

Chapter 11

Digital Aesthetics and Identity: Creativity in Fashion Design

Giving Body To Digital Fashion Tools

Bruna Petreca

Royal College of Art

bruna.petreca@network.rca.ac.uk

Abstract

‘Super technology is going to ask for super tactility’ (Lidewii Edelkoort). Exploring this statement, this chapter reflects on the disconnection between digital fashion tools that lack sensory feedback and the critical role of designers’ embodied experience for their practice. In order to support this discussion, additional literature is brought in, which shows that in dance bodily engagement is crucial for supporting and enhancing the creative process. This is done to explore aspects of mediation and embodiment further, and to propose a research agenda for the investigation of textile experience.

Index keywords

Textiles; embodied experience; affect; tactility; perception; multisensory

‘Super technology is going to ask for super tactility’ (Edelkoort, 2012). This statement provides a picture that plausibly reflects the socio-technical status of the fashion and textiles realm. The tactile experience of textiles is fundamentally ‘super tactile’, considering that textiles invariably come into close contact with our skin (Spence and Gallace, 2011). However, when it comes to digital interactions, this is not the case; irrespective of technological developments and research efforts towards creating digital textiles (Magnenat-Thalmann and Bonanni, 2008; Clarke and Harris, 2012; Atkinson et al., 2013), research shows that touching and feeling still remain problematic (Petreca et al., 2013).

‘Super technology’ is available in diverse forms, inside and outside our bodies, for individual and collective use, and for diverse purposes. Touch is gaining momentum,

surpassing a great period of visual and auditory predominance. Particularly in the fashion arena, where design tools and retail activities are increasingly transferring to digital, mediating touch became a matter of concern, unsurprisingly since this industry is still working towards physical outputs – and will probably carry on doing this so long as we need to wear clothes. We still struggle to bridge physical and digital experiences when applying these within the design realm, irrespective of the technological advances in embracing body movement and providing haptic feedback in other areas such as the gaming industry (Savva et al. 2012; Bianchi-Berthouze, 2013).

Given how crucial sensorimotor interaction and feedback in interaction with textiles are for designers, this has serious consequences for the fashion industry. Firstly, in terms of the distributed and situating strategies, which has been discussed elsewhere in terms of design practice broadly (Dormer, 1994; Cross, 2011). In fashion and textiles design we are also investigating how designers use physical things to progress their thinking (e.g. through moodboards and prototypes) and to communicate with stakeholders (e.g. samples, sketches) (Bang, 2009). Secondly, in terms of affective experience, in previous research I observed that the greater and freer the bodily engagement in interaction with textiles, the more the affective experience starts to take place; I have explored this aspect further with designers, and observed that the tactile experience of a physical textile drives the process of metaphor generation, which is crucial for conceptualisation in design (Petreca et al., 2015). This scenario emphasises that the physical engagement with textiles is part of designers' know-how.

In relation to the interactive and embodied perspective in investigating the tactile experience of a textile, I am challenged by the question of what that 'super tactility' might be like. The understanding of the physical characteristics of a textile, and its interpretation into a digital form, may be insufficient to get closer to a *digital textile feel*. In order to go beyond the super digital textile, I explore studies around embodied experience as a starting point to inform a new approach to our interaction with textiles, which may become useful in further technological developments.

Inviting the body into this conversation is the main proposal in this chapter. To do so, firstly, I revise the current status of tactility both in analogue and digital fashion, to rather focus on the engagement with textiles. Then I review the literature that will support the proposition of directions to further investigations between physical and digital textiles experience.

