Entwined approaches: integrating design, art and science in design research-by-practice

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Entwined approaches: integrating design, art and science in design research-by-practice

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Abstract

Drawing on experience gained through a recently completed practice-led PhD project in textiles this paper considers the importance of evolving design research methodologies that integrate the intuitive, creative and poetic approaches prevalent in professional design practice with more quantifiable academic research methods. The paper explores the relationship between scientific and artistic approaches in practice-led design research and possible means by which they can be balanced in order to accurately reflect both the technological and poetic aspects of such research.

This paper surveys existing discourse originating from studies of design practice, particularly regarding 'thinking-in-action' (Harrison, 1978; Schön, 1995; Cross, 2007; Pallasmaa, 2009), 'productive science' (Buchanan, 2007; Tooming Buchanan, 2010) and active documentation of studio practice (de Freitas, 2002). However, influential debate on the subject is not limited to the discipline of design. The paper also discusses how a multi-perspectival approach and the use of multi-strand methodologies originating from the social sciences (Richardson, 2000; Denzin & Lincoln, 2008) have been applied in a specifically textile design research context.

This paper, illustrated by examples drawn from the project, explores the potential of an integrated approach using a 'bricolage' of methods (Kincheloe, 2001) to produce original research outputs that address both theoretical and practical questions, allowing for investigation of the metaphysical, the emotional and the imaginative alongside the technical.
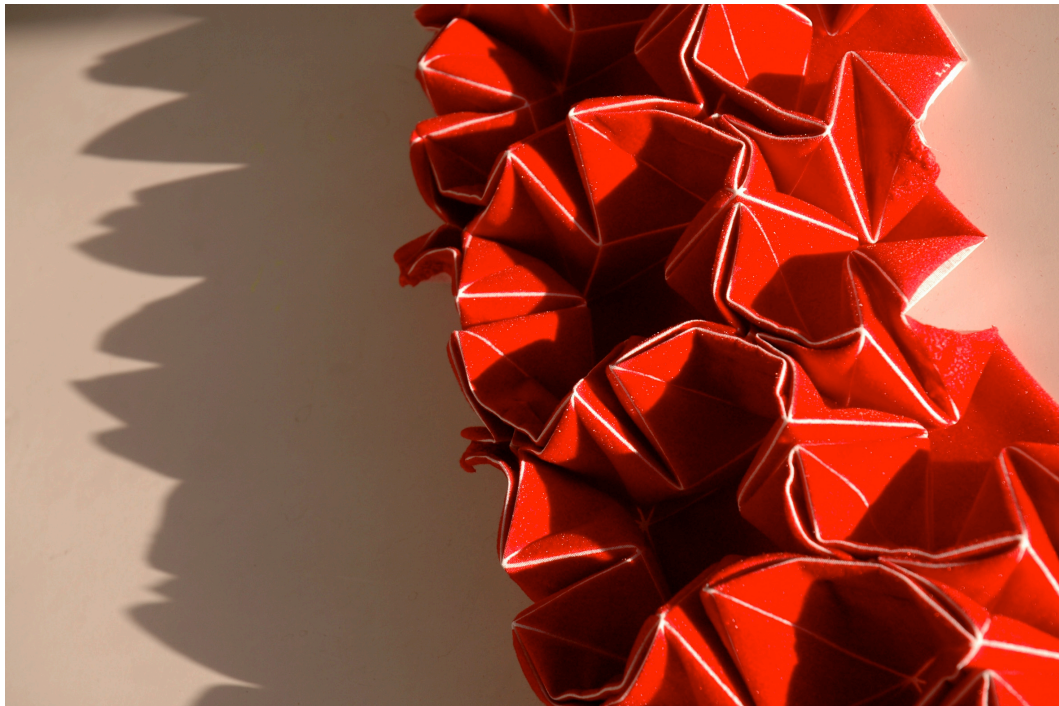
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Introduction

This paper has developed as part of a wider programme of PhD research entitled 'Structural Textiles: adaptable form and surface in three-dimensions'. In this research the fold has provided a point of focus for the generation of both new process and new thought. The project has developed and combined textile and non-textile production processes to create adaptable, self-supporting 3-D textile structures with shape-memory and customisable material properties (figure 1). These textiles have transferable application in diverse disciplines including sportswear, medicine, architecture, interior & product design.

Figure 1   Flock printed, shape-memory, origami-folded textile

Such developments more usually originate from material science, engineering and textile technology contexts. However, by building on research carried out by these disciplines but emphasising a 'poetic', design-orientated outlook the project investigated the potential for a more intuitive, non-linear approach to highlight hitherto overlooked elements in the design process. This paper, illustrated by examples drawn from the project, explores the relationship between scientific and artistic approaches in practice-led design research and possible means by which they can be balanced in order to accurately reflect both the technological and poetic aspects of such research.

