the role of craft in creative innovation: skin, cloth and metal

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Abstract

This paper explores the central idea of creative innovation in the crafts through research methodologies informed by experiential knowledge of fashion, textiles and jewellery practices. The relationship between the body, materials and technology is reinforced through discussion of aspects of two projects, Crafting Anatomies (Townsend et al 2015) and Flex-It (Dean and Niedderer 2014) which the authors were involved in and which draw on references to advanced, modern and historical crafting contexts. The paper seeks to demonstrate how craft, and research through craft, can facilitate creative innovation by mediating the recursive interaction between analogue and digital techniques (Adamson 2015).

In Crafting Anatomies, skin as material and clothing, is the starting point from which to craft new biological, surgical and wearable outcomes, informed by fashion and textile approaches. Flex-It explores elasticity as a medium for emotional expression in silver jewellery design and production, and how complex pieces devised using established techniques to incorporate moving parts, can be produced using additive manufacturing.

The examples demonstrate how craft continually reinvents itself, by contributing to its own development while benefiting the wider areas of human experience and existence.

Keywords: craft research, experiential knowledge, materials and technology

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Introduction

Creativity in art and design is often portrayed as the result of pure idea generation by artists and designers who are somehow freed from the constraints of acquiring the many hours of technical skill and know-how associated with craftsmanship (Sennett 2008). Dorst and Cross (2001: 435–36) help to explain this preconception, as the designer's finding of the surprise solution, which facilitates the creative leap, rather than routine or default solutions which facilitate the incremental changes that are often associated with craft. However, it is often incremental changes to the way new or established technologies are mediated via the hand and computer that leads to innovation.
As Adamson states:

> We should not simply see craft as the static ground from which the digital emerges. Instead, we should understand the interaction between the analogue and the digital as recursive, with each array of techniques decisively inflecting the other (Adamson in Openshaw 2015: 287).

This paper explores two distinct areas of craft practice, fashion/textiles and jewellery, to demonstrate how designer/makers in these areas iterate between traditional and digital tooling to develop new craft based methodologies, products and experiences to facilitate innovation. The first examples to be discussed centre on the relationship between skin and cloth, body and dress, as featured in Crafting Anatomies (Townsend et al 2015) where embroidered textile practices were employed to 'culture' biomaterials for a *Biological Atelier* (Congdon 2015); pattern cutting techniques informed dialogues around surgical procedures for *Skinship* (2016) and historical fashion items were studied and deconstructed to design speculative wearable technologies via the *Electric Corset* (Kettley et al 2015; Townsend et al 2015). The second project, Flex-It (Dean and Niedderer 2016) investigated the potential of flexibility as a functional and affective design element within jewellery design. The experimental research explored how to incorporate emotional expression through flexible parts into a series of ring prototypes. The design was based on pieces crafted using traditional techniques, through the structural development of metals using Additive Manufacture (AM).

All examples encompass a strong reliance on experiential knowledge of materials and making as catalysts to devise interdisciplinary methodologies and create innovative products that have the potential to enhance user/ human experience. The following section contextualises the relationship between experiential knowledge and creative innovation, prior to discussing the projects.

Creativity, innovation and experiential knowledge

In the last 20 years, the idea of creativity has been defined variously and by different disciplines (e.g. Csíkszentmihályi, 1996, Sternberg 1999, 2011, Kaufman and Beghetto, 2009, Cross 2011). Where the different views appear to converge, is that creativity denotes some way of thinking, doing or bringing something new into being that is worthwhile and that has not been thought of, done or made before. Creative ideas not only look at concepts and things in novel ways, but also bring together things that would not normally be thought related. The question that remains at the heart of the creativity debate is how creativity comes about and can be fostered. One of the earliest accounts and which is still current today is the insight by Polanyi (1985) that the step from the known to the unknown requires intuition and that this intuition is based on tacit knowledge, and in particular experiential knowledge (Niedderer 2007).