Tactility in analogue and digital fashion

When experiencing things, it is human nature to want to grasp, in order to *get it* (Claxton, 1997). It thus seems logical that most research and industry have focused on characterising and describing physical properties that determine the tactile experience of textiles. The tactile characteristics of textiles involve complex properties experienced by the tactile, visual, auditory and proprioceptive senses, which have been explored in the textile industry through the concept of textile hand (for a review see Ciesielska-Wrobel and Van Langenhove, 2012). ‘Textile hand’ encompasses ‘the tactile sensations or impressions that occur when fabrics are touched, squeezed, rubbed or otherwise manipulated’ (AATCC, 2012). This research spans from the 1930s (Peirce, 1930), to today through machinery capable of measuring compression, roughness, conductivity, and bending properties with a single test (Liao et al., 2014).

Such approaches have privileged the systematic quantitative description of textile properties. However, in order to create, we need to be able to take risk, and research has shown that the qualitative aspects of a design may be hindered by excessive definition (Edelman et al., 2009). Understanding a textile is important, as it provides some degree of confidence in terms of functional use. However, it is insufficient for supporting experience, as designers need stimulation that emerges through freer bodily engagement (Petreca et al., 2015). Additionally, designers are experienced in communicating and evoking these handling experiences. Designers need to synthesise the quantifiable knowledge (which usually they understand from acquired experience) and the intangible content (affect and subjective experience) and skilfully articulate these in design proposals. And in conversations about, and with materials, ‘on the tip of the tongue or from the tips of the fingers, the answer is always embodied’ (Saillard, 2012). These are also heavily reliant on tacit knowledge, that is, the use of physical things goes beyond verbal communication, as we can show someone how a fabric

drapes, but the manner in which we feel and appraise tactile properties is automatic and unrecognised. This highlights the ongoing disconnect between quantitative and qualitative approaches to the experience of textiles, when it comes to understanding the designer experience of these in the analogue, and the industry interest in productive information (i.e. quantifying physical properties of textiles) towards the replication of mass manufactured goods.

Moving into the digital, a similar pattern is noticed, again the attempt to grasp and *get it*. Here, most of the research tried to emulate physical textiles in the digital, by focusing on translating physical properties into a digital simulation. Interactive technologies for e-retail, or fashion and textiles co-design are emerging to support designers' activities. In these, research has attempted to provide haptic feedback to convey tactile properties with precision (*quantity*) when creating digital textiles (Dillon et al., 2006), with less attention given to the natural experience (*quality*). This approach has led to questionable choices when it comes to identifying or developing the type of technology needed to convey the textile hand in the digital environment.

In pursuing the feel of 'virtual textiles' in online platforms, most investigations attempted to integrate visual and haptic feedback. One example is the use of a force-feedback device to enable touch interaction and provide feedback (Magnenat-Thalmann and Bonanni, 2008). Whilst some progress was made in overcoming technological limitations, these show and adopt a narrow understanding of experiencing fabrics, as they do not support natural engagement. It is only recently that studies towards digital textiles have begun to address touch-related aspects (Dillon et al., 2000; Magnenat-Thalmann and Bonanni, 2008; Wu et al., 2011; Philpott and Summers, 2012), mostly through tactile feedback. A question that may be worth asking at this point is: if these technologies have been developed for quite a number of years, why are they still not adopted by industry and commerce?

One possible answer could be that current interactive media presentations of textiles poorly communicate their 'hand', and less attention has been given to gestures for handling textiles, or other properties (e.g. sound), and therefore to the type of technology needed to support such experiences (Petreca et al., 2013). Atkinson and

colleagues (2013) addressed the handling issue, showing that textiles are animated differently in response to different touch behaviour. These gestures (by non-experts) were explored, in order to devise interactive simulations of digital textile handling for touch-based display. The experiments highlighted an influence on the level of user engagement based on the use of gestures (Bianchi-Berthouze, 2013; Wu et al., 2011), and emphasised restrictions presented by the flat, rigid displays, to the users' experience as they limit and alter the types of gestures that can be used to handle textiles.

A question emerges as we start to more actively handle digital textiles of whether we can feel them, as most designers report that they cannot feel (Petreca et al., 2014). What we have seen so far are approaches that deal with extreme realism, that is, measuring physical properties of fabrics or emulating them in the digital, but what about the affective and subjective aspects? How can such crucial aspects of the designer know-how be factored, while pursuing technological advancement?

