Chapter 10

Contemporary themes in the design of AT for the ageing population: materiality, co-design and cultural influences

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Abstract. Products we purchase are much more than artefacts that fulfil functional needs in our life. We have grown to enact our consumer choices, even those regarding fast moving consumable goods, with careful considerations informed by numerous trials, recommendations and, growingly, environmental concerns in mind. Advanced manufacturing and progress in research and development are providing more choices for consumers even in quite specific and complex product markets. An exemption to this market trend is represented by assistive technologies (ATs). This is a relatively underdeveloped context despite the growing demands for assistive

devices by those in later life who need either support in accomplishing everyday life to stay independent or have complex co-occurring conditions. In this chapter, we explore why ATs, especially for older adults, are underdeveloped by exploring issues related to design approaches and cultural and social perceptions that have contributed to making consumers more or less sensitive and demanding towards the role of ATs in their lives. The chapter will conclude with recommendations that may be able to shift the perception of assistive devices so as to facilitate the user's emotional investment in the devices, attachment to them, which, in return, may lead to better adherence and faster adoption.

Keywords: Assistive Technology, Adoption, Identity, Desire, Lifestyle, Older Adults

1. The design of Assistive Technologies (ATs) beyond functional requirements

Products we purchase are much more than artefacts that fulfil functional needs in our life. We have grown to enact our identity through the consumer choices we make and in return to be defined by the goods we surround ourselves by [1]. In making consumer choices we follow friends' suggestions, online reviews, experts' advice, price and brand credibility. Personal taste and peers' acceptance are also factors that have great impact in our choice. Despite a growing number of older adults, extended longevity and, consequently, a longer period of comorbidity, the ATs market has not kept pace with what is required for a diverse group of consumers who need support in everyday tasks. ATs are still mostly designed with functional support in mind, little personalisation in the support of different physical requirements and almost no devices catering for aesthetic, emotional and cognitive differences. After an introduction about the long-standing debate on what requirements ATs are meant to support, the chapter reviews the causes that lead to the abandonment of ATs and the heighten challenges represented by designing for people with severe disabilities. The chapter then explores three trends in the design of AT for an ageing population: co-design, materiality and the cultural framework that surrounds their design and use.

'Assistive Technologies' (ATs) is used to describe devices aimed to increase or maintain the functional capabilities of individuals with injuries or declining abilities and to enhance overall well-being [2]. The range of ATs has been populated with subcategories differentiating between 'replacement parts' such as artificial limbs; 'orthopaedic prod-

ucts' for external applications; off-the-shelf products to help people coping with declining abilities in daily life settings [3]. Despite these categorisations, ATs often fail to move beyond the mere functional support they offer and to embrace the holistic role of support they could offer.

With the need to consider how ATs may support people holistically, the concept of Inclusive Design has been widely accepted in the design arena by considering extreme users so as to expand both the type of support and the user groups of ATs [4]. Inclusive design is defined as "The design of mainstream products and/or services that are accessible to, and usable by, as many people as reasonably possible ... without the need for special adaptation or specialised design" by the British Standards Institute [5]. Inclusive design is also known under several different terminologies, i.e. universal design, design for all, barrier-free design and accessible design in different countries, which are used in a similar way [6]. Inclusive design has been recognised internationally as a well-known design approach in mainstream products, services, and environments offering a clear business benefit; that of targeting people with differing abilities and needs, hence a wider market audience [7].

Hocking [8], in the US, established that 56% of ATs was abandoned, and 15% were never used in the first place. This may be attributed to a lack of empathy designers imbue in the design of ATs, and the resulting neglect of non-functional requirements such as aesthetics (ibid). The importance of non-physical aspects in design has already been stressed, and design movements concerned with psychosocial design attributes have been captured in approaches such as *meaning-centred design* [9]; *human-centred design* [10-11]; *experience design* [12-14] and *emotional design* [15]. However, a growing number of standardised devices that compensate for people's missing abilities continue to be developed with little consideration for the individual preferences, changing physical needs [16] and the positive/negative connotations encapsulated in the device [17]. As a result, the development of dedicated products that fall under the definition of ATs often promotes isolation rather than inclusion, being apart from the aesthetic and social standards of more appealing and versatile consumer products. The consequence is that more than one-third of the ATs that are purchased are abandoned when they are still needed [17-18].