In order to make something new, the craftsperson needs to acquire experiential knowledge of materials and technologies beyond a purely pragmatic level (Sennett 2009: 288). Creative innovation in the crafts is often facilitated through the development of 'new relationships between the handmade and the digital' which are changing the ways we think about, make and experience objects (Adamson in Openshaw 2015: 286). This idea is underpinned by Sennett's explanation of the word experience, via the dual German meanings of *Erlebnis* and *Erfahrung*: 'The first names the event or relationship that makes an emotional inner impress, the second an event, action or relationship that turns one outwards and requires skill rather than sensitivity' (Sennett 2008: 288). While this definition could be challenged in terms of *Erfahrung*, as what you learn through time may include skill *and* other kinds of knowledge, overall the we concur with the suggestion that intuition is based on our prior experiences, both emotional and sensory, as well as our intellectual ability to understand the world, i.e. through expertise, which can be both enabling through offering the power of understanding and explanation, and limiting by entrapping the mind in preconceptions of what has been learned.

Current debates on experiential knowledge continue to investigate the relationship between 'personal, experiential, cultural, emotional, environmental and social aspects' of designing and making as well as the notion of what we can know experientially from working and collaborating in different ways and with diverse materials (EKSIG 2015: 4).

For example, Lene Tanggaard[1] challenges the myth of the lone creative genius's idea by emphasising the interplay between theoretical and empirical elements, framing creativity the result of 'socio-material practice' (Tanggaard in EKSIG 2015: 10). Elvin Karana discusses the potential for new materials to present the possibility of new products through sensations, thoughts, feelings and behaviours (Karana et al. 2014). Karana's definition of 'innovation' is linked to the ability of a product to affect the maker and user's experience through an embodied form of analysis (Ibid.) This supports the authors' view that creative research and innovation in the crafts requires sensibilities of material understanding and human values through the joining of emotion *and* knowledge (Niedderer and Townsend 2014). The following projects illustrate how craft is instrumental within the creative process through highly skilled material selection, technology application, in response to human needs and experiences.

Crafting anatomies: skin, cloth and wearable technology

'Crafting Anatomies: Material, Performance, Identity' was an exhibition and symposium devised by Dr Katherine Townsend, Dr Amanda Briggs-Goode and Rhian Solomon in 2015 for Bonington Gallery, Nottingham.[2] The project 'placed the human body at the centre of a multi-disciplinary dialogue; exploring how this entity has been interpreted, crafted and reimagined in historical, contemporary and future contexts.' (Crafting Anatomies 2015). The Materials section of the exhibition focused on the parallels drawn between the skin and cloth, the body and dress, as evidenced in *Skin* at the Wellcome Trust, (2010) and at *Make: Shift 2014* hosted by the Crafts Council. The three projects described here focus on 'skin' as a bioengineered material (Congdon 2015), 'skin as cloth' – a meeting place for fashion and surgical practitioners (Skinship 2015) and historical dress as a 'second skin' and conduit towards wearable technology.

Biological Atelier

PhD researcher, Amy Congdon considers skin as a biomaterial in her Biological Atelier, a series of imaginative future fashion collections that explore 'the potential of biotechnology, what these new tools and materials could mean in the future' (Amy Congdon 2015). Her approach is informed by her education as a textile designer and various residencies with Microsoft, Nissan, SymbioticA, Biocouture and through working on the Biolace project (Ibid.). The pieces from her Extinct S/S 2082 collection exhibited in *Crafting Anatomies* included fashion accessories produced by culturing skin cells over digitally embroidered scaffolds to strategically control and shape their growth.

