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Textile Connections E-textiles to enhance connectedness for older adults experiencing loneliness

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Abstract: Staying connected to family, peers and the wider community can be challenging for older adults experiencing life-changing transitions such as bereavement, retirement or illness. Despite advancements in communication technologies, loneliness is a growing endemic social condition that can inherently undermine health and wellbeing, potentially causing greater risk of cognitive decline, onset disability, depression and feelings of loss of self. Low adoption of communication technologies by older people has been accredited to lack of confidence, concerns in terms of navigating complicated screens, small print and the misunderstanding of technical jargon. With research advocating internet-enabled objects in improving feelings of social connectedness, which is key to preventing or overcoming loneliness, this paper proposes that e-textiles (inherently electronic materials or electronic devices with more familiar textile components) is poised as one of the next possible frontiers for enabling communications. This paper reviews our relationship with the textile medium, considering its' transition from traditional to e-textiles before exploring the ways e-textiles might enable older users to communicate and connect with others.

Keywords: E-textiles, Social Connectedness, Social Communication, Digital Divide.

1. Introduction

People of all ages and circumstance are susceptible to loneliness (Age UK, 2011) but older adults may be more vulnerable due to various age related changes or decline, in health, mobility and social contacts or activities. And although various technologies (e.g. smartphones, tablets and social networking platforms) are readily available and designed to keep us connected, adoption by older adults is often low. Ofcom (2015) reported that 1 in 3 UK based adults aged 75 years and over identify as absolute non-users of the Internet or associated internet-enabled devices. Greater engagement with such devices for social activity could reduce older adults' risk of loneliness by providing new or continued interaction and companionship with others (Zickuhr & Madden, 2012).

And whilst, 89% of UK adults aged 65 years and over do use non-digital devices such as landline telephones as their primary mode of communication, 10% of this same demographic are reported to feel lonely all of the time (Campaign to End Loneliness, 2016).

It is key to make the distinction between the technical aspects of being connected (i.e. through the use of specific technology) and truly feeling connected to others (Wildevuur et. al., 2015). Overcoming discords in connectedness and empowering older adults to explore new ways of facilitating social connectedness necessitates attention to the desire by older adults to be readily social, active users and contributors to new technologies rather than passive subjects of the digital networked society (Bryson, 2014). It is important therefore that technologies enable meaningful, relevant forms of connectivity that resonate with the lives of older adults.

E-textiles are widely explored within the field of health and physical wellbeing in disciplines such as biomonitoring, rehabilitation, therapy and ergonomics (Malins et. al, 2012; McCann & Bryson, 2014; Paradiso & De Rossi, 2008). In these fields, e-textiles are used mainly to gather, measure and share information for physical health and to provide psychological fulfilment through the use of sensory textiles or crafts (McCann & Bryson, 2015; Cotten, 2013). We propose that e-textiles could be used to engage in new modes of connecting with others not just for the purposes of health monitoring. The properties of e-textiles could include the use of various visual, tactile, sensory and responsive elements to engage users in both physical and digital modes of interaction thereby potentially offering different and more intuitive ways of connecting with others, possibly strengthening existing relationships or accelerating the making of new ones.

In this paper, we briefly review our relationship with the textile medium, first exploring the historical role and process of making textiles and how this has developed with technologies and innovation. We then discuss how e-textiles might enable older users to bridge their 'Digital Divide'. Finally, we consider co-designing with older people as a route to discovering the possible ways e-textiles could be used for communication.

2. Literature Review

Traditional textiles are familiar and ubiquitous within virtually all cultures; created into clothing and used as protection from nature and the elements, and regarded as symbolic carriers to communicate personal style and beliefs. Traditional textiles are also passive which, in today's modern world, restricts their communicative capacity (Park & Jayaraman, 2003). Although the communicative use of traditional textiles, particularly through fashion, is used to signify identity and cultural symbolism, it is also very much context dependent (Davis, 1994). Davis (1994) theorised that identity ambivalence and ambiguity play a part in not only changes in fashion but also our interest and focus towards it.

