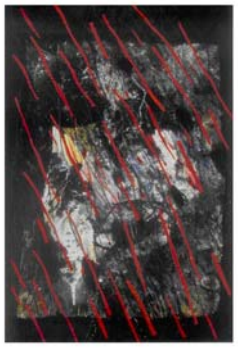
Keywords: Digital imaging, design medium, virtual space

Introduction

The development of digital imaging technology for the design of surface pattern and textiles has been largely driven by production concerns rather than a desire to exploit the creative potential of the medium (Leak, 1998). Much of the on-going research in the domain reflects this emphasis on technology. This paper seeks to address issues that surround its creative use in concept generation and the propagation of imagery in the design of printed textiles. It draws upon the findings of the first phase of the phenomenological research being undertaken at Cardiff School of Art and Design, UWIC and a current ongoing empirical investigation into creative practice using digital imaging technology that forms the second phase of the project.

The initial findings of the research indicate that digital imaging technology impacts not only on working processes but also on the phenomenon of the created artifact. Those practitioners who have been interviewed for the study have recognized the use of a developing visual language comprising complex layered and photographic imagery, with an extended color and tonal gamut. Digitally printed fabric output is challenging conventions of traditional pattern making and providing greater freedom in creative

exploitation of surface and color. Textile artists who are incorporating digital techniques are able to use the extended visual language to explore the narrative content of their work in new ways. For some of those interviewed this has dramatically changed the visual nature of the textile pieces being produced and for others it is extending their craft techniques to form new hybridized practice. The findings also indicate how the potential of digital communication is being exploited in practice, changing both corporate and individual working methods and providing opportunities for artists and designers to collaborate creatively at various stages in the production of both concept and artifact.



In defining the creative nature of practice it is necessary to focus on engagement with those types of tasks that are heuristic rather than algorithmic and where there is no clear and straightforward path to the design solution. For this reason the research to date has focused on those practitioners who are freed from the technical, economic and temporal constraints of industrial production and who are engaged in research, education or are involved in producing textile art. Research into the theory of creativity has provided evidence that extrinsic constraint which include manufacturing and technical considerations, meeting time deadlines, evaluation and reward can have a detrimental effect on creative motivation and practice (Amabile 1996). Those factors that have been proved to enhance creativity concern the intrinsic motivation of an individual: providing a sense of freedom, regarding work as play, risk taking, lack of constraint and self-absorption in the task (Sternberg, 1988). These positive and negative motivational factors have been useful in the assessment of the technological impact upon creative practice and the second phase of the research will examine those attributes that may assist heuristic task engagement.

The potential of these research findings in a wider context will be to illuminate the ways in which both hard and software can be developed to enhance creative practice. An understanding of creative digital tool use as well as psychological implications will benefit the training and employment of future designers and the development of the technology they use. By seeking to explore these issues phenomenologically, through analytical description of conscious experience, the nature of practice is revealed both in the heuristic process and the phenomenon of the created artifact. Video recordings, interviews and personal correspondence have been collated along with a photographic documentation of the material artifacts produced in order to provide data for analysis. The digital medium itself has proved invaluable as a tool in the research into its implication on creative textile practice.

Tool and Medium

The development and use of computers in the process of textile design and manufacture has, until recently, been driven largely by economic reasons; to facilitate a reduction in product development cycle time through efficient preparation of pre-print design work and design visualization.

Textile computer systems were developed primarily to meet production needs rather than to enhance the creativity of designers (Leak 1998). The cost of computer aided design systems and the inaccessibility of the software resulted in few U.K. designers, working outside industry, using them to innovate design concepts at the end of the millennium. (Jones, 1999). Developments in user-friendly software and reduction in both hardware and software costs is now providing greater access to the technology for those in the developed world. The computer can no longer be seen as simply a production tool but rather a new medium at the designers' disposal. In 1984 Kay made a useful analogy of the computer as a meta medium possible of conjuring 'media that cannot exist physically with degrees of freedom for representation and expression never before encountered' (Kay, 1984). Software applications provide a host of embedded skills and knowledge useful in the generation and manipulation of virtual imagery and provide a means of making available 'the effects of other people's skills to an individual without that individual having to acquire them (Dormer, 1994).