Congdon's method of growing skin cells to produce organic fabrications has been developed through collaboration with Lucy Di Silvio, Professor of Tissue Engineering, Kings College and her reconceptualisation of a 'biology lab as a material engineering lab', as discussed at Make: Shift 2014 (Crafts Council 2014). The desire to devise new tools and materials has resulted in a novel substrate and interdisciplinary methodology that blurs the roles of 'the designer, the craftsmen and the scientist' (Amy Congdon 2015). The process of crafting skin cells is speculative, design-led and a potentially sustainable future fabrication process that reflects 'the rise of a new bio-materiality'[3] (Collet in EKSIG 2015: 12). The significant difference is that Congdon is not working with 'synthetic', but 'human' biology, using 'living technology' to foster innovative substrates (Ibid.). The work represents how dedicated (textile) skills, based on 'the tactile acquisition of knowledge' (Philpott 2012: 53) can be deployed in conjunction with unrelated practices to develop pioneering structures. 'In such practice, innovation is generated through the maker's creative response to unforeseen behaviours of both process and material.' (Ibid.)

Skinship

Following the theme of skin as fabric, is the collaborative network sKINship (**www.skinship.co.uk**), who facilitate creative connections through exchanges between the fields of design and plastic surgery. Developed by Rhian Solomon in 2011, sKINship is a collective of specialists who 'cut, create and make' for the body, including bespoke pattern cutters, industrial designers, concept developers, footwear designers and consultants from a variety of reconstructive surgery specialisms (Solomon in Ravetz et al 2013: 114).

Working in collaboration with couture pattern cutter, Juliana Sissons, sKINship, has run a number of hands-on workshops to open up dialogues between disparate professions to develop innovative products and services. These have included creative pattern cutting for plastic surgeons from St Thomas' Hospital, London; conversations between Savile Row Tailors and specialist burns surgeons; plastic surgery workshops for designers and patients undergoing reconstructive surgery. Based on her specialist pattern cutting skills and new knowledge of surgical practices, Sissons has interpreted surgical cutting and construction techniques through experimental 'surgical fashion

1 Tanggaard, L. (2015) The Socio-materiality of Creativity, Keynote 1, EKSIG 2015.

2 Crafting Anatomies: Material, Performance, Identity, Bonington Gallery, Nottingham Trent University, 7 January- 4 February; Crafting Anatomies Symposium, 30 January 2015.

3 Collet, C. (2015) 'Harvested and Grown: The rise of a new bio-materiality', Keynote 3, EKSIG 2015.

garments', which investigate new concepts for dart manipulation to inform the contouring and fit of clothing. A collection of working prototypes draped and sewn from knitted jersey (the closest cloth to skin due to its construction) were displayed in *Crafting Anatomies* along with a film recording the dialogue between pattern cutter and surgeon.

Findings from the sKINship initiative include considerations of grain direction, colour (skin tone), pattern, and thickness of 'cloth', as guiding factors to inform the 'cut and construction' processes of the body for each 'craftsman'. The fashion and surgical practitioners have also observed technical similarities in the use of geometry, the opening and closing of angles, to create or reduce fullness and form, in addition to the capabilities of each party to visualise the body in two and three dimensions when creating symmetry through shaping (Skinship 2015). By drawing on the similarities (and sometimes differences) of how practitioners in each discipline 'think and work' (Cross 2011), sKINship is currently developing innovative tools, such as a surgical teaching garment that communicates two types of breast reconstruction procedure to patients.

