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From medical devices to everyday products: exploring cross-cultural perceptions of assistive technology

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ABSTRACT

Currently, the assistive technologies (ATs) market is under-developed, which limits individual choices. Many people appear reconciled to using available products that, at best, match functionalities to compensate for physical deficiencies. Yet people express a desire for personalized, elegant, discreet and bold artefacts that match their lifestyle and provide opportunities for self-expression. This study adopts a materiality-inspired methodology to explore ATs and to elicit insights into the perceptions and emotions of the study participants towards them. A comparative exploratory study between the UK and Taiwan has been conducted to explore diverse and cross-cultural perceptions. The findings suggest that the design of ATs needs to go beyond traditional considerations, such as price and compliance, and instead focus on how these products enhance users' positive sense of self. This in return may increase the rate of successful adoption of ATs in everyday life.

Introduction

As the population ages, the priority for many older and disabled people is to maintain their independence for as long as possible and to actively engage in social activities to reduce the risks of loneliness and isolation (Lewin et al. 2010). 'Ageing in place' is a concept 'that allows people to live independently by receiving services as needs change' (Phillips, Ajrouch, and Hillcoat-Nalletamby 2010, 17). Whilst the relationship between the person and their environment may continually change, the physical location remains constant

and familiar. This can be seen as a feasible alternative to moving into a residential nursing home and enables older people to receive services and care for as long as possible at home (Cheek, Nikpour, and Nowlin 2005).

The proportion of people who have difficulties with activities of daily living (ADLs) is increasing (Age UK 2017), specifically, in relationship to limited mobility and mental health conditions. A research study conducted with 3000 participants aged over 40 years (Silver 2012) identified key difficulties that included getting out and about (23%), household chores (18%), DIY (do-it-yourself) and gardening (11%), getting up from bed and getting ready for the day (9%), and cooking (8%).

From a medical perspective, the design of assistive technologies (ATs) – devices that increase or maintain functional capabilities of individuals with injuries or declining abilities as well as enhance overall wellbeing – is often framed in the context of problem-solving (Pullin 2009). This focus predominantly results in functional ATs that tend to be designed *for* the users, rather than *with* the users (Ravenberg 2012). This clinical approach further contributes to the predominant discourse around 'design for disability' and neglects the key principles of human-centred design, where products are created with people as interconnecting cognitive, emotional, social and physical beings.

The literature suggests that a paradigm shift is therefore advocated in the language of ATs to improve their everyday use, emotional connectivity with the users and an increased uptake and effectiveness. This paper explores novel ways to understand ATs with specific attention on balancing users' needs and safety with the aspiration to create person-centred products that enhance a person's sense of identity. The underlying aim of this research is therefore to explore what factors may change cultural and personal views of ATs to explore new language use the design of ATs. The research has involved a cross-cultural study comparing attitudes and perceptions between Taiwan and the UK. The rationale for inclusion of the two countries is due to perceived differences in the cultural perspectives – broadly described as Western-European and Asian-Chinese – that may result in alternative ways that ageing is understood and experienced. This paper further explores perceptions of older and younger adults as age may be a significant factor in how ATs are viewed.

The design of assistive technologies

A wide range of independent living aids, many of which are relatively inexpensive, have been designed to improve people's health, safety and wellbeing (Consumer Focus 2010). Development in this field has brought to the market a number of ATs within the following areas:

- Community equipment: products that are primarily intended to help disabled and/or older people with everyday living (e.g. toileting equipment, can openers, hoists, standing frames, scooters and walking frames).

- Orthoses: orthopaedic products that are externally applied and offer physical support (e.g. braces, sole inserts and limb support).
- Prostheses: 'replacement parts', such as artificial limbs, hip replacements, and breast reconstruction.

The market of ATs in the UK is estimated to have increased by 12.4% between 2009 and 2013. Mobility equipment, including daily living aids, wheelchairs and scooters, was the largest sector in the market for equipment for people living with a disability, accounting for 31.3% of the market total by value. However, in Western countries, ATs' disuse after one year from purchase has been estimated as one-third. This is caused by multiple reasons: cultural differences of the users, variety of device types, and an unclear definition of abandonment and disuse (Federici and Borsci 2016). Older adults may be overloaded by the emotional and cognitive investment required to use and incorporate ATs in everyday life and a focus on clear communication about how to use new devices is instrumental (Spinelli 2015; Spinelli, Micocci, and Ajovalasit 2017).