Cognitive psychological research has highlighted the links between intelligence and creativity and established that any creative enquiry or task demands fluency in the use of knowledge in the domain in which the action takes place. For an individual to practice creatively there is a necessity for information to be acquired, skills to be practiced and knowledge to become tacit (Dormer 1994). Any creative action requires the use of long-term memory for a set of basic structures that frame the enquiry along with a set of tacit skills that provide opportunity to experiment with ideas (Sternberg, 1988). For a textile designer using digital imaging technology this involves not only the acquisition of software competency but also a degree of aesthetic sensibility and technical textile or surface pattern 'know-how'.

The impact on creative use of the digital medium is therefore dependent on the level of acquired knowledge and practical expertise with the software. The complexity of software and the ease with which it is possible to mentally map its structures affects not only the speed with which digital crafting skills can be made tacit but also the degree to which an individual is motivated to learn to use it. Creative deployment of tools requires a degree of transparency in operation as 'better technology shifts psychological load from foreground cognition to background awareness' and 'establishes contexts that free us from having to keep too many considerations

actively in mind' (McCullough, 1996). In successful creative deployment, digital imaging technology can provide access to a wealth of embedded knowledge and freedom to access tools and expertise beyond replication in non-digital practice. If however the technology is difficult to access, software complex and difficult to mentally model, the impact will be detrimental to creativity due to the inhibiting of the intrinsic motivation essential for creativity (Amabile, 1996).

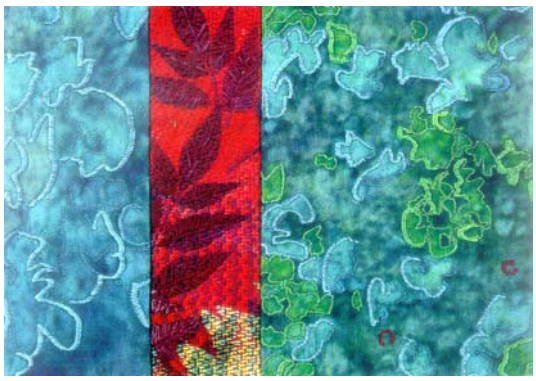
The first phase of the research revealed that most of those interviewed expressed concerns with learning to use software and most declined to describe themselves as experts. Many of them had overcome difficulties in achieving software fluency by specializing in particular functions or tools within specific software packages; the most notable of these being copy, cut and paste. The specialization in particular software functions provides fluency in practice enabling ideas to be explored without interruption to conceptual 'flow ' and providing confidence in technique which helps to maintain intrinsic motivation.

The flow of creative thought is enhanced in situations where there is freedom and choice; where an individual feels unconstrained, can think divergently and engage in play. The bringing together of unrelated concepts or mental images enables a practitioner to break set and explore new connections to generate ideas (Amabile, 1996). Digital imaging can assist in this kind of thinking amongst those individuals who have achieved a degree of transparent digital tool usage and who are fully engaged in the process. The potential to rapidly change visual ideas and store numerous variations and iterations facilitates choice and playful experimentation. Waste of materials and subsequent expense should an idea fail ceases to be an inhibiting factor when working in virtual space and so risk taking is enhanced. Artists interviewed in the first phase of the research indicated that digital imaging technology was frequently used at the generative stage of conceptual development to store images from a variety of sources. Hand rendered images, photographic material, video and electronically generated imagery can be blended together in the virtual dimension to provide new kinds of complex visual forms enabling memory, and sensuous responses to be developed and expressed in innovative formats.

The impact of this application of technology is evident in the visual outcome of the artifacts produced. Recent developments in textile digital ink jet printing technology mean that the complex multi layered images that it is now possible to create virtually can also be reproduced in material form. Those interviewed unanimously stated their belief that there was a new or evolving visual language evident as a result of digital technological deployment. Textile visual language has always been locked into technological development; each change creating 'a visual language which contains a wide range of dialects and which expands as new developments occur' (Briggs, 1995). The use of photographic imagery, the digital layering of image and the complexity of color and tone 'the inclusion of so much detail …on one piece of fabric is what the language is all about' (Earley, 2003).