Academic models suggesting possible approaches and methods for research-by-practice PhDs have been outlined by people including Gray & Malins (2004), Sullivan (2010), and Tooming Buchanan (2010). This paper surveys existing discourses on this theme. For example, considerable discussion surrounding the concept of 'thinking-in-action' has originated from studies of design practice (Harrison, 1978; Schön, 1995; Cross, 2007; Pallasmaa, 2009). Much debate in this area has been generated around the validity of multi-method approaches that create and disseminate knowledge by means other than the written exegesis, for example de Freitas (2002) discusses how active documentation of studio practice can help explicate unarticulated 'thinking-in-action'. However, influential debate on the subject is not limited to the design disciplines. Academics working in the social sciences acknowledge the benefits of multi-perspectival approaches and multi-strand methodologies (Richardson, 2000; Denzin & Lincoln, 2008). This paper discusses how these concepts have been applied specifically in a textile design research context and in particular how the use of a 'bricolage' of research methods, as described by Kincheloe (2001), allowed for dynamic, multi-perspectival analysis of both practical and theoretical aspects of the research.

Exploring the potential for an integrated methodology

Overlaps between scientific and artistic approaches

The research focused on developing high-functioning textiles for practical application in a range of situations that would also enhance the aesthetic of the environments in which they were used. A key hypothesis of the project was that development of technical and functional aspects of the work could be enhanced by the simultaneous evolution of metaphysical, emotional and imaginative elements. The methodology employed had to take particular account of this focus, ensuring that aesthetic considerations were not subservient to the functionality of the materials created. The study also had to elucidate the philosophical and cultural conventions that influenced the research design. Theory and practice had to be folded together to achieve 'a correspondence and even a communication between the two levels, between the two labyrinths, between the pleats of matter and the folds in the soul.' (Deleuze 2006: 4)

Historical differentiation

While scientific models of quantitative data collection and analysis have a place in the work, particularly in the functional development of material substrates for folding, they needed to be integrated into the wider fabric of the research, complimented by a range of artistic methods. As Laurel Richardson (2000: 937) says, 'Science is one lens; creative arts another. We see more deeply using two lenses.'

Historically in the UK the arts and the sciences have been posited as oppositional but this extreme science/art divide is a particularly English phenomenon, stemming from class-based cultural mores and a strictly partitioned system of education that forces narrower subject specialisation much earlier than elsewhere. The hierarchical struggle observed between these 'two cultures' by C.P. Snow (1959) was situated in this context. However, although the arts may be primarily concerned with 'affect' while science explores 'effect', both areas address the same fundamental questions regarding the nature of the world and the behaviour of things in it (Miller 2009). Kincheloe (2001: 683) notes,

> *...what we refer to as the traditional disciplines in the first decade of the 21st century are anything but fixed, uniform, and monolithic structures...We occupy a scholarly world with faded disciplinary boundary lines.*

In European countries e.g. Germany these malleable disciplinary boundaries are reflected in the language. For example 'Wissenschaft', the German equivalent of the word 'science' is a much looser term denoting any systematic body of enquiry. 'Wissen' means knowledge, while 'schaft' has its roots in 'schaffen', meaning to create or make; so 'wissenschaft' describes a process of 'creating knowledge'. This more pliable definition is more sympathetic to practice-led design research as both the poetic and technical aspects of the research emanate from the same core.

Academic models for research-by-practice

For many years design researchers have explored potential approaches to practice-led research. Gray and Malins (2004) note that due to the subjective nature of practice-led research it is most likely that hybrid methodologies will be devised '...which may use other models but will inevitably have [their] own distinct identity.' (Douglas quoted in Gray and Malins 2004: 22). I sought a suitably robust methodology inspired by Andre Gide (1971) who wrote:

> *Those who count are those who launch themselves into the unknown. One does not discover new lands without agreeing to lose sight, first of all and for a long time, of the shore.*

In textiles design there have been rapid changes in methodology and perspective to incorporate new developments in materials science and embedded technologies. Such design can construct a bridge between beauty and utility, a marriage of aesthetic and function. However, many earlier PhD theses on the development of technical textiles and textile processes were largely structured using academic models derived from scientific disciplines. Writing in the mid 90's, Baurley (1997) and Geesin (1995) chose to emphasise their objective development of process and their scientific testing of material properties rather than their subjective position as designers or the aesthetic, cultural or emotional impact of their work. This may have been due, in part, to the need to establish the then relatively new research-by-project model as a rigorous and valid form of academic enquiry. However, the symbolic and poetic aspects of this research were not addressed by employing the methodologies of materials scientists and textile technologists solely, pragmatically analysing data collected from documentation of material behaviour and production processes.