2.1 Textiles as Communicators: Cultural and Social Identity

Often first associated with utility, textiles have also acted throughout history as communicators of identity and community in a range of ways including the use of specific patterns and construction methods associated with unique cultures and heritage (e.g. Scottish clans and plaids) and storytelling through woven or printed imagery or typography (e.g. in tapestry). Sherwell (2001) discusses the handmade embroidered clothing as 'elaborate expressions' of national identity and social class by Palestinian refugee women. Indeed, Andrews (2015) identifies the physical properties, end-use and meaningful aesthetic content of textiles as key communication factors. Textiles have also been used to explain, elevate and disrupt the social as mobile communication tools for protest and expression of social identity in the spheres of politics, labour and human rights (Mitchell, 2011). For example,

during the First World War, soldiers purchased souvenir textiles (e.g. handkerchiefs) in military stores and sent them back to their families in promotion of their efforts and to boost morale (Andrews, 2008). Commemorative textiles act as social commentary through application of imagery and text to fabric. Contemporary examples include the concept of 'yarn-bombing' (or 'kniffiti'), where woollen structures are affixed within public spaces as art to reconfigure public ideals and aesthetics (Hahner & Varda, 2014).

Key also to the communicative properties of textiles is the act of making; the fibres that are used; the construction techniques; the end product form; the sharing of knowledge; and social activity. Fair Isle knitting, for example, is a knitting style born uniquely of the island north of Scotland and the women who created the original Fair Isle patterns are considered 'custodians' of their craft (Exclusively Fair Isle, 2016). Textiles and making have played significant roles throughout history across many cultures for necessity (e.g. shelter and protection) to recreation and demonstrating identity and worth (through dress, mastering of skills). Making textiles satisfies creative desires (Gauntlett, 2011), supports makers through times of change, distress or ill health (Vercillo, 2012) and Turney (2004) asserts that these acts of creation are symbolically essential in everyday life and in revealing 'the real and ideal self". Increasingly textile craft-based activities - and their associated social, interactive practice- are used in the fields of social care and health to support people in feeling well, connected and autonomous (Kenning, 2015).

2.2 Physical Properties and End-Use

The inherent properties of textiles such as chemical and physical attributes (e.g. dye retention and water absorbency respectively), thermal properties, performance of individual fibres (e.g. elastic recovery) and characteristic of bulk fibres (e.g. density and weight) contribute to our physiological experiences of comfort, warmth and weight with the medium (Stoll, 1953). Specific combinations of these properties result in specific experiences and associated meanings. In *Systeme de la Mode,* Barthes (1990), having conducted a quantitative analysis of fabrics, acknowledges them as having their own individual signifiers (e.g. material, colour, pattern) and it is only when combined with signifiers inherent to fashion (e.g. cut and drape) and signifiers apart from fashion (e.g. place), that deeper and context specific meanings can be communicated. Pertinently, Davis (1992) discusses textiles and fashion as language, however he counsels that the linguistics of these cannot be as 'sharply drawn or standardised' as spoken sound languages can be and this is echoed by Fiske (1982) who notes the influence of cultural or situational 'noise' as interference in deriving meaning.

The literature clearly highlights that there are many intricacies between textiles and fashion and that the messages or signifiers conveyed are circumstantially dependent. For the purposes of this paper, we focus on the communicative aspects of textiles as a medium specifically rather than its end use. E-textiles are certainly being successfully integrated into clothing and apparel as connective and communication tools but not all desirable and usable applications are wearable or related to fashion.

2.3 Textiles as Object

In reading textiles as objects, Andrews (2008) looks to material culture studies and semantics to examine the relationship between people and textiles. Citing the work of Kippendorf and Butter (1984), Andrews explains that meaning is to do with both the interactions with an object and the way in which it has been created. Indeed, from birth we are surrounded by textiles - we are clothed, warmed and protected by them - and from there on we establish an understanding of the qualities offered by the medium (Andrews, 2014). The significance of our early relationships with fabrics is acknowledged in many texts. Brett (2003) discusses the abundance of textile objects that surround

us as young children (blankets and soft toys) and the impact of these experiences. Our first understandings of being cared for, cleaned and warmed are accompanied by various cloth and fabrics (of differing texture, tactility and temperature regulation for example) and in our ensuing lives we are continually surrounded by fabrics (Damhurst et. al., 1999). Furthermore, Barnard (1996) recognises fabric tactility as communication in its' own right by drawing on commercial advertising to demonstrate the connotative meanings. For example, the undeniably powerful connotations of silk have been harnessed by the beauty industry to promote and advertise cosmetics and hair products.