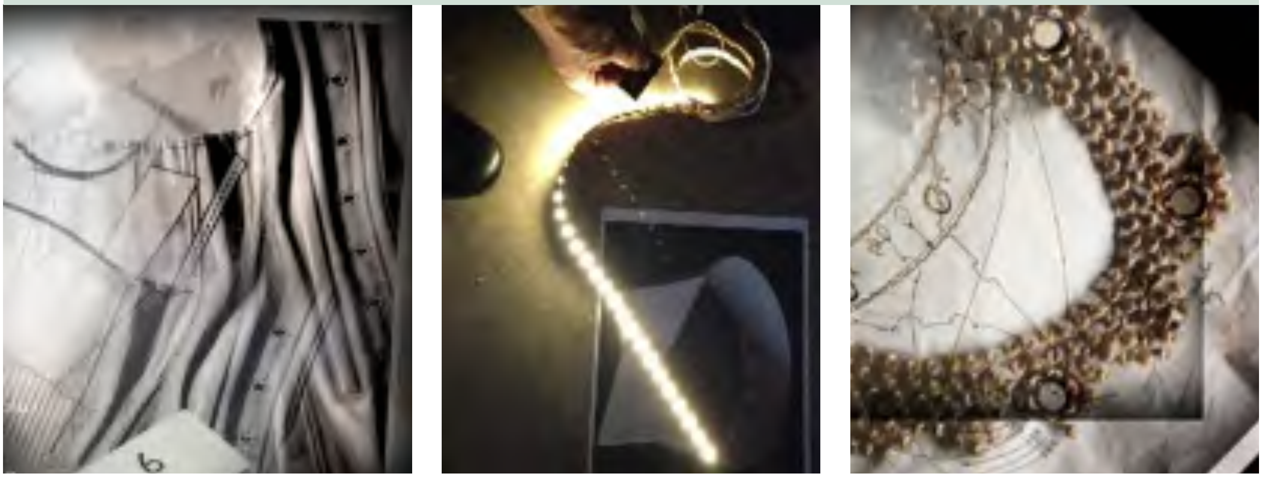
Figure 1a-c: Toile by Juliana Sissons based on plastic surgery reconstruction for Skinship (2015) ©*Skinship* 2015

The Electric Corset and other future histories

Moving to the relationship between skin and cloth, The Electric Corset conveyed how archival research into historical dress can inform the design of wearable technology. Devised by Dr Katherine Townsend, Dr Sarah Kettley and PhD researcher Sarah Walker the title for the project and exhibit was based on an advertisement for a Victorian 'electric corset' made which represented a wearable innovation from the past. The aim of the research/ practice was to demonstrate the wealth of historical artefacts and references available to designers of smart textiles and wearable technologies by considering the anatomy of dress as a catalyst for future wearable designs through an annotated physical anthology of historical artefacts and speculative prototypes (Townsend et al 2015). A process of selection was initiated through visiting and studying items held by Nottingham City Council Museums Collections in collaboration with the curator of Costume and Dress, Judith Edgar. The final pieces that were selected to exhibit and inform the creative ideation process included a white twill ('jean') woman's corset (1800-1810), a woman's dress collar, embellished with shells and glass beads (1920-30), detachable men's starched linen shirt collars (1850-1952) and a footman's livery coat (1890-1910).

Varying dimensions and themes were identified within the objects to inform speculative designs for future wearables such as: functionality, wash-ability and maintenance; layering and detailing to denote class and identity; modularity and loosely defined conceptual spaces between clothing and the body and adornment as a site for creative product development (Ibid). Accompanying the garments in the exhibition was a film that communicated the research methodology through still images, short video clips and quotations. The content included photographs of the garments and accessories (taken in the archive) and documentation of the process of experimental ideation, or 'play' inspired by the construction and decorative details of the items (Glazzard et al 2014). For example, the boning and ten-hole lacing of the corset; the buttons, fastenings, pockets and decorative cording of the footman's jacket and collar shapes inspired 2D drawings, collages and material sketches and assemblages. 3D partial garments were 'moulaged' by working on the half and full-size mannequins using cloth manipulation, stitching, smart elements such as basic circuits incorporating LilyPad (Arduino) and SMA's (shape memory alloys). The crafts-driven creative prototyping employs some of the principles of Kettley's 'foundations of craft', particularly steps 1-3 (of 7), which cover 'risk and visual language', 'extending material' and the 'internalisation of material' (Kettley 2012: 37-38) It also prioritises hand making as a 'way in' to the programming and use of digital tools (Taylor & Townsend 2014).