Further difficulties emerge when older adults require life-enhancing devices that are not routinely used by the general population and that

convey messages of vulnerability and stigmatisation. This, in return, affects the self-esteem and overall mental wellbeing, treatment adherence and social relations [19-22]. This picture is exacerbated by the normal decline of cognitive abilities that occurs with ageing, resulting in hindrance of novel technologies' usage and limitations to their adoption [23]. Learning difficulties affect information processing and the consequent decision-making older adults exercise when making informed decisions; rather than embarking on products that require a superior cognitive workload, older adults significantly rely on more spontaneous and effortless experiential-based knowledge [24-25] that eventually leads towards the purchase of standardised and popular products. This *per se* creates obstacles to innovation in the market of ATs, as mass-market products are better recognised and for the reasons aforementioned, they continue to be preferred, even when they may only partially address user needs.

The resignation to 'functional' rather than 'pleasing' products, has resulted in an increased perception of older adults as disabled [8] with their growing fear of being stigmatised [26]. This process is intensified by the role that ATs assume in a social context and how in return, social contexts may influence personal preferences [27-28]. In a study conducted by Pape [29], it was demonstrated that social factors, beyond usability and functionality, impact the choice of ATs. The use of an assistive device often piggybacks the acceptance of the disability and the device is more likely to be abandoned if it makes the users feel excluded from their social context, e.g. it doesn't match with the values of the community they are part of. In those cases, the dissonance between the individual self-representation and the expected social norms may cause deviation from others and the social interaction may be compromised [28 & 30].

2. Adoption and abandonment of ATs

The review conducted by Kraskowsky and Finlayson [31], and Wessels et al. [32] about non-use of ATs, identifies four main factors that affect ATs use:

1. Factors related to the person: this set of factors revolves around the expectations that a person has of himself /herself as well as the expectations that people in his or her social circle have of them using

the device. The list includes items such as age, gender, diagnosis, acceptance of the disability, emotional maturity, inner motivation, progression of disability, severity of disability, change in disability and use of multiple devices;
2. Factors related to the device: e.g. quality and appearance;
3. Factors related to the user's environment: social circle support, physical barriers, the presence of engagement opportunities for those who use ATs, access and availability of ATs on the market;
4. Factors related to the professional assessment of the users and nature of the intervention planned for the same: participation of the users and of their views in the assessment, instruction and training provided re the ATs, correct provision and installation process, length of the ATs delivery period and follow-up service.

The definition of 'non-use' in ATs entails a complex interconnection of several elements that go beyond the mere usability and functionality of the device. As stressed in studies conducted by Federici and Borsci [33] with healthcare professionals and end users, the user experience of an assistive solution is affected not only by the quality of the interaction between the user and the solution itself but also by the perceived quality of the professional service provided. The interplay between personal related factors and factors related to the user's environment are explored in a comparative study [34] between young and older users demonstrating that while products for children may imbue a higher level of enjoyment, devices for older adults are perceived exclusively in relation to function, e.g. they predominantly convey the physical support they provide to a person with health decline.
The finding of this study suggest the need for a double design intervention: 1) a functional customisation by means of a personalisation that allow product changes for multiple purposes and functions to reflect the complex disability of the users and its evolution; and 2) an effort to include technical and futuristic features in ATs so as to empower the users and excite them about the deployment of technology for smart ATs, in line with technologically advanced mainstream products, that were more likely accepted with enthusiasm by the study participants. In a further study, Shinohara and Wobbrock [28] conducted an interview with 20 people with disabilities to understand the use of ATs in social and professional contexts. They found two common perceived misperceptions when using ATs in a social context:

1. the ATs functionally eliminate a disability;
2. people who normally use ATs, are helpless without them.

An example described in the study is that of two participants with visual impairments who used the iPhone, a mainstream technology, due to its accessibility features. As ATs appear different from mainstream products, a common misperception would be that the two people involved would be unable to use mainstream technologies without help. Therefore, design interventions should also be aimed at providing support in the form of ATs that are indistinguishable by mainstream products to alleviate the common misperception that disabilities dominate and control those who are affected by them.