2.4 Transitioning from Traditional to E-textiles

Buechley et al. (2013) cited the wider use of textiles as a medium as one of the 'curious gaps in our use of computers'. Whilst the fusion of computing with textile fibres has further enhanced the communicative capabilities of textiles as a medium, creating materials and end products that can communicate by extending the physical into the digital world is still a growing field. This fusion of textiles with technology – or *e-textiles* – began with the Jacquard Loom in the early C19th though the inevitability of combining electronics and textiles could arguably hark to the much earlier incorporation of metal – superior conductive materials - into textiles for decorative embellishment and armour (Buechley et. al., 2013). The transition from traditional textiles to e-textiles is charted simply in Figure 1.
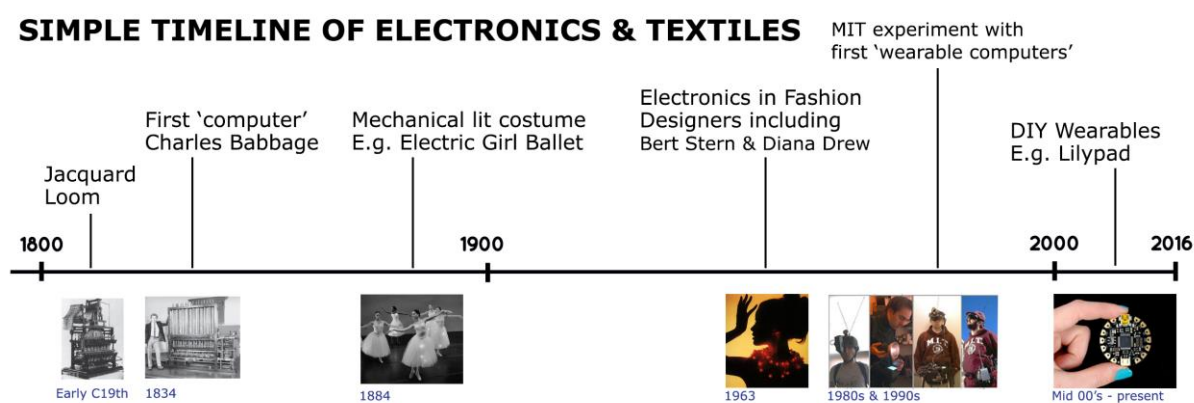

Figure 1 Simple timeline charting the development of e-textiles (not to scale, informed by Buechley et. al., 2013)

The term e-textiles encapsulates the embedding of electronics such as conductive fibres or elements within a textile itself, thereby negating the need for external wires or hard electronics or by housing the 'computer' inside a textile object. The potential within this field in creating new ways of connecting is vast and already being explored; within the realms of phatic - or social - and haptic research and development, textiles are married with sensors and responsive devices that emit heat, pressure or light for example. In this way, e-textiles can emulate non-verbal, physical interactions that are important exchanges in developing emotional connection (Vetere et. al., 2005).

3. Case Studies: E-textile Projects

Many e-textile applications are wearable and therefore associated with fashion. However, fashion is not a field often recognised for sympathy for the aged (Twigg, 2006) and thus, we note that many recent e-textile design investigations that address issues pertaining to ageing are formed into bespoke objects rather than for fashion or clothing. The following case studies comprise of e-textile

objects that explore various communicative capacities of the medium in meeting the needs of older adults experiencing challenges as a result of ageing and associated life transitions.

3.1 E-textiles: Conduit for Communication and Expressing Emotions

Ageing and genetics are confirmed risk factors for dementia and cognitive decline and these symptoms affect a great many older adults (Alzheimer Scotland, 2016). Tactile Dialogues from Eindhoven University of Technology and Metatronics is a pillow constructed with touch responsive sensors and vibrating motors that vibrate and pulsate (Schelle et. al., 2015). Created through a user-centred design process, the pillow is designed to aesthetically fit within a care or home setting and aims to generate positive communication and interactions between caregivers and individuals with dementia. They sit together with the pillow across their laps, exploring the surface and vibrations of the pillow together. In generating these vibrations - by stroking or pressing on different areas of the pillow - users can engage in nonverbal but bodily dialogues, sharing the physical object itself and inhabiting the immediate space around it. The pillow is constructed using thick, weighty and textural fabrics that encourage a range of hand movements that engage different sensors and vibration patterns (Schelle et. al, 2015). This pillow is an exemplar of using e-textiles as a conduit for communication; the inviting tactile and responsive yet familiar nature of the object encourages users to interact and connect with one another in non-linear ways. This can be powerful in achieving feelings of emotional and social connectedness. However, the pillow serves primarily as a conversation starter rather than an on-going conversational tool, which might hinder the maintenance of longer-term connections with family and care members. In addition, the capabilities of this tool, having been created explicitly for individuals with dementia, may only appeal to this specific user group, rather than supporting older adults with no or other additional needs.