Figure 2a-c: The Electric Corset and Other Future Histories (2015) Experimental Ideation ©*Electric Corset* 2015



The methodology presents a viable way of working with visual and tactile 'concepts of craft' (Macdonald 2005) to further the field of wearables design. The approach pre-empts the invention and availability of specific technologies by considering identity and expression as functions of clothing and adornment and by drawing on the fields of embodied participation, interaction and service design approaches (Kettley et al 2015). It was also intended to help build critical mass in anthropological, crafts-driven approaches to smart textiles and wearable technology and inform critical debate around the body in relation to new embedded technologies.

Flex-it: integrating emotional expression into jewellery design

Lionel Dean and Kristina Niedderer's research focuses on exploring material intervention to affect the user's experience and emotions akin to Karana et al's philosophy (2014). The research investigates the potential of flexibility as a functional and affective design element as well as its potential applications which bridge the areas of jewellery design and emotion design through the structural development of metals using Additive Manufacture (AM) also known as 3D printing.

Research into AM in metals, in particular Direct Metal Laser Sintering (DMLS) and Selective Laser Melting (SLM), is still highly specialist and is mainly focused on achieving structural complexity, by seeking to eliminate flexing to create stability through enhanced strength and stiffness (Murr et al. 2012). Based on their research into the nature of flexible structures and of current deformable AM geometries, Dean and Niedderer (2016) identified various technical applications and a small number of individual practitioners exploring AM to create extremely flexible objects and materials (e.g. Kleemann, 2012; i.materialise, 2013). Their findings indicated limited research into the affective qualities of flexible AM structures resulting in the formulation of a series of practical experiments to explore their emotional and functional design potential. The experiments built on Niedderer's work (2012) with Argentium silver and laser welding, where she explored the notion of movement as an alternative to visual semiotic and appraisal approaches to create product expression. The study developed a 'soma-semiotic framework' as an aid for creating and interpreting complex emotions in design, which was further developed through the Flex-It project in collaboration with Dean (Dean and Niedderer 2016).

The soma-semiotic framework distinguishes expressive, functional and behavioural movement, which can have both concrete and symbolic meaning, and is read through a combination of semiotic and somatic interpretation. Niedderer distinguishes the three key features of the framework as: semiotic and semantic object indicators; their individual emotional meaning; and the summative interpretation of all meanings as shown in Table 1 (Niedderer 2012: 65-66).

Table 1: Schema of soma-semiotic framework of emotion

Meaning / Indicator	Description of movement/image	Soma-semiotic interpretation of individual movement/ image with regard to emotion	Soma-semiotic interpretation of combined movement/image with regard to emotion
Movement 1 (expressive/ functional/ behavioural)	...	...	...
Movement 2 (expressive/ functional/ behavioural)	...	...	
Visual image 1	...	...	

Figures 3(L) & 4(R): Showing Niedderer's original pieces that the prototypes were based on and the first CAD model ©*Niedderer* 2015

Figures 5(L) & 6(R) showing working prototypes with internal scaffolds and final design, produced without internal supports ©*Niedderer* 2015

Dean and Niedderer's experiments focused on the use of stainless steel (SAE grade 316L) with SLM to create flexible structures. The initial prototype was based on an existing piece of jewellery designed by Niedderer (Fig. 3) chosen because it already contained an element of flexible structuring in the form of a spiral spring - which had the potential the dual functionality of flexible sizing via the petal moving shapes - and for the abstracted (but recognisable) flower shape, which imbued the design with meaning. It was also selected for its complex structure, which was difficult and time consuming to produce using traditional methods, making its translation through 3D printing (AM) appropriate.

The AM process allowed for greater complexity in terms of the number of spring elements, but at the same time, the nature of the formed AM material restricted the design to finer movements than in the conventionally made pieces. The resulting form was effectively an array of springs arranged radially around the finger and joined by a rigid outer ring (Fig. 4). In spite of their free form potential, AM layer-built technologies each have their own practical limitations (Dean 2013: 170–73) and in common with many other AM metal technologies, SLM, the process used for the prototypes in this research, normally requires a sacrificial scaffold-like support structure to be built along with the part. Following numerous trials (Fig. 5) to eliminate the need for an internal support structure, the final design (Fig. 6) was built without any internal supports, which allowed for easier clean up and finishing.