3. ATs design for mobility impairments among older people

According to the statistics released by the UK Office for Disability Issues, the prevalence of disability rises with age. Around 6% of children are disabled, compared to 16% of working age adults and 45% of adults over State Pension age [35]. The scale of age-associated disability can vary in the future depending upon the health status of the older people. However, the current indicators point towards an increase in the number of impaired mobility issues due to old age [36].

In extreme cases of mobility impairments, the ATs prescribed resemble medical technology devices even more [37]. Hence what mainly characterises the approach to their design, is a problem-solving oriented process [38]. In such problem-solving approach patients feel that AT products are designed “for them and not with them” [39].

Similarly, due to the lack of participation in professional assessment and prescription of ATs, patients are also deprived of the chance to choose an AT device, which may be purchased or prescribed for them by a third party [4]. Increasingly, efforts have been made to adapt, standard design techniques like Inclusive Design (ID) and co-design for ATs, to encourage end-user evaluation of prototypes [40] and to improve the design process itself [41]. The design of ATs in such cases may be seen as extremely challenging due to the abilities of the users, the involvement of multiple stakeholders and input of cross-disciplinary expertise [42].

People with severe mobility impairments are prescribed Environmental Control (EC) devices. An EC device allows the patients to control sev-

eral peripheral devices, for example, TV, lights, radio, telephone etc. [43]. These devices may help to provide some independence, to decrease social isolation, and finally to open up venues for education and employment. However, there is little research in support of the effectiveness of EC devices [44].

EC devices can operate through numerous methods for control and input. The most widely used method of input is a simple switch-based (single click) control device. Customised input options for patients have emerged recently, according to the type and severity of their mobility impairment. However, as the severity of the impairment increases, the chances of operating these devices gracefully continues to decrease.

The availability of off-the-shelf, voice-controlled technology has influenced patients' requests and aspirations. The ease of use of speech recognition has led to its inclusion into many types of EC integrated systems [45-47] which mobility impaired users seem to prefer [48] due to its speed and relatively effortless interaction [49].

However, the voice-controlled technology embedded in EC devices are not very reliable and limited to a set of commands [50]. On the other hand, speech recognition technology used nowadays in Interactive Smart Agents (ISA) like Amazon Echo, Google Home etc., have the ability to understand natural language. These ISA devices also offer comparable functionalities in terms of controlling smart devices around the home, potentially contributing more significantly to the independence and dignity of disabled patients. Whilst supporting patients in controlling their surroundings more effectively, voice control devices are also beneficial as they afford interactions that are more natural and socially and emotionally acceptable [51].

4. Co-design approaches for ATs: designing with older adults

Designers have a social responsibility to design products and services for the common good. Design should, therefore, promote healthy behaviours and enhance the wellbeing of everyone, including older adults. However, there is a significant disparity in cases of design to improve life, health and wellbeing products and who it is actually benefiting from them [52-53]. Older adults form a minority when it comes to new product development.

Part of the problem lies in the traditional user-centred methodologies employed for designing assisted technologies. Although such approaches are effective in developing empathy for mainstream adult users [54], they fall short when it comes to older adults. This is because it is not always clear at the time of design, to know what constitutes actual needs for the intended older adult users, and how ATs may affect these. This knowledge may be difficult to gather because design typically concerns products or services that do not yet exist [55]. This is where co-design can have a real impact, by designing "with" as opposed to designing "for" people. Therefore, one approach that has been proposed to design more effective technology for older adults is to include them in the design process from the requirement stage throughout the development phase [56].

As co-design [57] enables a wide range of people, including older adults, to make a creative contribution in the solution but critically also in the formulation of a problem (a task predominantly led previously by designers), it creates new opportunities for using materiality for eliciting aspirations. A key element of co-design is that users are seen as 'domain experts' of their own needs and experiences [58] providing ways for people to engage with each other as well as providing ways to communicate, be creative, share insights and test out new ideas [59]. Therefore, through this, we can gain a better understanding of the everyday relationship of older users with existing technologies but also material objects in their homes as well as other aspects of social life. Within the context of ATs, co-design enables going *beyond 'obvious health technologies' to explore more mundane aspects of materiality, such as the built environment* [60], which form key aspects within the sociology of health.