Figure 11:1 ABOUT HERE.

Caption to read: Super technology aspiring to human touch. Illustration: Carmem Saito.

There seems to be a disconnection between the designer experience and digital tools. In its current state, technology is impeding the possibility of people-textile interaction. Considering the view that our tactile experience with textiles is complex, embodied and affective, it may not be fully supported by trying to mimic touch digitally. Given the tactility in fashion practice, some crucial elements to the analogue experience of textiles may help structure our progression in the digital. These are highlighted here.

1. Pluri-touch: multimodal, multimedia

Touch is a very complex system, and if we consider the Aristotelian perspective that touch does not have a 'proper sensible' (Marmodoro, 2014), that is, a single modality of feeling (as in hearing a sound), but multiple modalities (temperature, pressure, velocity, time), this will allow us to deal with touch as a multimodal sense. This is

relevant for design, considering research that shows designers use of diverse media (e.g. sketches, prototypes, etcetera) to harness their thinking and explore aspects of texture, form and function that may be relevant for the tactile interaction.

2. Factoring body movement

In my previous research I have observed several instances in which body movement plays a crucial role in feeling textiles. This has been done both in investigations of designers' analogue experience of a textile (Petreca et al., 2015), as well as in observing non-experts in order to create digital textiles through interactive videos (Atkinson et al., 2013). In both approaches it became clear that only considering hand interaction is insufficient to understand the complexity of what is entailed in 'feeling a textile'; the feeling arises as the body freely and fully engages in experiencing. Besides, fashion designers, like choreographers, design for body movement, specifically their creative processes are centred on the body. Hence, not only do they feel with full body, but also create for moving bodies. Thus, the question arises of whether we can bring some of the new understandings in embodied cognition around dance, to inform how the communication of textile feel may progress within the digital.

Super tactility is in feeling

When touching physical textiles we experience the presence of a thing, and this is a complex multisensory encounter (Gallace and Spence, 2014) that, beyond the discriminatory aspects, elicits primary responses (Petreca et al., 2015), which are visceral. Our experience of textiles is embodied and depends on our touch behaviour (sensorimotor involvement), the consequent textile deformation, and the multisensory feedback (tactile, auditory and visual) afforded by this interaction (Petreca et al., 2013).

In haptic touch (that is, with movement), either active or passive (that is, touching or being touched), both kinaesthetic (movement) and proprioceptive (bodily position) systems are activated. Research in Human Computer Interaction (HCI) indicates that allowing more natural types of body movement (Bianchi-Bethouze, 2013) and touch behaviour (Wu et al., 2011) improves proprioception, emotional engagement and

impacts on the perception of the evaluated item. Research also shows that the type of gesture used has an effect on the level of engagement of the user, arising from visual and proprioceptive feedback (Wu et al., 2011). However, in design we currently rely on technology that poorly embraces these technological advances and new knowledge, and we still struggle to bridge physical and digital experiences, missing the feel.

In order to structure a tactics of how we may progress in creating digital textiles, I draw on research on embodied and affective experience. A phenomenological perspective informs the choice of concepts to be introduced here, with the premise that we perceive the world with connected body and mind (Merleau-Ponty, 2002). Here, I also highlight movement, following Sheets-Johnstone's (2011) suggestion that movement is crucial for our ability to make distinctions in experiencing.

Embodied aspects: going beyond hands to integrate the body

It seems as though we have focused far too much in hand interactions with textiles, and this has limited their interpretation to a quantified manner. However, hands belong to a body, moving and perceiving in an environment. In inviting the body, it is important to make a distinction on how to approach the body. The literature clarifies the concepts of body schema and body image. Body schema is related to our physical dispositions (structure), that is, the body capacity to move due to its sensory-motor acquired abilities (functions). This is related to habits, in terms of acts performed automatically, without coming to the reflective level (awareness), but that are related to intentions (Gallagher, 2011). Body image reflects perception, beliefs (that is, conceptual understanding and emotional attitudes related to one's own body (Gallagher, 2011). This is related to the phenomenal structure of our embodied existence.