A significant theoretical contribution to explain the role of emotions in decision-making among older adults is the *Socioemotional Selectivity Theory* (Blyth et al. 2005; Carstensen 2006), which argues that older people have heightened awareness of their own mortality, and thereby, rely more on the affective system as a means to achieve positive outcomes. Studies highlight the ways that the design of ATs are imbued with personal and social meanings: whilst products can be seen to enhance the possibilities for an independent and active lifestyle, they can also contribute to a sense of isolation and stigmatization (Gibson et al. 2007). Stigmatization and the use of ATs by people who acquire disabilities in later life often results in the abandonment of devices (Luborsky 1993; Zimmer and Chappell 1999; Parette and Scherer 2004). Older adults feel an increased sense of vulnerability when they are asked to include devices in their everyday lives that that are not routinely used by the general population (Lebbon and Boess 1998; Polgar 2002; Parette and Scherer 2004). The same authors also believe that stigmatization can lead to a negative impact on a person's self-esteem and overall mental wellbeing, the degree of their compliance to treatment, and to their social relationships. Due to stigma, users of ATs generally prefer to use less visible and discreet devices (Smith-Lewis 1992; Brookes 1998).

Jon Allen's studies (2005) on Augmentative and Alternative Communication (AAC) devices highlight possibilities to rule out stigmatism through the design of modularized and desirable items, assembled on demand. Personalization is further recommended to let the user have control over design elements, promote their personal preferences, prolong the device's usage period (Hurst and Tobias 2011) and improve social inclusion (Augusto et al. 2013). Newell (2003) see opportunities to improve ATs' design

as the industry moves away from the traditional medical model of clinical devices and makes in-roads into the wider and mainstream products within the consumer market.

Users of ATs are often supplied with standardized aids which are unable to change as physical needs evolve over time, and therefore unable to support a complex rehabilitation trajectory. This has inadvertently resulted in people who use ATs reporting an increased perception of themselves as disabled (Hocking 1999) and an enhanced fear of being stigmatized (Bright and Coventry 2013).

Little consideration has been given to how ATs, which are in intimate proximity to the body, may affect the person's view of their embodied self. As objects, ATs are often permeated with negative emotions, such as dependence, decline and disgust. In this context, a sense of 'psychological contamination' (Rozin and Fallon 1987) may occur due to the user's proximity to an object that acts as a continual, public and visual reminder of disability and/or declining abilities. By following the principle of similarity, devices whose aesthetic features resemble a 'disgusting' item or devices that bring up memories of disabilities, are likely to be rejected and negatively perceived. Narratives of 'medicine' around ATs remain predominant in the design language of ATs, with minimal movement towards narratives of consumerism, personalization, flexibility, and style. As a result, older people may reconcile themselves to use available products that, at best, match functionalities to compensate for their physical deficiencies. Research suggests that users express a wish for more personalized, discreet and at times bold artefacts that fit with changing physical abilities (Parette and Scherer 2004).

This underdeveloped market of ATs perpetuates the message that the only agency that unsatisfied users can perform is that of rejecting ATs. Studies on 'materiality' focus on the border between the subject (the person) and the object (the product/artefact) that is often not distinguishable (Miller 1987) because individuals use material objects to achieve certain goals (Borgerson 2005). In Miller's concept of materiality, the consumers form, alter and transform themselves through their relationships with objects – through their use – and, in this relationship, the context of cultural consumption is born. In this context, the user is not simply a passive consumer but also a producer of cultural interpretation, understanding and usage of the objects; in other words, a process of transformation takes place between the subject and the object. The transposition of Miller's idea of materiality to the cultural and individual consumption of ATs (that is the usage) leads to discouraging reflections. If the dialectic relationship between subjects and objects forges the identity of the consumers/users and initiate and imbue the cultural context that surrounds the usage, then it can be assumed that a limited and limiting range of medically inspired ATs can only foster a process of identity

construction that is distorted and incomplete. On the other hand, when objects/products *realize* desirable values that can enhance diversity and self-expression, design achieves its highest social contribution. This research utilizes a materiality-inspired methodology to investigate how the physical characteristics of ATs, in this context, meaning as cultural objects, have profound meaning for the individuals who interact with them.