Adding qualitative and poetic approaches illuminate different perspectives, allowing for investigation of the metaphysical, the emotional and the imaginative alongside the technical. However, in order to have academic validity the experiential knowledge unearthed must have some transferable significance. There is a strong subjective element to artistic practice, but this is not necessarily a deficiency, as it would be seen in scientific thinking. As Stefan Collini (1993: x1vi) says;

> *...it has become more widely accepted that different forms of intellectual enquiry quite properly furnish us with a variety of kinds of knowledge and understanding, no one of which constitutes the model to which all the others should seek to conform.*

Subjective approaches can be legitimised through conscious conceptualisation that challenges, analyses and supersedes habitual ways of working to reveal meanings that contain a degree of universality. By exploring personal responses to technical materials artistic methods can clearly communicate material properties to wider audiences than any technical data sheet. This is beautifully illustrated by a group of artists and designers who used the hi-spec materials of Japanese advanced fibre developers in their work (Kara 2009). The work does not directly convey the technical details of the product but rather the qualities that these properties could bring to objects, revealing the potentialities of materials by revealing the poetic in the scientific.

Research paradigms have been evolving to reflect the dual nature of the designer/ technologist and more pliable thesis models are emerging. A fundamental aspect common to these models is the singular importance of continual *reflection* on the practice. Zane Berzina (2004) used human skin as metaphor and model at the core of her research, analysing its biological structure and properties as a springboard for the development of novel technical textiles. Using medical imaging alongside more artistic techniques she developed textiles for display in gallery contexts. To achieve this she constructed a hybrid methodology that passed through stages of initial research and classification of key aspects to be developed, experimentation and analysis of these experiments followed by synthesis of this information into textile art outcomes. Her approach could be loosely equated with that of 'productive science', comprising three key activities: the identification of the functional aspects of the design, the exploration of these aspects, and finally their integration into a creative work that 'has impact and emotional integrity' (Tooming Buchanan, 2010). Tooming Buchanan investigates the potential of 'productive science' to provide a rigorous research model that enables the creative practitioner to integrate both functional and artistic elements of the research. Using this strategy she focuses particularly on the unification of emotion, creativity and user experience of her textile art outcomes with their scientifically measured sound dampening properties. She notes the significance of reflective practice at all three stages.

> 'Productive science suggests the artistic logic of someone who studies a situation, reflects on all of the factors that bear on creation, carries out the work of realizing an idea in concrete form and materials, and then reflects on the total experience in order to gain deeper understanding of an art. (Ibid, 2010)

These more flexible approaches, examples of which are also emerging in other disciplines such as the social sciences (Richardson 2000) and archaeology (Shanks 2004), offer the opportunity for more creative responses in the research, constructing alternative narratives through methods such as film, illustration, drama and creative writing. However, they only allude to the cyclical nature of design development. Fundamental to the framework of this project is the recognition and incorporation a cyclical or spiralling process of iterative design at the centre of the research: practice informs theory, which in turn informs practice.

Multi-method techniques and the 'bricolage'

Gray (2004: 21) suggests, "…a characteristic of 'artistic' methodology is a pluralist approach using a multi-method technique." The term 'bricolage' is used in the social sciences to describe a research approach that combines a variety of empirical and

interpretive methods within a single study. The bricoleur operates in the interstices between disciplines, creating conceptual connections and facilitating interactions across disciplinary boundaries.

> *Bricolage does not simply tolerate difference but cultivates it as a spark to researcher creativity.* (Kincheloe 2001: 687)

The interdisciplinarity of the bricolage can act as an agent of change that moves, dissolves or otherwise alters disciplinary boundaries; advancing traditional, single discipline methodologies by amalgamating a range of select approaches. The bricolage folds multiple layers of knowledge and discourse together creating novel points of interaction between the researcher and the researched, producing enriched interpretations of the subject of study.

Ramsgard Thomsen's (2008) 'Slow furl' textile installation illustrates how the use of multiple methods can reveal aspects of the project that are otherwise imperceptible or hidden. This large installation comprises a wooden framework supporting an articulated textile skin. Inspired by the action of breathing but slowed to a glacial pace the conductive fabric switches activating motors in the framework when it folds and touches itself, thereby instigating its own movement. However, the piece moves so slowly it is imperceptible except when photographed or filmed over an extended period of time. Her speeded up films and photographic sequences show dramatic shifts of form that cannot be seen in real time.