In terms of bodily aspects, the structure of *percept*, *concept* and *affect* provided by the body image concept allows for going beyond the physical aspects of the experience. They open up a dynamic between internal and external processes, which are crucial for understanding experience from this embodied perspective. The body schema highlights the importance of the physical structure of the body in cognition. These

concepts provide a holistic approach to the body, hence should not be considered in isolation.

Interactive sense-making

Embodied cognition theory proposes that we think with our bodies and with things (Kirsh, 2013); some processes of making sense from this interactive perspective are defined by Kirsh (2013) as crucial for its understanding – *perception, projection, and imagination*. ‘Projection’ sees what could be through what is. In other words it is a sort of augmented reality supported by things, which are projected upon. Unlike ‘Perception’, which sees what is, and is therefore tied to physical stimuli, ‘Projection’ relies on stimuli as a support (‘anchor’) to prospect. It also differs from ‘Imagination’, as imagination has no present link to a physical stimulus, and the process is held internally to the person imagining. Kirsh also shows that the body itself can be used to model, simulate and create, by examining dancers’ practices such as marking (this is ‘a simplified or abstract’, and shortened, version of a dance sequence, which is used by dancers when memorizing or rehearsing). Dancers’ mark by performing their sequence in a sketchy manner, and the studies reveal that when comparing dancers in the marking condition with dancers performing a sequence fully, those in the marking condition are the ones that memorise the sequence better; and both of these physically active conditions are more effective than when dancers imagine (mental simulation) that they are performing. The genius in this process beyond the effectiveness of marking, where ‘externalizing thought processes improve or reshapes inner processes’ (Kirsh, 2013: 13), is that it shows that engaging our bodies freely, like sketching, is better for practicing, learning and creating, instead of performing in a complete, realistic manner. This relates to design research discussed earlier showing that imperfect models are better to support thinking (Edelman et al., 2009).

Materials experience in HCI

As materials are gaining digital counterparts or being fit for digital interactivity, the creative processes of making are strongly affected. Hence it is timely to investigate this space where blended physical and digital experiences happen, to generate understanding around such interactions and bring insight into opportunities for support. To start to look into materials experience within this intersection, Giaccardi

and Karana (2015) introduced a framework for materials experience for HCI. They propose a view that is less about distinguishing physical and digital, but focused on the situated interactions. They consider materials experience to occur in four levels: *sensorial*, *interpretative (meanings)*, *affective (emotions)*, and *performative*. Here the performative level allows for interactivity to be encompassed, and brings dynamicity by attending to situated ‘ways of doing’ (Giaccardi and Karana, 2015: 2448). In the performative level, interactions through touch are highlighted; this goes beyond appreciating materials experiential qualities, to encompass using and making. Both these processes involve diverse levels of hands-on exploration (van Bezooeyen 2013, in Karana et al., 2013). This approach is a significant progression in approximating physical and digital, and shows an analogous structure to that observed in body image, but also in terms of internal and external processes discussed through embodied cognition theory.

Synthesising an approach to textiles experience

Touching is an inherently interactive experience (Sonneveld and Schifferstein, 2008), where touch and being touched equally contribute to its unfolding (Merleau-Ponty, 2014). Cutting across the themes *embodied aspects*, *interactive sense-making* and *materials experience* overlaps were noticed between foundational concepts, engaging on the (i) physical, (ii) conceptual, and (iii) emotional levels, and their dynamics that occurs between internal and external acts or processes, or physical and digital.