Perception and usage of ATs in Asian-Chinese culture

In 2018, the population of older people in Taiwan (65 years old and over) reached 14% of the overall population and is set to hit 20% in 2061 (Liao 2018); in a single generation span, Taiwan has been transformed from an 'ageing society' to an 'aged society'. This trend is similar to the whole of Asia. The Western world has had much longer transitions – it took the UK 45 years to become an aged society (1930–1975) and France 100 years – and so they had more time to adjust to such changes (Kinsella and He 2008). The demographic shifts raised urgent issues in the need to create appropriate environments for older people to age in place. In Taiwan, a Ten-Year Care Plan was developed by the Ministry of Health and Welfare of the Executive Yuan in 2007 in order to enhance dignity and autonomy as well as to improve the quality of life of the disabled and ageing population. The plan, modified in 2017, includes multiple and continuous services to support families, homes and communities for the disabled and ageing adults.

ATs can be a contributing factor to more effective management of changing demographics. At times ATs include innovative technology components, making them more complex for ageing users who are less familiar with them. However, the digital gap may be even narrower in Taiwan wherein 2017, a report from the Foreseeing Innovative New Digiservice (FIND Team 2017) showed that 60.2% of ageing adults (over 55) own a smartphone and 20% of them had experience in TV shopping and online shopping. The report highlighted that adults aged 55–64 are more active than their older peers. This increased familiarity with technology of the younger old people – people younger than 75 years old – shows a promising future in which communication, social engagement, health and care needs and daily life aspirations could be supported by ATs that may be accepted more promptly by the younger old population cohort as they grow older.

The increase in the average life span has brought business opportunities. Older adults in Taiwan can obtain ATs through government subsidy and consider the use of ATs helpful (Chuang 2010). The most purchased ATs from 'Momo' (a large online shopping website) in 2017 were walkers, wheelchairs, and bath chairs (National Development Council report 2014). These personal and mobility ATs provide older adults with the opportunity to

retain independence and dignity in later life. Other ATs, such as smart-watches are getting more popular in the Taiwanese market. Similarly, in China, the ageing population is willing to adopt newer technologies to improve their social participation and connections (Chandra and Das 2018). In addition, ATs have become more acceptable, hence well adopted by active and independent older adults (Lin 2017). Items such as the first four-wheel electric scooter, released in 1989 in Taiwan, have grown in popularity (Hsu and Yang 2009) because of the convenience and independence they bring, and increased penetration in the market has reduced its social stigma. Despite the growing popularity of and demand for ATs, older adults feel they have very few options in the underdeveloped consumer markets of ATs, which does not, for instance, enable personalization (Chen and Chiang 2010).

There is limited research in the area of comparison of the Western and Asian sensitivities around ATs and how through a cultural lens they may be perceived differently. There are, however, studies contrasting the UK and Taiwanese health insurance systems (Kuo 2009) and research on the different perceptions of basic design elements such as shape and aesthetics preferences in visual art (Lu, Cok, and Zhu 2014).

The study

This study aimed to understand and explore the perceptions and emotions associated with ATs from both younger and older adults and from across two different cultural frameworks. Ethical approval for the study was gained from Brunel University London. The study involved six focus groups in the UK (four with older people and two with younger people) and four focus groups in Taiwan (two with older people and two with younger people). During each focus group, the study explored the perceptions and emotions amongst the participants when they touch and interact with the ATs and as they envisioned the use of ATs for themselves or others. In this context, the materiality and perceive nature of the ATs was central to the methodology. The study also investigated how the participants' perceptions changed when young children or older adults were shown to be the users of ATs.

The participants' sample included the following:

- In the UK: 13 British older adults (eight women and five men, ranging from 60 to 85 years old) and six younger adults (four women and two men, ranging from 19 to 34 years old).
- In Taiwan: 13 Taiwanese older adults (eight women and five men, ranging from 65 to 88 years old) and 10 younger adults from National Taipei University (eight women and two men, ranging from 20 to 44 years old).
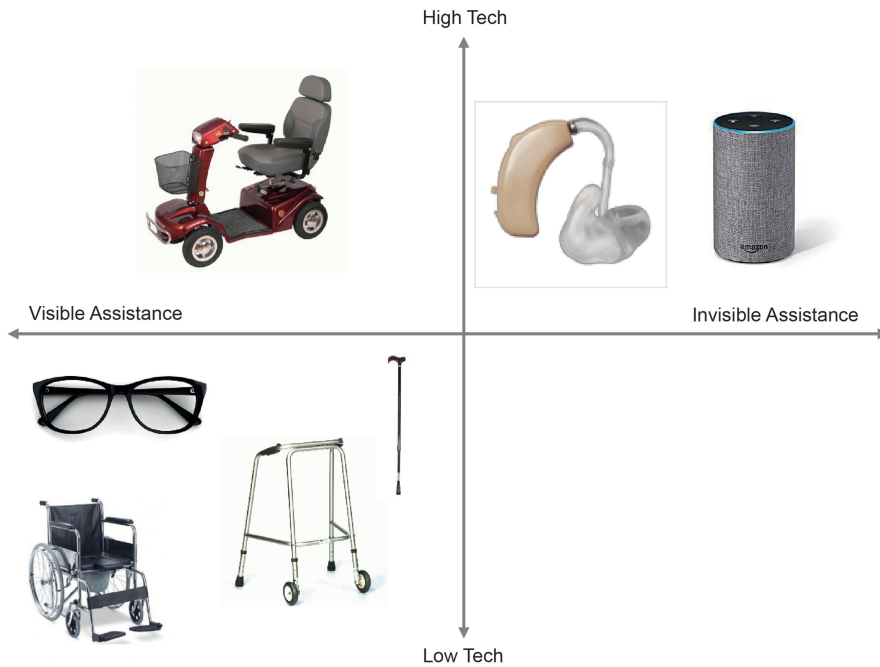
Figure 1. The seven prompts used in the focus group.

Being a current user of ATs was not a necessary condition to take part in the study. Nonetheless, some of the participants had familiarity with certain devices due to their own experience or through their use by family and friends. Following a process of informed consent and a reminder about the purpose of the study, ground rules for the activities were agreed, for example, consideration of all participants' identity and for all discussions to remain confidential. Each focus group lasted between 70 and 90 min. To protect participants' anonymity and confidentiality the names reported here are pseudonyms; each focus group conversation was transcribed verbatim.

A range of technology prompts were included, and participants were encouraged to touch, handle and interact with the ATs.

Whilst ATs as objects may influence activities in everyday life, they are often experienced as mundane, taken-for-granted and invisible; alternatively, ATs can feel ever-present and highly visible. Due to the different nature and context of ATs as objects, we decided to choose a wide range of different ATs as prompts. There were namely (see Figure 1): a pair of glasses, a hearing aid, a standard and a folding walking cane, a wheelchair, a Zimmer frame, a motorized scooter, and an Amazon Alexa.

The prompts were introduced one by one, followed by visual images depicting each device in a range of contexts of use (domestic, hospital, and

social settings) and used by diverse groups of users (children, middle-aged people, older adults). Participants were encouraged to:

- discuss and explore their feelings and emotions when they saw a range of different people using each device
- touch and feel the prompts, share their perceptions and emotions, consider themselves as possible users of each device and recall any previous experiences with the ATs.

By apprehending objects through physical touching and seeing of the ATs, the focus groups aimed to elicit positive and negative reactions to each of the objects presented. Participants talked about previous personal experiences with similar objects. The narratives elicited were often linked to specific physical characteristics of the devices as the participants touched them and had memories about the ways objects worked, for example, ways to adjust, hold and position the ATs. This resonated with Leonardi (2017) who argued that the materiality of objects is the necessary 'linchpin' that connects people's embodied experiences of the objects with their everyday use.

Thematic analysis was conducted separately on the data collected in the UK and Taiwan. A comparison of the country-based themes was then performed iteratively until saturation was achieved.

This exploratory study is limited as it is small in scale with the views of only 42 participants and only seven ATs were included.

Analysis and findings

The four key themes emerged from the study are now presented. As participants were encouraged to experience the material nature of the objects, the interpretations within the four themes are anchored to the ATs as cultural artefacts within the study.

Independence and self-determination

Participants appreciated that older people respond to their disabilities by aiming to maintain their independence. A common feeling was that devices can function to compensate for the limited or missing ability of the users. This is illustrated by Tom (61, UK) who previously needed to use a wheelchair but felt 'almost invisible and incredibly vulnerable' when using it. He explained how he felt out of control and dependent on the person pushing him and continued 'I'd rather struggle with crutches'. A sense of 'being in control' of his own independence was for him a priority. Negative feelings appeared therefore to be associated with a device limiting a person's sense of power and self-determination.