Despite the possible negative connotations of the word, the bricolage rigorously questions fundamental assumptions about disciplinary mores. Kincheloe (2001: 686) says of the bricoleur:

> *As they study the methods of diverse disciplines, they are forced to compare not only methods but also differing epistemologies and social theoretical assumptions. Such diversity frames research orientations as particular socially constructed perspectives – not sacrosanct pathways to the truth.*

The bricoleur is not just 'making do' with what is to hand to bodge an outcome but actively seeking out or constructing tools appropriate to a specific task by combining the best and most relevant aspects of various traditional methodological approaches. This conceptual and practical framework entails the folding and refolding of disparate elements in an iterative process of synthesis to create coherent meaning.

Application of the 'bricolage' in textile design research

Conceptual Foundations

This project used observation, documentation and analysis of material behaviour in production processes in combination with creative writing, film making and drawing to develop self-supporting textile forms, allowing their evaluation from multiple viewpoints. To achieve balance and academic rigor it was necessary to devise systems to record and reflect upon the pragmatic and the phenomenological aspects of the research without losing the spontaneity of embodied, playful and intuitive design practices.

As with much design research, this project contained both technological and artistic aspects. Specifically, it applied 'soft' artistic thinking to the 'hard' scientific topic of textile technology and futures. Pennina Barnett (1999: 26) elucidates the concept of 'soft' logic, employing drapery as a poetic metaphor to illustrate the potential of Deleuze's 'soft' flexible thinking.

> *What if the poetics of cloth were composed of 'soft logics', modes of thought that twist and turn and stretch and fold? And in this movement new encounters were made, beyond the constraints of binaries? The binary offers two possibilities, 'either/ or'; 'soft logics' offer multiple possibilities. They are the realm of the 'and/or' where anything can happen. Binaries exclude: 'soft logics' are to think without excluding.*

In Deleuzian folding ones own thoughts become enfolded with those of another, juxtaposing hitherto unrelated ideas and generating new meaning as a result of this unexpected relationship. This folded thinking is a process of pliable and dynamic transformation and could be seen as a reversal of the prioritisation of logical rationalisation over intuition. Barnett (1999: 26) describes it as, '…a form of experimentation: an essentially creative and critical activity, activated when the mind is "provoked by an encounter with the unknown or the unfamiliar"…'

Methods employing 'soft logics' are often seen as woolly and ill defined with no clearly articulated concept or goal. Its passivity has negative connotations, being influenced by external forces seen as weak. However, the pliability of 'soft' thinking, its openness to include the unforeseen allows more opportunity for the unexpected to occur. Barnett argues,

> *…if 'soft' suggests an elastic surface, a tensile quality that yields to pressure, this is not a weakness; for 'an object that gives in is actually stronger than one that resists, because it also permits the opportunity to be oneself in a new way'.* (Ibid: 26)

This flexible, 'soft' thinking provided a conceptual foundation for the project.

This research comprised of differing elements necessitated a combination of approaches. Some parts were weighted towards scientific 'problem-focused' approaches (Cross, 2007) e.g. logging precise technical parameters of production to assist replication or controlled amendment. Other aspects were more suited to 'solution-focused' design approaches a creative approach. Applying the 'soft logics' of Barnett (1999), modelled on Deleuze & Guattari (2004) to this 'bricolage' of methods one can acknowledge the tension between seemingly oppositional approaches but recognise their connection as gradated divergence rather than absolute difference.

Deleuze and Guattari's pliable conceptualisation of folding and unfolding and of the striated and the smooth imagines continuous and reversible dialogues not separate discrete entities. The term 'striation' is used in the textiles industry to describe a fabric whose slubbed, uneven surface indicates a fault in manufacturing. However, here the word has no such negative connotations, referring instead to divided states of being. Striation is structured, quantifiable, differentiated, partitioned space and being a narrowing of choices, an 'either/or', it could be seen as certain and committed valuing decision over indecision and possibly comparable to scientific approaches. By contrast smooth space is physically continuous, amorphous and undifferentiated, non-quantifiable

and open, perhaps analogous to artistic methodologies. However, it is important to recognise that one eventually becomes the other.

> *...smooth space allows itself to be striated, and striated space reimparts a smooth space, with potentially very different values, scope and signs. Perhaps we must say that all progress is made in striated space, but all becoming occurs in smooth space.* (Deleuze & Guattari 2004: 486)

The juxtaposition of both states and continual transformation of one condition to the other enriches the meaning of both. Similarly the integration of quantitative and qualitative approaches can achieve more than either method used in isolation. Spontaneous and intuitive ways of working, where tacit knowledge is of profound importance, are easy to dismiss as invalid and lacking in rigour. However, such approaches used in combination with other methods open up opportunities for innovation missed when only using linear, logically rationalised working practices.