Involving older adults in co-design comes with challenges, these normally are: general decline in sensory perception, cognitive difficulties, mobility needs, fatigue, and lack of technical knowledge [61]. However, several visual aid tools and storytelling techniques have been developed to help engage older adults in the co-design process [62-63]. Nevertheless, the design of products for older consumers tends to focus on specific chronic health conditions, such as for stroke survivors [64-65] people living with dementia [66-67] and other health-related conditions [68-69], rather than the mainstream older adult market.

However, co-design-based research conducted with older consumers across different health and ATs reveals several benefits. More precise-

ly, these benefits are related to improving the creative process, the service or product, project management, and longer-term effects [70], whilst also impacting significantly on the design of assistive technology devices, to make them more fit for purpose [71]. The experience of the 'Ageing Together' project also shows that co-design can succeed in introducing helpful technology into the lives of older adults [72].
Furthermore, the work of De Couvreur et al. [73] shows how the process of collaborative co-designing, making and using artifacts fosters several elements of subject well-being in itself. Besides engaging in a productive approach that empowers older people in the process of co-designing and evaluating technologies for themselves, the findings from Leong and Johnston [74] reveal that co-design is capable of enhancing older adults' independence, social agency and well-being.
In the current UK and European political climate, as the government passes more control to communities and individuals, co-design might have a significant role to play in the transformation of public services [75]. This represents an opportunity for the wider adoption of co-design and co-production approaches to develop ATs for growing ageing communities.

5. ATs as objects: materiality, emotions and everyday life

Narratives of medicine, decline, and functionality around ATs remain predominant, with minimal changes towards narratives of consumerism, flexibility, and style. Borgerson [76] has argued the significance of the relationship between social and self-identity and material objects in consumption - and how a focus on materiality may enhance our knowledge and understanding of consumer relationships, processes and practices. Objects are symbols of consumption and are significant to how people develop, portray and enhance our narratives of self as part of constructing our identities and lifestyles. In this context, objects such as ATs become extensions of the embodied self – and co-constitute our sense of identity. Material objects are therefore central to our social identities, for example, in relation to gender, age, ethnicity and social class [77] and presentation of our embodied self in everyday life. It is therefore notable that there are limited choices and styles associated with many ATs. The negative connotations around a sense of stigma, dependence and decline can moreover limit the opportunities for self-

expression. ATs are rarely viewed as objects of desire and the people who use them as consumers. This is where the design for flexibility and consumption in ATs can challenge and change the milieu and opportunities for self-expression in people's everyday lives. A focus on material culture may, therefore, open up the possibilities of enhancing a shift in narratives and language around assistive technologies that may result in improvements in their adoption and effective use, as well as the emotional connection to ATs.

There has been increasing recognition of the significance of material culture in health and social care [60]. This can include objects that are central to our mundane and habitual everyday lives and are thereby taken for granted and unnoticed as the objects are embodied and embedded in our tacit and daily routines, this may include, for example, bowls, glasses and clothing [60] [78]. For Miller, '[O]bjects are important because they are evident, and they physically constrain or enable, but often because we do not 'see' them' [79:5]. ATs are objects – either very small (glasses and hearing aids) or larger in size (walking sticks, wheelchairs) – that become central to people's daily routines, the everyday care of the body, and may be experienced as mundane, taken for granted and invisible. Alternatively, assistive technologies can feel ever present, imposing and highly visible to personal and social worlds.

For Buse et al. [60], 'materialities of care' can be a means to make visible mundane, frequently unnoticed aspects of material culture within health and social care contexts. In particular, Buse et al [60] identify three distinct but interconnected analytical ways in which material culture can be explored: namely, *spatialities of care*, *temporalities of care* and *practices of care*. With *spatialities of care,* the researchers refer to the way in which space influences the possible embodied actions, social interactions and care practices that ATs can enable. The ways ATs are used in different spaces from the hospital, home and public areas in this context would be significant. Second, time is central to care, and the *temporalities of care* highlight the multiple and intersections of time and routines associated with care, from transitory moments to everyday routines, and institutional regimes of care. People who use ATs have usually been assessed as needing an aid and do therefore have journeys and transitions with their objects across and within time. Third, *care*