The examples and theories introduced in this chapter show evidence of how the physical level has been favoured so far in research and technological attempts, which is highlighted by designers reports that they ‘can’t feel’ the digital textiles. Could it be that if the body is further engaged, beyond hand, better experiences of digital textiles would be achieved? Or even novel ways to communicate a textile feel would be designed? What if multimodal approaches would also be investigated? An example of how this may progress can be seen in the work by Ho and colleagues (2012), where visual simulation was presented through an interactive mirror and sound feedback was combined to allow consumers to try on a ‘virtual jacket’. The sound feedback supported the participant’s experience of wearing the digital garment. Perhaps this will be a less realistic and a more imaginary and affective approach. If we could build

on the new knowledge around dancers embodied cognition, where less realistic and sketchier movements enhance their practice, what that may look like within the fashion designer practice?

Moving with textiles: Towards Sensational Technology

Throughout this chapter I have reflected on the super technology and super tactility themes, in order to get to a more embodied perspective to how we may progress research on digital fashion tools, using digital textiles as a case study to unravel the underlying tension in this area. Crucially, I suggest that approaches so far demonstrate a difficulty in addressing such experience considering all levels here identified across the selected literature – perceptual, conceptual and affective levels. This issue is not new to technological research, and researchers into haptics and robotics have discussed themes embracing the lack of human senses (Mosher, 1967), to the need for pushing a redefinition of what touch may be like digitally (Parisi, 2014). Such reflections are also relevant within fashion design, but should consider its specific tools and practices.

In order to challenge this ‘lacking human senses’ view, I would like to finally agree with the designers that suggested they could not feel digital textiles, which indeed they cannot, at least not in a similar manner as they do with physical textiles. This is the danger of trying to mimic textiles digitally – we are bound to such unfair comparisons. Reflecting on the aspects of a better composition around *perceptual, conceptual and affective* levels of experience, with the dynamics of movement, I introduce a final example, which is a masterpiece virtual textile. The work by the dancer Loie Fuller (Au, 1988), who when creating a virtual textile (augmenting the real with special effects), seem to have asked: how can I do this physically, materially? She combined dance, lighting effects, textiles and pigments, to produce pieces such as the Serpentine dance. The outcome pieces show textiles that are alive; they take shape, flow, and are orchestrated by the dancer movements; this composition is what keeps it human. There is a bodily reference, which although lost at times, returns and provides a reference point that guides the oneiric experience. It is a piece in process of becoming, the dancer and the textile, transforming, mutating, and revealing their qualities. This fantastic approach exemplifies the types of outcome that

can be achieved when the virtual happens in presence: it becomes magic. Such an example of an augmented real that leads to a successful virtual, synthesising ‘form and content’ (Au, 1988: 88), highlights the magical outcomes produced when there is a seamless bridge between quantity (science, technique) and quality (art).

Sensational technology for fashion

It is clear by now that in order to experience a textile, designers ‘need to feel’. Since feeling seems to involve a balance between perceptual, conceptual and affective levels of experience, there is a need to balance the current *realistic* (physical) approach to digital textiles with the *imaginary* and the *emotional*. This is a matter that artists and designers master – and is what Kandinsky (1947) would term ‘composition’ in his book *Concerning the Spiritual in Art*. Besides, design should be all about creating magically (Flusser, 1995), and to do that we need to bring the scientific, quantifiable closer to the aesthetic, that relies on affect and subjective experience. And as Merleau-Ponty argued, ‘In movement, the relations between my decision and my body are magical ones.’ (2014: 96-97).

In order to venture in this direction, interdisciplinary research will be needed, especially considering (i) bodily dynamics in experiencing textiles, and (ii) introspection and awareness. This would initiate a novel phase for research, where the goal to be achieved is to create *sensational technology*, that is phenomenal and allowing for the free experience of sensation. Through the study of body movements, it may be possible to enhance not only technology developments, but also to revise pedagogical approaches in fashion, to give a greater presence to bodily practices – to think with things and with the body (Kirsh, 2013). This research will benefit from gathering fine grained description of experience, to better understand the dynamics involved in experiencing textiles. In my experience of working with first-person methods, this is a promising path to engaging with the pre-verbal experiences of designers in detailed and systematic manner, which provides relevant insights into technology development (Petreca et al., 2015).