Color and Perception

Evidence from the first phase of the research highlighted the ways in which the difficulty in achieving color parity between digital virtual color and the printed output act as both an inhibiter and motivator in the creative process. The difficulty in replicating the color gamut viewed on screen by those practitioners who were without access to color management software tools and photo spectrometers has led to two approaches. For some the printed outcome would be considered 'a catalyst for change' (Leak, 1998); viewed as a stage in the creative process to be accepted, worked with through the application of hand rendered color or modified using other textile embellishment techniques. Others interviewed found color issues de-motivating, frustrating and, as a result, inhibiting to creativity (Brandeis, 2003).



Color is a psychophysical phenomenon and the perceptual limitation of color issues means that sharing and communicating color between technology and individuals continues to be fraught with difficulty. Current technological developments will assist in color communication and solve some of these problems. The impact on creative practice will inevitably be heavily affected by the psychological viewpoint of the practitioner, access to color management tools and the degree of perceived constraint that color disparity places on freedom to innovate concepts.

Hybrid Crafting

The digitally printed fabric outcome has been described by several of those interviewed as being flat, lifeless and lacking sensuousness. For some this was a response to the quality of printed color but for others it was awareness that the material lacked 'aura'; that as a product of a machine it no longer conveyed the emotional charge that the human hand endows (Wilson, 1998) This dissatisfaction has led some practitioners to regard the cloth as a transitional stage in the creative process rather than a completed artifact. The result has been a hybridization of digital and handcrafting skills producing artifacts in which ancient and traditional craft techniques are combined with digital technology.

Anthropologists have suggested that to make with the hands is an innate human capacity and through hand experience the brain develops manipulative, kinesthetic and language skills which build memory and knowledge of the world (Dissanayake, 2000); (Wilson, 1998). The combination of kinesthetic and tactile information supplied to the brain from hand experience is combined with sensory information from the visual system to build the visuospatial images that are necessary for imaginative and creative thought (Wilson, 1998). It is inevitable that practitioners who have highly developed sensitivity through manipulative crafting processes will feel constrained by the lack of sensory stimuli inherent in digital crafting. The hardware and peripheral devices that are most commonly used do not exploit the complex neuromuscular potential of fingers and thumbs nor the hand-eye coordination or force feedback that is the natural development of hand manipulation. Rather the hands are expected to move mice or keys while the eyes are looking at a monitor located in a different physical location. Although this is also the case in activities such as playing a musical instrument it is unusual in those that work a material (McCullough, 1996). Research indicates that the left and right hand perform different but complimentary functions: the non-dominant hand framing the movement of the dominant. The dominant hand executes tasks that are 'micrometric, rehearsed and internally driven or pre-programmed' for example in writing, whereas the non-dominant hand positions the paper during the process and 'is macro metric, improvisational and externally driven' (Wilson 1998). Working together symbiotically, the hands are able to supply information to the brain that 'shapes creativity itself' (McCullough, 1996). The digital tools that are commonly used by most practitioners, mouse, keyboard, pen and digitizing tablet, do not capitalize on the complex potential of the hands. These peripherals have been described by those interviewed as 'clumsy, awkward and frustrating' and, as sensory input devices, are inhibiting to creative flow. Current research into physical crafting in the virtual environment using bodily kinesthetic skills may provide the key to the development of haptic tools that will aid a more intuitive

hands-on approach to working with technology.

Physical handcrafting requires time to practice so that skills become tacit and the tool use transparent (Dormer, 1994). There is time for reflection on practice and for concepts to evolve. Digital tools provide rapid progress and proliferation of ideas requiring continuous decision-making and memory recall. The speed of work and the lack of sensory stimulus from the hands may cause entrenchment in working methods or conceptual models; there is a danger of the individual becoming a 'mouse potato,' content to click and gaze quiescently at the monitor without reflection on practice as it occurs (McCullough, 1996).

On the other hand, the rapid production and manipulation of images can be viewed as a positive motivator to creativity. Research has found that sensory stimulation prior to creative task engagement enhances divergent thinking (Amabile, 1996). The facility to rapidly generate and view large numbers of images, to assemble, reassemble, collage, layer, duplicate, store and retrieve them, provides rich source material for concept initiation. At the generative stage of the design process, the iterative cycle of building a visual concept can progress swiftly and its progress can be recorded, modified and developed more rapidly than in hand rendered work. Time can be utilized in playful exploration of concept, suspending judgment and without inhibition since the concepts exist in the semi reality of virtual space.