practices highlight the dynamic relations between objects, meanings and the body in which practices are attuned to tactile and 'sensory ways of knowing' [60: 249]. Material objects therefore have an active role in the ways health and social care interactions are created and in the ordering of care relationships, in which the AT as an object can be central to regulating bodies in health and social care through the predominance of assessments of mobility and safety, the monitoring of everyday activities of life, and underlie discourses of discharge, safety and risk assessments of the user. In this context, the materiality of ATs may shape and facilitate caring relationships, relationships that often denote hierarchical structure and power, in which, for example, the current very limited options of design of ATs in health care systems constrain and limit practices of care, and result in fewer choices and self-expression for the user. However, through the process of 'material imagining' [80] in which more personalised and flexible ATs as objects can be reimagined and designed, novel and reimagined 'possibilities for care' and care relationships can also be opened up (cf. Buse and Twigg [81]). Materialities of ATs, therefore, focus the attention on relationships within the care journey as well as on interconnections between bodies, objects and spaces.

Everyday practices can reveal the ways in which bodies, materials and identities are constituted, and how the use for ATs may disrupt everyday routines that then need to be reformed in new contexts. A focus on the materiality of ATs as everyday objects provides an original lens to look at the interplay between body, object and the self, which renegotiate their respective roles in order to adjust to the introduction of ATs [82]. As objects in everyday life, ATs are therefore imbued with sociocultural and emotional meanings and are invested with of social and emotional significance. There is a wide range of emotions associated with objects that Ahmed [82] explores, including pleasure, pain, shame, fear and hate. ATs are permeated with emotions which enhance or limit the way the objects are seen, experienced and utilised in everyday life. For example, emotions and meanings associated with ATs can range from desire to disgust, independence to stigma, and feelings of shame to enhanced well-being [83-84]. The emotions connected to the ATs can not only influence the persons' sense of identity, their relationships with the materiality of the objects, but also the extent to which they are responsible for emotions that hinder or enable the users' presence and participation in public and private spaces. The meanings

around ATs as objects are continually performed, negotiated and, at times, resisted. ATs therefore not only highlight the significance of the aesthetics of care but how the use of ATs as objects in everyday life is lived and felt [78].

A methodology in which the materiality of ATs as objects is used as ways to elicit data can also be a means to understand more about the ATs in everyday life. A focus on materiality may be a novel lens through which the doing of health and social care practices and relationships can be re-examined with a focus on the way objects may shape health and social care encounters and moments [60]. In this context, novel and reimagined designs of ATs may result in a move away from a predominant focus on function in care practices that surround older people, to more personalised pathways of approaching care relationships that can facilitate a more sensate and flexible approach by 'caring through things' [85]. A material approach can moreover make visible the unseen, the mundane and the taken for granted nature of ATs in health and social care, making it more feasible to tease out attributes, values and design language elements that may scaffold very different interactions with ATs as companions and objects of desire. The desire to facilitate the user to have more power and control in the design, choice and consumption of ATs has, therefore, the potential to reconfigure care relationships, care journeys and imaginaries of need.

6. Culture as an interpretative framework for the use of ATs

The ageing phenomenon is global and cuts across cultural frameworks. However different cultures have experienced this ageing transformation at varied speed. Researchers globally believe that at least a partial solution to this societal issue resides in technology, its design and application [86]. However cultural frameworks are likely to impact how technological products are perceived and consequently used. The term 'culture' is all-encompassing and has found definitions based on discipline-based research [87-88-89-90-91-92]. Its meaning shifts from time to time, though in the current literature there is an agreement in considering culture as the body of social programs, economic systems, political ideologies, and technological systems [93]. Culture also tends to be defined within descriptive and symbolic contexts; in the former, culture

is viewed as race or ethnicity where a group of people share the same beliefs, ideas, values and artifacts; in the latter, culture refers to the meanings and experiences represented in members' actions and behaviours [94]. Culture is dynamic, and it enables its members to evolve and adapt in the same ecosystem they contribute to shaping [95]. Various cultural groups reflect their attitudinal, spiritual and emotional explanations of health behaviours in very different ways, and this reflects the role that culture plays in the mental and physical health of human beings. Kagawa-Singer et al [96] propose a cultural framework for health, which integrates culture into health research. Burke et al [97] also stress how the impact of culture in health research affects the language, meanings and interpretation of terminology used in relation to health and social care.