Alternatively, the electric scooter conveyed, for some participants, independence and empowerment. As Tom (61, UK) said 'in the place where I used to work, there were a couple of people using electric wheelchairs, yet they were exerting themselves … [because] even with this device, there is something manual that shows that despite a disability, you are still able – to look after yourself and be independent'. Electric scooters were perceived quite positively by Taiwanese older adults. For example, Ying (67, Taiwan) said 'I like electric scooters because I don't need other people's help and I can move freely'. Yu (67, Taiwan) similarly stated 'I feel younger and free when I ride my electric scooter because my mobility will not be limited by my house'. The study in Taiwan revealed that young and older adults regard electric scooters as general means of transport, with the positive emotions of autonomy, empowerment and independence attached to them.

Younger adults in the UK however mainly expressed a sense of negative and passive images around the use of the electric scooter: 'The first thing that I think when I see that scooter is that people using it are lazy' said Laura (28, UK). Bob (34, UK) reported the experience of one of his friends suffering from obesity and a severe leg impairment that forced him to use mobility aids; 'When he is on his electric scooter, he feels other people stare at him and judge him as lazy just because of his obesity'. Whilst older persons using an electric scooter are considered more acceptable, electric scooters are linked to negative emotions when users were younger.

The participants perceived an electric scooter as useful and a 'good compromise' in the sense that a motorized vehicle provided options to be manually controlled and capable to cover longer distances, extending the freedom and capabilities of an unaided user. In this respect, ATs are seen as amplifiers of users' abilities in the sense of executing the users' will by' boosting' their current abilities. As Laura (34, UK) remarked 'When embracing high-tech devices, it is preferable to reinforce our existing abilities and go beyond our limits … when I think about high-tech devices, I mean something that, when I am walking, it goes faster than me'.

A similar narrative about independence emerged when the participants discussed Alexa. Older adults in the UK perceived it as a tool only needed when absolutely incapable of self-sufficiency, whilst older adults in Taiwan so the introduction of this technology as a positive addition to their lifestyle. These polarized views of Alexa are an example of how the cultural context can inform the interpretation of a device.

Influence of social acceptance on individual adoption

When talking about eyeglasses, hearing aids and walking canes, devices that are used in close proximity with the body in everyday life, participants

highlighted the importance of their social acceptance. Participants had divided feelings associated with these devices because these ATs are highly visible and are often viewed as an 'extension of the self'. For Sue and Tom (both 61, UK), explained that nowadays people are less inclined to disguise their disability due to improved aesthetics and social acceptance of ATs. Dawn (68, UK) stated that 'devices like prosthetic limbs are becoming more accepted because of the diffusion of advanced sports equipment seen at the Paralympic games'. As Sue (61, UK) said 'people with disability are not necessarily stereotyped into a group anymore [...] if you see someone who has got a hearing device you don't think about it. My father struggles to wear hearing aids because he is showing that he is old, but I have friends in their 30 s and 40 s who wear hearing aids [...] and you can talk to them because they wear it and, in a way, it's just like anything else these days'. UK participants displayed an overall positive attitude towards these ATs; this was also encouraged by a renewed sense of acceptance as transmitted by the media (in particular, the Paralympic Games).

In contrast, the Taiwanese participants elicited a 'passive' approach to ATs acceptance; Hui (44, Taiwan) said 'my friend's grandfather would rather risk himself being run over by a scooter on a busy street than wearing his hearing aid because he feels shameful to wear it. He doesn't want to appear to be old and useless'. Hsiu (75, Taiwan) stressed that 'hearing aids are too big, and I don't want to use it. It is supposed to be lighter and smaller, in other words, it should be invisible'. Older adults in Taiwan prefer ATs to be invisible, or ATs that emphasize personal choices. In the case of wheelchairs, a device that cannot be invisible, participants showed interest in objects that are elegant, light and sporty. Demonstrating how the physical characteristics of ATs may influence their adoption, Lin (68, Taiwan) remarked that 'black wheelchairs make me feel sad and old, I prefer brighter colours, such as blue or silver'. Xiu (75, Taiwan) also said 'I prefer ATs in bright colours that match, such as the white and red one'.