The perceived logic and structure of the technology can appear to limit the potential for serendipity on which creative practice thrives. Case study research indicates, however, that practitioners who are positively motivated to use digital imaging and who take a relaxed and playful approach to the creative task seem able to devise methods for achieving spontaneity. The mental attitude towards the technology seems to be key to its creative potential and personality traits have been shown to greatly affect individual creative task engagement (Amabile, 1996).

Speed of concept generation and design development is also enhanced by the facility for rapid communication of visual ideas. It is possible to gain swift feed back from others and the design development cycle can accommodate external influence and technical constraints in a positive way to provide designs that are both novel and appropriate solutions to the task. Electronic data transfer saves time and a rapid response to initial ideas may inhibit entrenchment and functional fixedness that have been found to have negative effects on creative task engagement. In a world of tight deadlines and rapid change, any mechanism that speeds up the decision-making and algorithmic processes of design development is useful. However, there is considerable agreement amongst those involved in cognitive psychological research that 'creativity takes time' (Sternberg, 1988) and that time is required for reflection, revision and the nurturing of the elements of generative thought. It is imperative that those wishing to reap the benefits of digital imaging within creative design practice are able to invest sufficient time in exploratory playfulness at the generative stage.

Phase 2 - a collaborative experiment

The speed and ease with which it is possible to communicate digital visual data enables intervention at various stages in the development of a design concept. The initial findings the research has revealed a number of ways that practitioners are collaborating digitally with other individuals with

complementary skills: textile designers with fashion designers, designers with technologists and artists with designers . In many cases the technology is providing a means for sharing creative thought and design expertise that would be difficult to achieve without it.

Digital imaging makes available the tools with which it is possible to creatively intervene in the generative stage of conceptual development. The second phase of the research is seeking to explore these issues through empirical research in which the generative design process is being communicated and shared between the researcher and a textile practitioner. The analysis of both the process involved and the artifact produced during the experiment will provide insight into how creativity may be affected by digital imaging technology. The project has evolved out of case study research in which the Scottish textile artist Alison Bell was filmed and interviewed. Bell's textile work exhibits a changed visual language as a result of the incorporation of digital imaging in her creative process. Her textile artifacts are digitally inkjet printed on to silk and further embellished using a hybrid craft technique in which she hand renders layers of dyes and elaborates the fabric surface using appliqué and stitch.
Bell's work is influenced by the location in which she lives and expresses her concerns with the impact of man on the environment and its transactional effect. For this reason a specific geographic location familiar to both the practitioner and researcher was selected as the visual starting point for the experiment and reference material in the form of watercolor sketches and digital photographs were made. It was agreed that the concept of shared visual memory of this location would form the basis of the work produced and it was anticipated that the digital conjoining and intervention into two sets of memories would stimulate imagination and enhance creativity. A decision was made before the experiment commenced that six digital renderings would be made, each one building upon the others previous iteration but with no restrictions on what intervention or addition could be made to the previous stage. The images were saved onto CD and exchanged following each rendering. On completion of the experiment, it was agreed that the final result would be digitally printed on silk.

Any empirical exploration of creativity as a phenomenon must take account of the social and personal influences on creative motivation and note those aspects of technological use that act as both positive and negative extrinsic motivational forces. In order to be creative an individual requires freedom of self-expression that is unrestricted and non-judgmental; it must be possible to take risks, think in a divergent manner and be relaxed. The task must be considered more like play than work and be one in which the individual can become fully engaged and absorbed in without distraction (Gardner, 1993). Interview feed back during the experiment indicates that the participants have been able to feel uninhibited by the process despite the evaluative nature of the study and Bell has indicated that she has found the experience 'playful and stimulating'. The empirical evidence gained to date supports the view that the potentially negative extrinsic motivational factors such as evaluation and reward can act in a positive way when the evaluation is supportive and the reward is not a distraction but providing stimulation for future intrinsic motivation (Amabile, 1996). Further experiments are planned to establish the validity of the findings from this initial phase.