Reflective making

The evolution of knowledge through making is enfolded into both designing and the research-by-project PhD structure. Making and meaning are inextricably intertwined. Harrison (1978), Schön (1995) and more recently Cross (2007) and Pallasmaa (2009) have all considered the generative potential of 'reflection-in-action', where the practitioner evaluates and analyses their actions as they make, responding to information generated by the process and adjusting their actions accordingly. The reflective creative process can be a transformative experience for the creator, revealing hidden areas of enquiry, sub-conscious influences and obstacles. Donald Schön (1995: 78) describes the development of design through making as a reflective 'conversation with the materials of the situation', yet this dynamic dialogue is fleeting and ephemeral. Research-by-project, like archaeology, attempts to preserve and record this unpreservable moment; to re-construct, re-imagine and analyse these activities. Through noticing and recording previously unvalued, unobserved or abandoned details of the making process novel critical theory can emerge. However, the necessity to observe design practice from a position of distance whilst simultaneously being wholly engaged in the activity presents the designer/ researcher with a fundamental problem. How can the maker when totally absorbed in the often instinctive and intuitive making process concurrently dispassionately observe, note and consider all the knowledge processes, both tacit and explicit, and actions, both conscious and unconscious, that constitute this making? This paradox can create tension between making and the wider project.

Active documentation

de Freitas's (2002) investigation of the working methods of postgraduate art and design students demonstrates that active documentation of studio practice using methods including visual, textual, video and audio documentation can help the practitioner articulate processes and forces in action when making intuitive decisions in the design process. This documentation provides a significant point of interaction between practice and theory. Talking of 'active documentation' de Freitas (2002:6) states:

> *As a research method, it is an appropriate hybrid tool for critique, strategic planning, decision- making and exegesis writing. As a method for locating and negotiating theoretical and practical concerns, it could play a role in theory construction relating to art and design research.*
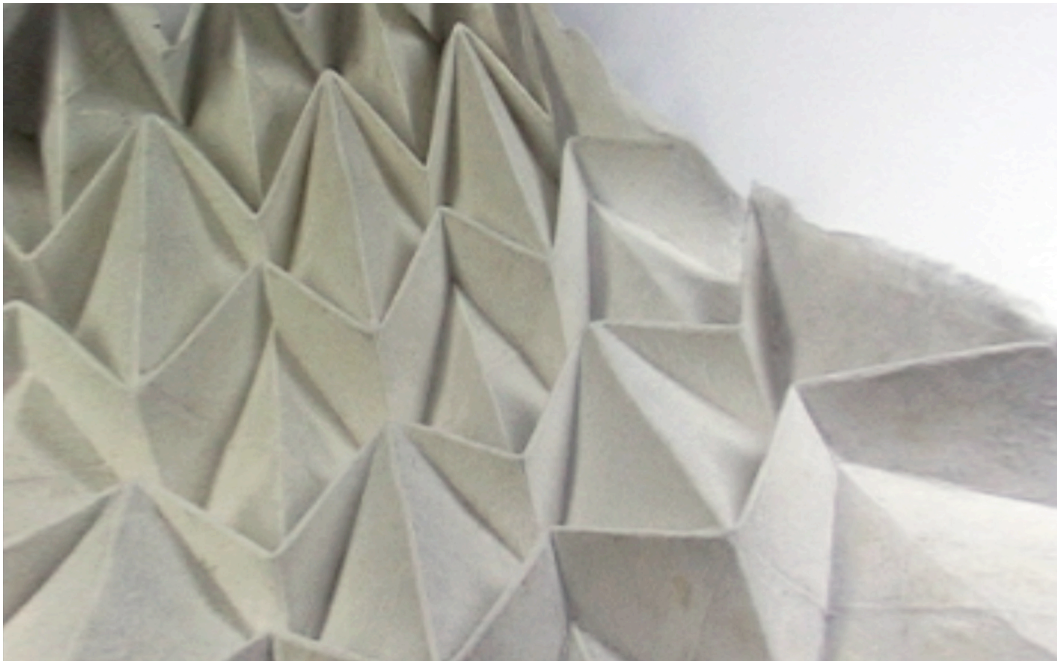
However, it is essential that these documentation methods be systematically integrated with reflective practices in order to evolve the practice in a meaningful way. The validity of such documentation as a credible research method is supported by the work of many designer/researchers. For example, Pedgley (2007) scrutinised a range of self-reportage methods, particularly focusing on diary writing in his PhD centred on technical innovation in industrial-design practice. These studies have shown that such methods can be particularly beneficial in situations where the practitioner has to perform a dual role, carrying out practical work whilst simultaneously applying systems of self-analysis. However, a balance must be struck between the immediacy of documentation that occurs concurrent with the practice and post-event reportage, to maximize opportunities for the collection of accurate data whilst minimizing disruption to the design practice being studied.