The soma-semiotic framework was applied to analyse the pieces with regard to their affective qualities and expression in comparison with the originals. Like the originals, the design was intended to be sized to fit the desired finger comfortably through flexing without a change of geometry, and that the ring, once in place, could rock against the finger. The result of the analysis was that while the design had been intended to offer a greater aspect of playfulness, instead the current design further emphasised perceptions of functionality and technicality. The intended 'function' of the springs is perceived to be a 'one size fits all' adjustability, which rather masks and distracts from the playful aims. This is useful to understand to help with the further design development. Now, with the better understanding of the design expression as well as the performance of the SLM material, the intention is to disassociate flexible movement from function and create less obvious movements that provoke a greater emotional response.

The case study demonstrates two ways in which experiential knowledge has been used to achieve innovation: Firstly, it enabled a perspective on what SLM printing could be used for and achieve: rather than creating structural rigidity, the experiments tried to ascertain how structural flexibility can be exploited, in this case with regard to the expression of emotions. Although this work is in its early stages, this new perspective might offer potential for a number of further development options. Secondly, the nature of the design required finding ways of eliminating the usual support structures.

Conclusion

The crafting approaches discussed here demonstrate how creative innovation occurs when established practices of making are integrated with, or reinterpreted via advanced technologies. The case studies go some way to proving Adamson's assertion that craft should not be viewed as 'static ground', from which a superior form of digital production 'emerges'. (Adamson in Openshaw 2015: 287) The relationships between different (craft) disciplines, bodies of knowledge, and technologies are iterative, or as Adamson calls them, 'recursive' (Ibid.). The role of tacit or the 'tactile acquisition of knowledge' (Philpott 2012: 53) of materials and making are also highlighted as being essential when stepping into unknown territory. For example, the use of 'scaffolds' to structurally support cellular (skin) growth and SLM (metal) fabrication, produced using existing textile and precious metal working (e.g. silversmithing) skills in the work of Congdon, Dean and Niederrer. The shared but different 'material understanding'(Solomon 2013) that plastic surgeons have of skin and pattern cutters have of cloth was significant in Skinship's development of new approaches to surgical procedures. The integration of analogue components with digital images informed by textile and fashion design and construction methods informed the development of potential wearable prototypes.

In the publication, *Together*, Sennett (2013) explores craftsmanship as a collaborative act, one of cooperation with other individuals and organisations from diverse cultures, backgrounds and with different belief and value systems. This is exemplified in various degrees by the examples cited above: the textile designer and scientist in the *Biological Atelier*; the pattern cutter and surgeon in *Skinship*, the crafts-driven wearables design team and curator in the *Electric Corset* and the silversmith and additive manufacturer in *Flex-It*. The specialist knowledge and skills applied, combined and exchanged in all these cases are supported through interdisciplinary cooperation, which Sennett considers to be a craft skill in itself. The craft methodologies and outcomes discussed represent innovation in terms of future biomaterials that are more sustainable, surgical procedures that enhance patient wellbeing, wearable technologies that are synthesised with fashion more intuitively and jewellery that has the capacity to respond more flexibly to the practical and emotional expressions of the wearer.

References

Amy Congdon, (2015) Available at www.amycongdon.com [10 February 2016].

Adamson, G. (2007), *Thinking through Craft*, Oxford: Berg.

Chakrabarti, A. (2006), 'Defining and supporting design creativity', *International Design Conference* – DESIGN 2006, Dubrovnik, Croatia, 15–18 May, pp. 479–86.

Cross, N. (2011) *Design Thinking: Understanding How Designers Think and Work*. Oxford: Berg.

Csíkszentmihályi, Mihály (1996). Creativity: Flow and the Psychology of Discovery and Invention. Harper Collins.