Besides mediating the feel of our objects into digital media, our direct experience with textiles should not be neglected. The analogical experience has much to tell us,

especially on the dynamics between real and virtual, perceptible and imaginary. From a research point of view, there is a great challenge in investigating possibilities of what could be done relying on the various options of seamless digital technologies to getting people closer to experiencing digital textiles like those we have not yet felt.

Acknowledgement

Thanks to CNPq – Conselho Nacional de Desenvolvimento Científico e Tecnológico, Ministry for Science and Technology of Brazil. Thanks to Professor Sharon Baurley, Professor Nadia Bianchi-Berthouze, Paula Petreca and Carmem Saito, for the inspiring discussions while preparing this chapter.

References

AATCC Committee RA89 (2012) ‘AATCC Test Method 202-2012: Relative hand value of textiles: instrumental method’, in: *American Association of Textile Chemists and Colorists*, pp. 404-406.

Atkinson, Douglas, Watkins, Penelope, Padilla, Stefano, Chantler, Mike, and Baurley, Sharon (2011) ‘Synthesising design methodologies for the transmission of tactile qualities in digital media’. In: *Digital Engagement’11*, 15/17 November, 2011, Newcastle, UK. Newcastle: IEEE.

Au, Susan (1988) *Ballet & Modern Dance*. London: Thames & Hudson.

Bang, Anne Louise (2009) ‘Triad as a means for dialogue about emotional values in textile design’. *8th European Academy of Design Conference*. The Robert Gordon University: Aberdeen, Scotland.

Bianchi-Berthouze, Nadia. (2013) Understanding the role of body movement in player engagement. *Human Computer Interaction* 28 (1), pp. 40-75.

Clarke, Sarah E. Braddock and Harris, Jane (2012) *Digital Visions in Fashion + Textiles: Made in Code*. London: Thames & Hudson.

Ciesielska-Wrobel, Izabela Luiza, and Van Langenhove, Lieva (2012) 'The hand of textiles - definitions, achievements, perspectives: a review'. *Textile Research Journal* 82(14):1457-1468.

Claxton, Guy (1998) *Hare Brain Tortoise Mind*. London: Fourth Estate.

Cross, Nigel (2011) *Design Thinking*. New York: Berg.

Dillon, Patricia, Moody, Wendy, Bartlett, Rebecca, Scully, Patricia, Morgan, Roger and James, Christopher (2000) 'Sensing the fabric: To simulate sensation through sensory evaluation and in response to standard acceptable properties of specific materials when viewed as a digital image', *Proceedings Haptic Human-Computer Interaction, First International Workshop*. Springer, pp. 63-68.

Dormer, Peter (1994) *The Art of the Maker: Skill and Its Meaning in Art, Craft and Design*. London: Thames & Hudson.

Edelkoort, Lidewij. Interview to Dezeen Live. Available at: <<http://www.dezeen.com/2012/12/28/super-technology-is-going-to-ask-for-super-tactility-li-edelkoort-at-dezeen-live/>>. Accessed on: 30/01/2016.

Edelman, Jonathan Antonio, Leifer, Larry, Banerjee, Banny, Sonalkar, Neeraj, Jung, Malte, and Lande, Micah. (2009). 'Hidden in plain sight: affordances of shared models in team-based design'. *Proceedings of International Conference of Engineering Design - ICED'09*, the 17th International Conference on Engineering Design, 24-27 August 2009, Stanford University, CA, USA.

Flusser, Villem (1995). *On the word design*. *Design Issues* 11(3): 50-53.

Ho, Cristy, Jones, Russ, King, Scott, Murray, Lynne, and Spence, Charles (2013) Multisensory augmented reality in the context of a retail clothing application. *Audio Branding Academy yearbook 2012/2013*, pp. 167-174, Germany: Nomos Publishers.