To capture practical details of substrate construction in this project a data collection form was devised to gather a standard data set as the work was made. This evolved over time to optimise its simple integration into the making process, eventually metamorphosing into a searchable electronic database. The categorisation of samples in this way is a means of imposing order through comparison, encouraging detailed analysis of how individual elements conform or deviate from clearly delineated constraints. Pragmatically, categorisation gives an overall structure and coherence to the collection and ensures essential data is not lost. However, the taxonomy of material is a creative generative exercise, an active process of concept development that allows the identification of generic elements through the recognition of similarity and difference. The designation of distinct categories provided foundations from which to build however, this organisational structure was vulnerable to change and reclassification as objects were encountered that did not conform to existing categories. Boundary-jumping entities challenged existing structures and conceptions, forcing reassessment that advanced the work.

Documentary video and audio recording of the making process promoted reflection-in-action, capturing information unnoticed at the time, allowing the retrospective review, evaluation, and analysis of the practice from an external position after the event whilst maintaining a fluid and intuitive approach to the work at the point of making. This adoption of a detached and critical view goes beyond initial subjectively remembered narratives to enable close analysis of the practice. Using such ethnographic techniques to verify one's own activity mitigates the pitfalls of relying on inaccurate 'composite' memory that fold in on itself to construct fictive narratives from imperfectly recalled fragments. In this project the method was a positive example of documentation process altering the making activity. Consciously and audibly discussing the making with myself as the process progressed encouraged elaboration of the rapid succession of ideas that surfaced throughout the practice. To have these contemplations captured fostered deeper reflection, as the pressure to remember them for later documentation was removed; these reflective conversations could be revisited and reconsidered later. In this procedure practice and theory became seamlessly enfolded, evolving simultaneously.
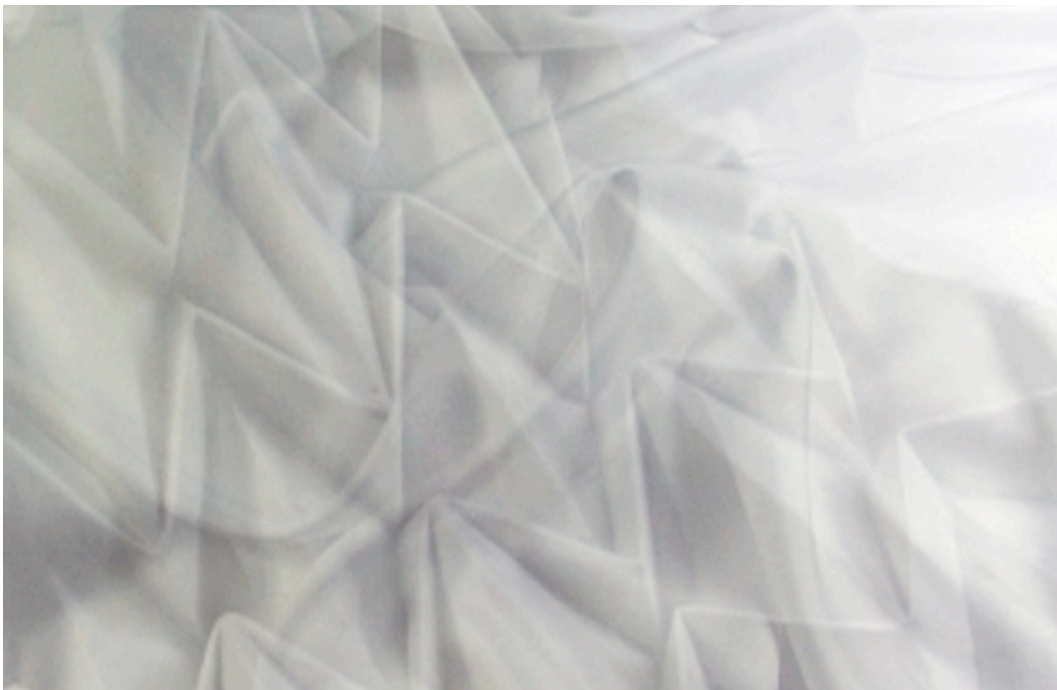
Creative evolution and analysis

Video recording evolved both pragmatic and poetic aspects of the practice, dissolving the boundary between analysis and imagination. Initially videos were made primarily to document aspects of the production process and the mobility of the samples (figure 2).