Younger adults appeared more concerned about the social acceptance of wearing assistive devices. Lucy (34, UK) said 'It is part of humankind to exclude whatever we don't understand. Half of the population wears glasses that is why they look more acceptable but if you see a hearing aid, I think people would still stare and, in the end, if the person is a female, she will drag her hair to cover it up'. When a device is not completely socially accepted, the participants suggested that the solution would be to camouflage it. Laura (28, UK) talked about hearing aids saying, 'I would make it black not to stand out … matte and black to look like a shadow'. She further showed a picture on her smartphone of high-tech hearing aids whose shape resembles a set of sporty earphones and she explained the desire to resemble modern design languages and trends to facilitate social

acceptance. Similarly, Taiwanese participants would prefer fashionable and stylish items if ATs were to be seen (Liu 20, Taiwan).

Long-term vs. short-term ATs

Both age groups displayed a difference in the acceptance and purchase preferences of ATs, depending on whether the ATs supported permanent or temporary conditions. As Tom (61, UK) explained 'If I had to use [a walking stick] for a long period of time, I would go for a nicer one, but a basic one didn't worry me at all when I had to use it'. Sarah (74, UK) added 'it [a walking stick] is a fashion statement … I know my mother wouldn't use the walking stick from the hospital, but she has got a small black one and she is quite happy to use that'. Nas (26, UK) said 'for temporary use, I would go for the cheapest [stick] but if it's for a permanent condition I would go for a fancier, wooden one, which has carved things in it with a holding ring … I'm so fancy … I wouldn't mind spending money if it's [for] a permanent condition'.

These observations suggest that the selection of ATs is not the result of personal investments, in terms of emotions and resources, if their use is anticipated to be only temporary. The AT was accepted purely in terms of its function and performance over a short period of time. Long-term use instead requires more personal, aesthetic and emotional connectivity in which the AT as an object reflects the users' aesthetic preferences, sense of identity and enables their self-expression. Time of use was therefore the main factor when participants were asked which walking cane they would have preferred, a more conventional or foldable one, as Louise (79, UK) stated 'It depends how much [long] I need it'.

Control vs. automation

Participants demonstrated an interest in the potential of voice-controlled devices, e.g. Amazon Alexa, however, they did not consider it appropriate for their current needs. Tom (61, UK) said 'I suppose I see using it to be lazy I'd like to be in control for a long time. At the moment, it's not something I see [for me]'. Louise (79, UK) expressed her willingness to rely on people or on her own abilities for as long as possible instead of voice-controlled devices that would make her feel passive and lazy. Participants acknowledged the 'magical' power of the voice-controlled devices (Marta, 60, UK) and the entertaining value it offered (Sue, 61, UK); however the interaction with the device was also labelled as 'not natural' by Tom (61, UK) for those who are physically fit; whilst would be justifiable in the context of severe disability.

In contrast, younger participants showed a higher familiarity with and interest in voice-controlled devices and they appreciated how far technology could improve their lifestyle. Martin, a 19-year-old man (UK) who uses insulin pump every day, said 'I would want technology to take over completely. There is a device that can measure and inject by itself and you don't have to interfere, and it works … it's amazing! It has not been approved yet by the insurance company [so it is not available on the NHS] but if you have the money you can buy it. Sometimes it goes wrong, OK, but then 9 out of 10 days are good days'.

Older adults from Taiwan were fascinated by Amazon's Alexa, and they expressed a fondness towards this technology. Participants perceived Alexa as 'fabulous', particularly for emergency services and home safety (Yu, 67, Taiwan). Yu further added that 'if an emergency happens, the technological device can automatically call the hospital and my children'. Participants also see Alexa as a house-keeper and a security guard against burglary (Mei, 74, Lan, 65, Taiwan). Similarly, younger adults consider the device as a health-care and alarm system which could alert them if there was an emergency, e.g. a fall, a stroke (Wang 44, Hsu 21, Taiwan).

The study participants saw the potential voice-controlled devices in care and emergency services, and, in these circumstances, more autonomous devices would be accepted.

Discussion

This qualitative study highlights four key themes that emerged from the exploration of ATs preferences among younger and older people. Following tangible interactions with seven selected ATs, a materiality-inspired methodology has enabled us to highlight alternate discourse around a number of issues that were thematically presented. Polarized narratives have emerged with regards to the necessity of making ATs invisible in those circumstances where pluralism is yet an uncommon cultural value. Invisibility is often achieved through disguising ATs as objects that subsume functions of everyday life (e.g. umbrellas, Nordic walking stick, Bluetooth earpieces, jewellery, etc.). However, when invisibility is not possible, a growing desire for boldness, fun and personalization seems to become an important characteristic for ATs. In a society where homogenization has been a strong cultural value, perhaps it could be understood how having 'something different' on or very near to one's face (e.g. hearing aid) may be rejected, as it contributes to defining one's appearance as deviant. On the contrary, in a society that has been more liberal, like the UK, where diversity in fashion and body accessories has been dominant for decades, one may not perceive a device in the proximity to the face as controversial.