3.2 E-textiles: Prompting Communication and Social Connectedness

Nice to Meet You – a tablecloth printed with thermochromic ink – from Jeanine Kierkels's (2009) masters studies, is an interactive group activity tool for care homes that aims to reduce loneliness and enable residents to become better acquainted by creating pleasant social experiences. Residents sit around the table and share pictures or other stimuli in the centre of the tablecloth to generate conversation and establish shared knowledge or experiences. Gradually patterns are revealed in response to body heat and greater detail is produced the longer residents are seated and interacting with one another (Jeanine Kierkels, 2009). As well as storytelling, residents are encouraged to spend longer periods of time at the table as they are physically affecting change in the patterns of the tablecloth and this potentially allows them to get to know one another better. This project empowers users to interact with new materials and technologies by augmenting familiar textile objects in everyday instances of use, illustrating that approaching and applying digital technologies in gentle and atypical ways can enhance expectations for use. However, the e-textile object in itself does not facilitate the generation of positive communication and connections. Whilst the reactive nature of the tablecloth can encourage participation, it is only one part of the activity and the success of this depends on the input and engagement of the user/s.

3.3. E-textiles: Communicating Identity and Personality

BESiDE Research worked with care home residents to create a range of appealing, useful and useable wearable items that would gather location and physical activity data to inform the future design of more enabling built care environments. Employing co-design craft activities as a core route to gaining understanding about acceptability of wearable technologies, the project found that the incorporation of meaningful, personally symbolic fabrics was important to wearers with overall style,

imagery, colour, pattern and cultural associations of fabrics acting as communicators of identity and personality. For example, one participant used Black Watch tartan in his design as a nod to his regiment and reported that displaying this 'symbol' in a novel way (i.e. as part of the new wearable design), prompted new conversations and bonds with others in the care home as they asked questions about the object and its' meaning (Nevay & Lim, 2015). Incorporating personally meaningful or communicative fabrics into the wearable designs changed users' perceptions of how new technologies and devices might resonate or fit better within their daily lives. This project demonstrates the potency of a co-design process in engaging users as experts of their own experiences (Sanders & Stappers, 2008) and as designers of their own desirable e-textile objects; reimagining their use as a visual opportunity to express themselves beyond the data collection function. This work however focused on the aesthetics of the outer 'coverings' of the wearable objects rather than the 'e'-ness of the textile. There is room to build on the lessons learned here and apply this to the ways e-textiles could be used for communication of identity, personality and emotions rather than for health.

4. Bridging the Digital Divide: How might older people use e-textiles to feel more connected?

E-textiles are one of the 'computational crafts' (others are ceramics and glass) to explore the bridging of the gap between craft and technology (Buechley et. al, 2013). The appeal of e-textiles might be accredited to their oddness in which they unite incongruent materials and components to blend the physical with the digital, the visible with the invisible (Kafai, Fields & Searle, 2012). In combining the unfamiliar with the familiar, it may also be poised to address the so-called 'Digital Divide' which places older users' adoption of new technologies consistently behind that of their younger counterparts (Zickuhr & Madden, 2012). This divide has been accredited to users' fears about safety, underestimation of their prior knowledge and experience (Lim & Newell, 2016), age-related decline in motor and cognitive capabilities (Rogers et. al, 2005) and the prevalence of developers to target younger consumers (Vroman et. al, 2015). Older users' usage of technology is more likely to be needs and benefit orientated rather than for fashion or social activity with some of the least performed ICT tasks being sending instant messages, making a call via the internet and getting to know new people online (Vroman et. al, 2015). Greater engagement with ICT and digital devices for social activity could reduce older adults' risk of loneliness by providing new or continued interaction and companionship with others and fostering a sense of belonging and social connectedness (Zolkepli & Kamarulzaman, 2015) however they need to be designed with sensitivity.