Figure 2   **Still from a video documenting the mobility of an origami-folded textile**

However subsequent iterations of these videos progressed further into abstraction. The inherent contradiction of using video, essentially coloured light, to depict tactile surface was turned to an advantage. Obscuring the tactile transformed my relationship to the textile, creating alternative frames of reference that unleashed imagination. The videos now not only captured the dynamism of the folded structures but also intentionally abstracted their physical form to encourage a re-conceptualisation of the object, its scale, its shape, its material (figure 3). This moulded the next iteration of the physical form in a cyclical process, the re-design of physical space occurring through oscillation between physicality and immateriality, a journey from 3-D to 2-D and back again.

Figure 3   **Video still with layered images contrasting hard and soft folded textiles**

To explore concepts verbally methods such as clustering, generative and free-writing helped to capture aspects of the project using a personal voice, important as I am embedded in my research not a detached, passive observer. Written work reflected the gradual repositioning of the practice, encompassing both technical and artistic approaches as I began to articulate poetic responses to the processes of the research.

As writing moves into the literary realm the visual is conjured by the verbal, metaphor and simile sketching with words. However, analysis and conceptualisation through visual thinking cultivates different perspectives than those developed through verbal syntax, unearthing different types of knowledge. For example, sequential drawings showing the opening of flowers (figure 4) revealed micro and macro folding evident in the packing and deployment of gladioli flowers and provided inspiration for the development of biomimetic and biomorphic folded structures. Drawing generates physical interaction between the drawer and the drawn. The embodied movement at the heart of this interface embedding one within the activity, negating the mind/ body dichotomy that can be present in verbal conceptualisation. Drawing is performative thinking, an attempt to capture the abstract. Through the action of rubbing out, over drawing and altering one is able to activate and reconstruct memory to produce new ideas (Bould & Oldridge 2008).

Figure 4   Gladioli flowers opening, pencil on paper

Denzin and Lincoln describe the multi-strand methodologies of qualitative research using metaphors of quilt making and filmmaking: processes of montage that carefully select and order numerous distinct fragments to create new meaning.

> *These interpretive practices involve aesthetic issues, an aesthetics of representation that goes beyond the pragmatic or the practical.* (Denzin & Lincoln 2008: 6)

The montage has the power to create conceptual disruptions, forcing new thinking (Adorno 1997, pp.155-156). Removed from familiar frames of reference juxtaposed against seemingly unrelated items new associations take place. On a micro scale, the montage of photographs depicting samples created as part of the research alongside a variety of folded natural and man-made objects prompted re-evaluation of these samples as well as the conceptual framing of the project (figure 5). Juxtaposition of pictures from different categories led to an investigation of the extent to which the properties of these disparate folding types could be controlled and cross-pollinated in the practice to create infinitely variable textile forms.
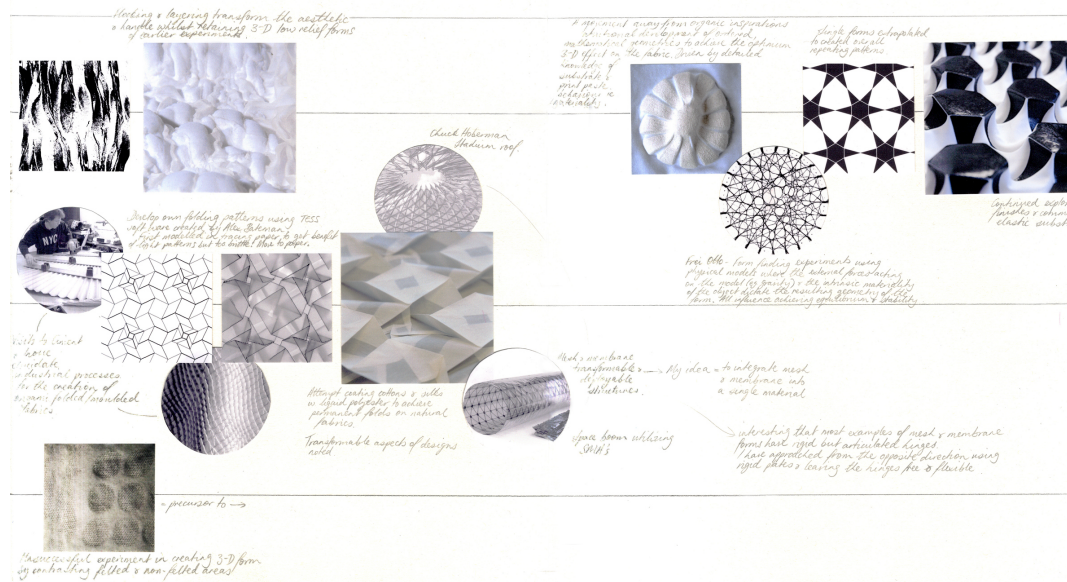