Liao, Xiao, Li, Yi, Hu, Junyan, Wu, Xinxing, and Li, Quanhai (2014) 'A simultaneous measurement method to characterize touch properties of textile materials.' *Fibers and Polymers* 15, no. 7 (2014): 1548-1559.

Marmodoro, Anna (2014) *Aristotle on Perceiving Objects*. New York: Oxford University Press.

Gallace, Alberto and Spence, Charles (2014) *In touch with the future: The sense of touch from cognitive neuroscience to virtual reality*. Oxford: Oxford University Press.

Giaccardi, Elisa and Karana, Elvin (2015). 'Foundations of Materials Experience: An Approach for HCI'. *Proceedings CHI2015*.

Kirsh, David (2013) 'Embodied Cognition and the Magical Future of Interaction Design'. *TOCHI* 20(1).

Magnenat-Thalmann, Nadia and Bonanni, Ugo (2008) Haptic sensing of virtual textiles, in: Grunwald, M. Ed. *Human Haptic Perception: Basics and Applications*. Birkhauser, Basel, Switzerland, pp. 513-523.

Merleau-Ponty, Merleau (2014, 2012) *Phenomenology of Perception*. New York: Routledge.

Mosher, Ralph S. (1967) *Handyman to Hardiman*. Research and Development Centre – General Electric Company.

Kawabata, Sueo and Nima, Masako (1988) 'Fabric Performance in Clothing and Clothing Manufacture', *Journal of the Textile Institute* 80(1): 19-50.

Kandinsky, Wassily (1947) *Concerning the spiritual in art*. 5th Ed. New York: George Wittenborn.

Parisi, David (2014) 'Reach In and Feel Something: On the Strategic Reconstruction of Touch in Virtual Space'. *Animation* (9) 2.

Peirce, Frederick Thomas (1930) 'The handle of cloth as a measurable quality'. *Journal of the Textile Institute* 21: 337–416.

Petrecu, Bruna, Bianchi-Berthouze, Nadia, Baurley, Sharon, Watkins, Penelope, Atkinson, Douglas (2013) 'An embodiment perspective of affective touch behaviour in experiencing digital textiles'. *Proceedings ACII 2013*.

Petrecu, Bruna, Atkinson, Douglas, Bianchi-Berthouze, Nadia, Furniss, Dominic, Baurley, Sharon (2014) 'The future of textiles sourcing: exploring the potential for digital tools'. *9th Design & Emotion International Conference*, 8-10 Oct 2014.

Petrecu, Bruna, Bianchi-Berthouze, Nadia, Baurley, Sharon (2015). 'How Do Designers Feel Textiles?' *Proceedings of the International Conference on Affective Computing and Intelligent Interaction (ACII)*. IEEE: 982-987.

Philpott, Matthew and Summers, Ian R. (2012) 'Evaluating a Multipoint Tactile Renderer for Virtual Textured Surfaces'. *Springer*, pp. 121-126.

Savva, Nikolaos, Scarinzi, Alfonsina, and Bianchi-Berthouze, Nadia (2012) 'Continuous recognition of player's affective body expression as dynamic quality of aesthetic experience'. *IEEE Transactions on Computational Intelligence and AI in Games* 4(3), pp. 199-212.

Sheets-Johnstone, Maxine (2011) *The Primacy of Movement*. 2nd Edition. Philadelphia: John Benjamins Publishing Co.

Spence, Charles and Gallace, Alberto (2011) 'Multisensory design: reaching out to touch the consumer'. *Psychology & Marketing*, 28(3): 267–308.

Wu, Di, Wu, T., Singh, Harsimrat, Padilla, Stefano, Atkinson, Douglas, Bianchi-Berthouze, Nadia, Chantler, Mike, Baurley, Sharon (2011) 'The Affective experience of handling digital fabrics: Tactile and visual cross-modal effects'. *Springer LNCS* 6974: 427-436.