Perceptions of ATs are also related to the extent to which the AT was needed for the long- or the short term. For example, if the need of ATs is temporary, participants expressed more acceptance of the ATs in their current design and function. Aesthetic concerns, however, are voiced more significantly when the need for an AT is permanent; the participants expected to invest financial and emotional resources aimed at personalizing the device and at making it unique and precious. Devices amplifying human capabilities were extremely well received in the study and, in contrast, users showed disdain ATs that substitute or replace the agency of the user.

Older adults in Taiwan were keen to define digital and electric assistive products as convenient and technologically evolved, some sort of avant-garde pieces to be proud of. In the UK, the same ATs were seen as products that would diminish physical activity and therefore develop a passive, even lazy, lifestyle. Such difference may be explained by the growing adoption of ICT in Asia with the intention to accelerate economic growth and, consequently, the benevolent reception of all technological products. On the contrary, in the Western culture, a narrative of youth and power is associated with self-reliance and independence, hence making use of resources and powers that derived through technology are less appealing.

This study does not directly focus on the detailed design of the ATs but aims to excavate the narratives of language, desire, disgust, control and choice elicited in the material interaction with ATs. For Miller, 'Objects are important not because they are evident and physically constrain or enable, but often precisely because we do not *see* them' (2005, 5). By incorporating the ATs into the focus groups as probes, the material nature of objects became visible and participants, out of curiosity, as they had never come across the device before, or due to engagement in the activity, had handled and felt the ATs. In this context, a focus on the materiality of ATs as objects provided a novel lens through which to explore the interplay between the body, object and identity. The physical interaction with the objects brought to the surface experiences and emotions that would have been more distant if the objects had not been present. The ATs were shown to be imbued with meanings from stigma to independence and from desire to disgust that indicated how the use of ATs as objects in everyday life may be lived and felt. This was especially notable around the visibility of the ATs in everyday life and the significance of the use of the ATs in public and private space. Meanings around ATs as objects appeared to be contested, negotiated and, at times, resisted. A materiality inspired methodology has therefore started to make visible the unseen, the mundane and the 'taken-for-granted' nature of ATs that may also challenge some of the attributes and values within design language.

It is clear that a limiting ATs market strongly constrained users' choice and that a medically inspired culture is still the paradigm that underpins most of

the artefacts that support disabled and ageing people. Currently, the dominating design conceptualizes the users as in 'ill health', as 'patients', and very little innovation has been introduced to alter this assumption. The increasing financial contributions that users make towards the cost of ATs is slowly changing expectations and preferences, and bringing attention to how ATs are designed. Very gradually, the ATs market is becoming less monopolized as new companies offer better value in the form of more aspirational assistive products, which the users prefer to standardize products, even if the costs are higher. The extra cost, as discussed in the findings, is justifiable when a device ought to support long-term conditions and additional attributes are important for the device to become an extension of its user.

Conclusions

This study collected experiences and narratives of tangible interactions between young and older adults and ATs. This was achieved through a materiality-inspired methodology whereby participants had the opportunity to physically handle the ATs and by so doing they recounted feelings and/or memories of using ATs. The findings unequivocally suggest that across cultural contexts, themes such as risk, functional characteristics, price and homogenization are surpassed and the current focus to enable acceptance needs to be focussed on developing ATs that can be emotionally invested and that reflect the identity, sense of self and cultural context amongst the users. On setting the agenda for future development of ATs, designers need to put aside surpassed narratives as they acted as constraining factors that kept the ATs market underdeveloped and stale. A stronger design focus placed on engendering identity in all its forms of expression could further unpack personal accounts of how ATs accompany and scaffold the life of their owners and users. By discovering the emotional links that users develop with ATs through time and personal stories, design studies might be better equipped to inspire positive lifestyle where frail and disabled people can still exercise personal choice.

Disclosure statement

Notes on contributors

Dr Gabriella Spinelli is a Reader in Design at Brunel University London. Her research explores the relationship between identity, design interventions and behaviour. In the last 10 years, she has focussed on how the design of products, services, technology and systems can support wellbeing.

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