Lim (2010) and Coleman et. al. (2015) argued that older people may struggle to use or be less likely to use forward-thinking technologies even if they meet their needs and wants. They suggest that by examining traditional technologies (in our case textiles) and considering how these could be built upon, new technologies such as e-textiles could play a role in encouraging engagement and interaction as shown by the above case studies. Moreover there is room to bridge this digital divide by involving older people within the design process, as shown by Tactile Dialogues and BESiDE projects where users, designers and technologists explored new, novel future interactions and together created unique and usable technologies. Such collaborations could prove key in bridging the digital divide further, empowering older adults as active participants and designers. Indeed, Computer Interactive Reminiscence and Communication AID (CIRCA) project researchers have discussed the value of empowering older users in the design and use of a personalised communication tool for older people with dementia and their carers. Observing that 'pressure is mostly on caregivers' to create stimulating and sustaining conversations for people with dementia,

CIRCA created a multimedia computerised system that involved users in the design of content and usability. The content is randomised during use establishing both the person with dementia and the carer as equals as neither knows what content will be shown next. This empowers users as vital contributors of knowledge and storytelling (Gowans et. al, 2007). Co-design, as a methodology grounded in the understanding of real life experiences, ideas and skills of people who need and use products or services, allows space for such learning and contributions. Co-design invites users to participate in the design process from start to finish and this investment of time, energy and knowledge within a project, coupled with the acknowledgement of their expertise, can validate users' contributions, producing feelings of pride and ownership of the 'things' they have created.

Drawing on the case studies as examples, it is possible to envision e-textiles as exciting tools for social communication and connectedness beyond health monitoring or medical contexts. Whilst typical examples are screen based, e-textiles can make use of the broader physical properties of textiles to create new modes of interaction, potentially leading to connectedness. For example, Tactile Dialogues discuss the idea of weight and warmth of textiles as key to the design of their communication tool: "We chose a pillow knowing that people with dementia react better to the outside world when there is extra weight on their bodies" (Bohmer, 2016). An observation supported by the authors' own research activity in dementia day-care where, in helping a service-user to 'settle' and 'tune into' an activity, a care staff member placed a textured, quilted blanket onto her lap which she could run her hands over and feel warm and untroubled during group activity and conversation.

E-textiles could bridge discords between digital spaces and physical objects as they proffer opportunity to occupy both, enabling users to continue inhabiting and interact with the physical world whilst intuitively navigating the technological world. And whilst the authors accept that technological innovations will never replace the physicality of person-to-person interaction, 'soft' technologies and e-textiles have the potential to perform a specific role in comforting users and intimating connectedness by augmenting, extending and supporting digital social interaction into the physical realm. E-textiles might also improve digital literacy and confidence (Buechley et. al., 2013). And the continuing rise of the D.I.Y. kit culture (LilyPad for example), where anyone can construct e-textile objects from scratch at home, challenges stereotypes about who uses, creates and informs technology. This culture of making might challenge current barriers to technologies for many people including older adults. Furthermore, as a field that draws on materials, crafts and practices that are traditionally associated with women (Orth, 2013), e-textiles might offer older females who according to the Office of National Statistics (2016) outnumber older men, an alternative route into technology.

Engaging with e-textiles as a mode of and vehicle for communication could allow older adults to create new and resonant ways of connecting with others, identify new opportunities for interaction and enable users as makers to express their emotions, personality and identity. An example in practice is an idea born of one of the authors' Grandfather's recent relocation into sheltered housing. In discussion, they conceptualised an e-textile system consisting of knitted copper yarn coasters that react to the heat or weight of a teapot that could signal to other residents in the complex that a neighbour is making a pot of tea and would welcome company (Figure 2). This concept playfully engages e-textiles as critical social touch points, playing on a social ritual that is readily acknowledged as a 'norm' for connecting with others and augmenting familiar textile objects in the home to support people in coming together.
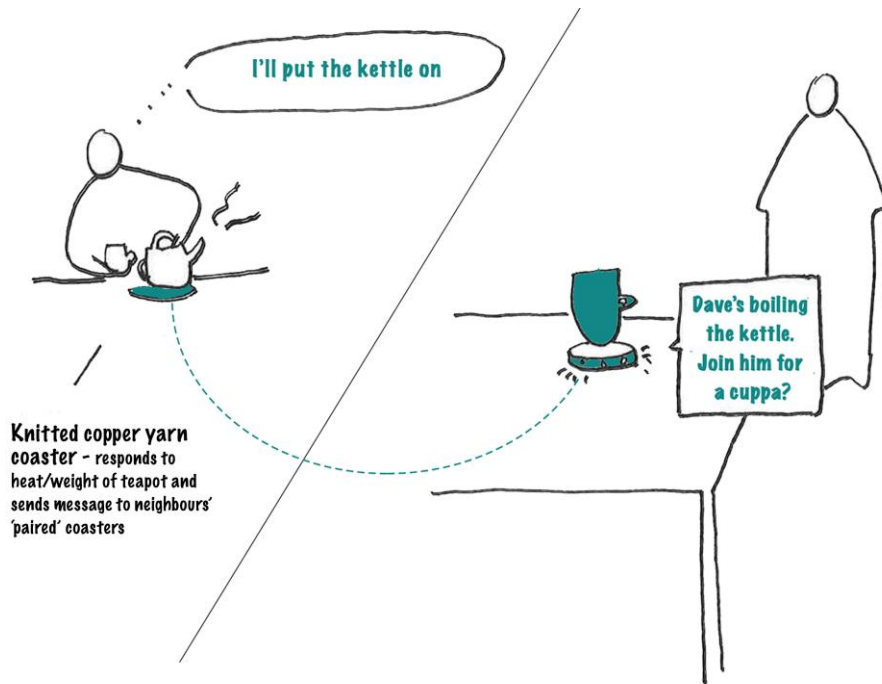
Figure 2 E-textile concept in supporting social connectedness