Although this research is still at an early stage, it is evident that digital imaging is

impacting on creative practice as revealed in both the created artifact and the generative process. The effect of technological deployment on creativity is however also dependent on the intrinsic motivation of the practitioner and their psychological attitude to it. For some practitioners the mental modeling required to engage with software is inhibiting and breaks conceptual flow and for others the lack of physical tool manipulation is demotivating. However for those practitioners who have overcome these constraints through practice, play and specialization, the technology provides access to a wealth of tools and embedded knowledge that can enhance the creative process. The ease with which electronic data can be communicated is also facilitating collaboration and providing a means of shared imagination, making thought visible, sparking insight and enabling innovation.

Footnotes:

Research findings presented at PixelRaiders2, Sheffield Hallam University, April 2004 www.pixelraiders.org Treadaway, C. (2004). Digital reflection; the integration of digital imaging into the creative practice of printed surface pattern and textile designers. PixelRaiders2, Sheffield Hallam University.

Creativity is defined in The Dictionary of Psychology as " mental processes that lead to solutions, ideas or conceptualizations, artistic forms, theories or products that are unique and novel." Reber, A. S. (1985). The Penguin Dictionary of Psychology. Harmondsworth, Middlesex, Penguin.

Gardner's theory of multiple intelligences Gardner, H. (1985). Frames of mind : the theory of multiple intelligences. New York, Basic Books.

P.N. Johnson Laird in Freedom and Constraint in Creativity discusses this in terms of improvisation in music. Sternberg, R. J. (1988). The nature of creativity: contemporary psychological perspectives. Cambridge, Cambridge University Press.

Amabile states that 'the intrinsically motivated state (marked by involvement in and playful enjoyment of the task) is conducive to creativity, but the extrinsically motivated state…is detrimental' Amabile, T. M. (1996). Creativity in context: update to The social psychology of creativity. Boulder, Colo.; Oxford, Westview Press.

Csikszentmihalyi wrote of a creative "state of flow" or "flow experience". " Those "in flow" are not conscious of the experience at the moment; on reflection however, such people feel that they have been fully alive, totally realized and involved in a "peak experience." Gardner, H. (1993). Creating minds : an anatomy of creativity seen through the lives of Freud, Einstein, Picasso, Stravinsky, Eliot, Graham, and Gandhi. New York, BasicBooks.

The introduction of engraved plate, roller and silkscreen processes each contributed to a change in the visual format and structure of the surface patterns produced for printed textiles.

The ATCC, C2C (Communications Subcommittee-Electronic Standards Sub Committee) and the SDC, WG12 are currently working together to create a universal standard for global color management.

In his essay "The Work of Art in the Age of Mechanical Reproduction (1934), Walter Benjamin uses the term 'aura' to describe the emotive element that is lacking in the machine manufactured product.
'When personal desire prompts anyone to learn to do anything well with the hands, an extremely complicated process is initiated that endows the work with a powerful emotional charge.' Wilson, F. R. (1998). The Hand. New York, Pantheon Books.

The Tacitus Project at Edinburgh University is investigating the use of the Phantom haptic device to enables users to touch feel and manipulate virtual environments. It aims to "create a generic virtual environment in which the applied artist feels uninhibited and can bring their experience and knowledge to

extend their creativity to the digital medium." Shillito, A. M. (2002). The Tacitus Project. Pixel Raiders.

Evidence in case study material Alison Bell, August 2003. Personality traits include: self discipline, ability to delay gratification, perseverance in the face of frustration, independence of judgment, tolerance for ambiguity, high degree of autonomy, absence of sex role stereo-typing, risk taking and self initiated, task orientated striving for excellence. Amabile, T. M. (1996). Creativity in context : update to The social psychology of creativity. Boulder, Colo.; Oxford, Westview Press.

"The very nature of creativity depends on the time constraints involved and the opportunity to revise or nurture the outcomes once produced." Tardiff, T.Z. and Sternberg R.J. in 'What do we know about creativity?' Sternberg, R. J. (1988). The nature of creativity: contemporary psychological perspectives. Cambridge, Cambridge University Press.

J.R. Campbell (textile designer) and Jean Parsons (fashion designer)
Philip Delamore, London College of Fashion
Alison Bell (textile artist)

Shillito, A. M. (2004). The TACITUS experience: a new spatial, multi-sensory digital interface supporting creativity. PixelRaiders2, Sheffield Hallam University, Sheffield Hallam University.

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