Dean, L. (2008), 'Titanium Jewellery: High end design straight from the machine', *Time Compression Technology Conference*, Coventry, UK, 21-22 October 2008.

Dean, L. and Niedderer (2016) Flex-It: Craft Research, Vol 7 (1), Bristol, UK: Intellect Journals, pp. 51-77.

Dorst, K. and Cross, N. (2001), 'Creativity in the design process: co-evolution of problem–solution', *Design Studies*, 22:5, pp. 425–37.

EKSIG (2015) Tangible Means, International Conference 2015 of the DRS Special Interest Group on Experiential Knowledge, Design School Kolding and the University of Southern Denmark, 25-26 November, URL: experientialknowledge.org.uk/proceedings_2015_files/EKSIG2015_Proceedings.pdf

Glazzard, M., Kettley, S., Acti, T. M., & Harrigan, K. (2014) 'Experimental Collaborations from Garment to Costume: Play and the thing as design outcome', Craft + Design Enquiry (6), pp. 137-157.

i.materialise (2013), 'Rubber-like', Available from i.materialise.com/materials/rubber-like [Accessed 9 September 2013].

Kaufman, J. C., and Beghetto, R. A. (2009). 'Beyond Big and Little: The Four C Model of Creativity', *Review of General Psychology*, 13, 1-12.

Kettley, S., Townsend, K., and Walker, S., 2015. Evidencing Embodied Participatory Design. *Proceedings of Critical Alternatives 5th Dicennial Aarhus Conference*, 17-21 August, Aarhus.

Kettley, S., (2012) 'The Foundations of Craft: A suggested protocol for introducing craft to other disciplines', Craft Research, 3, Bristol: Intellect Journals, pp. 33-51.

Kleemann, F. (2012), 'Flexible space structures' Available from fk3d.de/category/3d_printing/ [Accessed 6 September 2013].

MacDonald, J. (2005), 'Concepts of Craft', in M. Rampley (ed.), *Exploring Visual Culture: Definitions, Concepts, Contexts*, Edinburgh, UK: Edinburgh University Press, pp. 135–36.

Niedderer, K. (2012), 'Exploring elasticity as a medium for emotional expression in silver design', *International Journal of Design*, 6:3, pp. 57–69.

Niedderer, K. (2007). Mapping the Meaning of Knowledge in Design Research. Design Research Quarterly, 2(2). URL: www.drsq.org/issues/drq2-2.pdf

Openshaw, J. (2015) 'Postdigital Artisans: Craftsmanship with a new Aesthetic in Fashion, Art, Design and Architecture', The Netherlands: Frame Publishers.

Philpott, R. (2012) 'Crafting Innovation: The intersection of craft and technology in the production of contemporary textiles', craft Research, Vol 3, Bristol: Intellect Journals, pp. 53-74.

Polanyi, M. (1958). *Personal Knowledge*. London: Routledge & Kegan Paul.

Skinship (2016) Available from www.skinship.co.uk [10 February 2016].

Solomon, R. (2013) Skinship: An Exchange of Material Understanding between Plastic Surgery and Pattern Cutting, in Ravetz, A., Kettle, A. & Felcey, H. (2013) Collaboration through Craft, London and New York: Bloomsbury.

Sternberg, R.J. (2011) 'Creativity'. *Cognitive Psychology* (6 ed.). Cengage Learning.

Sternberg, R.J. (1999) *Handbook of Creativity*. Cambridge University Press.

Taylor, J. and Townsend, K. (2014) 'Reprogramming the Hand: Bridging the craft skills gap in 3D/digital fashion knitwear design', *Craft Research*, vol. 5 (2), pp. 1 Intellect, October 2014.

Townsend, K., Kettley, S. & Walker, S. (2015) 'The Electric Corset and Other Future Histories', Installation and film, in *Crafting Anatomies: Material, Identity, Performance*, Bonington Gallery, School of Art & Design, 7 Jan-4 Feb and Crafting Anatomies Symposium, Nottingham Trent University, 30 Jan.