4.1 Imagining possible future e-textiles as social connectors

Working with older adults with experience or knowledge of loneliness, the authors propose that e-textile concepts such as this might be explored and expanded upon by engaging in a progressive series of co-design workshops to craft, prototype and test ideas. Building on the method employed by Frohlich et al. (2012), a series of three themed 'inspiration' workshops held two weeks apart will guide participants in exploring and ideating original e-textile prototypes (Figure 3).
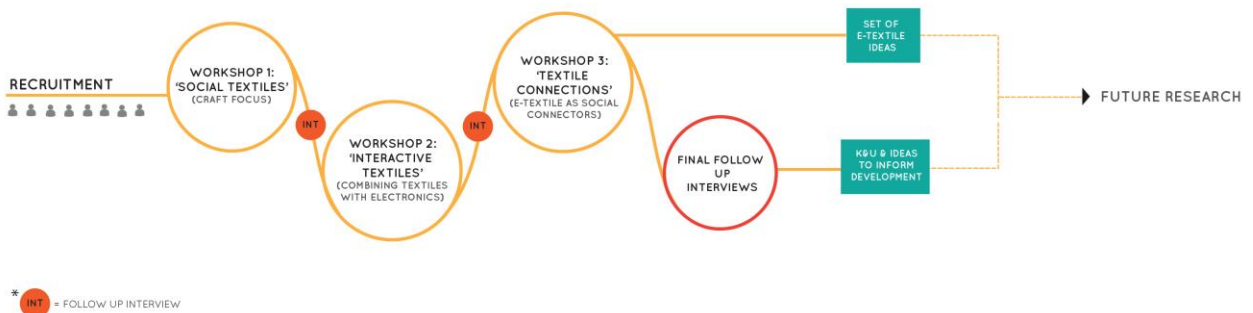

Figure 3 Inspiration Workshop Method

Participants aged 65 years and over with an interest in textile design have been recruited from local knitting and craft groups. Eight participants will work together with two or three design facilitators over the course of three workshops. Firstly, participants will create personal textile objects, (these may be handheld or wearable for example), using a mix of traditional and contemporary materials and techniques. Secondly, they will imagine possible interactions with the aid of demonstrations of sample e-textile sensors and switches. And thirdly, they will conceptualise their e-textile ideas as social connectors by discussing and mapping out possible scenarios for use. Individual interviews will be conducted following each workshop to gather further insights.

5. Conclusion

This paper has proposed that e-textiles is poised as one of the next possible frontiers for enabling communications. We have discussed some of the benefits offered by the medium and the field of e-textiles, and have identified co-design as an opportunity to discover further benefits for older users.

The authors' future work will involve engaging older people in co-design workshops to imagine new ways of augmenting e-textiles and in the process developing their skillsets and ways of thinking. We envisage an approach that encourages inclusive, intuitive, social and pragmatic design practice. This will provide key insights when exploring ways to connect socially with other people and reimagining the realms of communicative technology. By harnessing existing skills and using e-textiles as a vehicle to create new interactions, we hope to engender a sense of discovery, empowerment and ownership of the design process within our working groups.

Given the diversity of craft practice within our 'maker community', and indeed the subjective nature of loneliness and social connectedness at the heart of these studies, it is difficult to predict the kind of outcomes that we might encounter. Some creations may be about communication where others may focus on attachment or reminiscence. Indeed, there are many different routes or pathways to connectedness, and it is undoubtedly the case that – in order to be successful – future e-textiles will be required to respond to the sensibilities, and the needs, of those who might benefit from their use.

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