Figure 5   **Detail of a larger photographic series exploring the relationship between different types of folding**

On a larger scale this method combining disparate verbal and visual material has proved useful throughout the research to diagram concept and structure, resulting in the diagrammatic montage of the overall research structure (figure 6). On a practical level the taxonomic organisation of elements of the 'bricolage' has helped to elucidate connections between differing production techniques and to re-examine existing categorisation of the various samples created, pattern recognition occurring as a result of this organisational process. This example of gradual self-organisation highlights the importance of iterative working in developing robust taxonomies and suggests that the development of a rational structure can be intuitively developed. However, the taxonomical diagram is not only an assessment tool, used "to identify consistency across different design processes, projects and the overall body of ... work." (Moussavi & Zaera Polo 2004) but also gives an operational or process paradigm with great generative potential. Referring to the diagram could be a way of overcoming habitual practice and preconception. It encourages the deconstruction of outcomes to a series of generic elements that can be traced further and further back along their lineage, thereby surfacing potentials that may have been overlooked. Recognition of homologous structures and processes across disparate outcomes enables the targeted alteration of textiles to create transferable functionality and application. New branches can be added to the diagram as required when offspring are born from new iterations.

This combination of diverse processes of conceptualisation, a 'bricolage' approach synthesized using principles of 'soft' thinking, has aided the research process and links

theory and practice, the poetic and the technical, the ephemeral and the concrete. This methodological montage question the relationship of individual parts within the whole and can be a means by which to reunify disparate elements into new creations. Individual methods combined to become a multilayered narrative of the whole, a complex account full of twists, self-references and reflections folding one over another. Using this range of activities enabled the viewing the project from different standpoints and engaged the whole body in the process of thinking, a kinaesthetic generation of knowledge that had significant value for the exploration of both form and concept.

Figure 6   **Detail of diagrammatic montage of research elements**

Conclusion

In order to study the textiles at the core of the research it was necessary to examine the processes of making, the technical behaviour of the materials used, and also to examine the outcomes from a point of separation and distance. The enquiry also had to consider the philosophical and cultural principles that have impacted on the research design. I found using a 'bricolage' of methods allowed for dynamic, multi-perspectival analysis of the evolving research problem. Through the use of diverse methods the project could be deconstructed into multiple constituent parts, new links and connections being forged by refolding the material together in fresh arrangements. Refraction of core themes through different media altered their appearance, assisting recognition and consideration of diverse and sometimes conflicting viewpoints and generating new thinking.

I sought to create coherence through the hermeneutic synthesis of images, texts and data to rework disparate and refracted viewpoints into a unified and cohesive whole. In a process influenced by Deleuze's (2006) concepts of folding, ideas are pleated in on themselves in a unification of conceptual exteriority and interiority. While tangible folds provided the catalyst for physical and theoretical evolution, dynamic thought endeavoured to actively fold materiality and concept together into a cohesive whole more profound than the surface appearance of the physical fold.

Such conceptual folding is a search for the re-contextualisation of meaning rather than for absolute truth. While folds separate and isolate areas both physically and conceptually an

infinite potential for constant refolding allows for future renegotiation of these relationships. This creates 'a topology by which inner and outer spaces are in contact with each other' (Conley 2005: 113). Thus, subjectivity, affectivity and materiality are connected and intertwined: physical, temporal and conceptual worlds are not separate but continuous, although differentiated by folding.

> *The division of the continuous must not be taken as of sand dividing into grains, but as that of a sheet of paper or of a tunic in folds, in such a way that an infinite number of folds can be produced, some smaller than others, but without the body ever dissolving into points or minima.* (Michel Serres quoted in Deleuze, 2006: 6)

By highlighting the essential connectivity of all things, which allows seemingly oppositional or divided states to exist simultaneously yet without contradiction this conceptual approach when applied to a 'bricolage' of methods folds together diverse modes of being, thinking and representation to make coherent and continuous meaning.

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Rachel is passionate about textile design futures, developing knowledge in this area through individual and collaborative research projects funded by organisations including the AHRC, the EPSRC and the Textile Institute. Her research focuses on the development of performance textiles and deployable structure with transferable application in disciplines ranging from sports wear and product design to architecture and interiors. She has significant professional experience in fine art textile installation, commercial textile design, and illustration, as well as lecturing in the UK and abroad. She has worked at companies including Lewis & Lewis and Jonathan Saunders, and as part of Kings College London's "The Materials Library presents…" on events and workshops at Tate Modern and at the Wellcome Trust, exploring the crossover between material science and art.