The trend of product design has evolved from one-size fits all to personalization that fits diverse consumers' needs and aspirations. The Usability and functionality of a product used to be key factors when people chose to buy an item, but they are now the basic attributes that consumers are looking for. Gradually, as the needs for usability and functions of a product have been fulfilled, consumers have started to pay more attention to the aesthetic value and the meaning that products can bring to their lifestyle.

In modern society, a product is considered an extension of the owner, representing the owner's personal or social identity [98-99-100]. Whilst the appearance of products may express the owner/user personal identity [101], the complex meaning of products has been recognised almost a century ago and defined in the space populated by the users, the socio-cultural groups, the availability of other products and the changing nature of the interplay between these parts over time [102].

The importance of cultural sensitivity in interpreting the space in which the meaning of product is identified and evolves has been highlighted by Wang [103] and in practical terms, such understanding of the cultural framework that surrounds products has been found to increase sales and reach out to larger market shares [104-105]. As for any other products' category, it is reasonable to assume that culture would inform the way people belonging to such culture would interpret and use ATs; specifically, how a culture perceive disability and ageing would pervade how people would relate to those ATs that become the embodiment of either disability and fragility or empowerment and self-determination. When studying a set of ATs with participants from dif-

ferent cultural settings [84], feedback demonstrated some interesting differences, especially concerning the appreciation of technological intervention, imbued with divergent cultural connotations across countries. For example, while an electric scooter is associated with decline and laziness in the UK study, a sense of empowerment and independence was attributed to the same device by Taiwanese participants.

The most popular ATs purchased in Taiwan in 2017 from a major online catalogue where ATs for basic individual needs: walking frames, wheelchairs and bath chairs [106]. Digital ATs, able to detect and monitor the geographical location and physical exercise are also becoming more popular and this trend follows the increase of smartphone in the young-old population [107]. This is generally contributing to a wider acceptance of ATs [108] and in a study we conducted it was clear that, even within a culture of homogenisation such as that of Asia, older adults felt relatively comfortable to make use of ATs that would set them apart. We found that Asian participants were more conforming to social etiquette and acceptance and whilst they identified ATs as tools for living, they yet wished to somehow comply with what their peers would consider normalized appearance. For example, we discovered that ATs in proximity to the face were considered stigmatizing more than other ATs as the face is the most observed and noticed part of the human body during social interaction. Boldness, on the other hand, was considered an important attribute in ATs' design by the English participants who had accepted the gradual physical fragility that the ageing process may cause [83-84].

The enablement of core values such as personal freedom, independence and feeling in control caused users to emotionally invest in their ATs and to consider them as precious possessions. By elevating ATs to *enabling objects*, ATs participate in redefining the meaning of the assistance they provide. It is this gradual shift in adoption, emotional investment and cultural definition that may enable designers, manufacturers and health professionals to reconsider the participation of users in the creation and prescription of novel and appropriate ATs.

7. Reflections on the design of ATs

Humans are the intricate stratification of needs, aspirations, expectations and values. Our identity is also construed by the physical ability

and appearance that our bodies enable. In considering the complex interplay between social, physical, emotional and economic factors that determine the circumstances of our lives we often neglect to consider how much of our outlook is manifested in the products and experiences we chose to own, and we decide to take part in. The freedom to select and use what we like and can afford is not often an option for individuals who are ageing or with a disability. Their world includes devices that they must use if they wish to retain some independence, mobility and dignity. However, the limited choice of ATs available to them creates a vicious cycle where reduced choice leads to either abandonment of the prescribed devices, or to resignation to use what is perceived as fundamentally hostile because it lacks thoughtfulness and has no merit or place in enabling lives.

Why the ATs market is still so behind in an era where equality and inclusion are at the forefront of the media debate is rather puzzling, especially when we have developed design approaches, manufacturing processing and culturally sensitive tools that could allow a courageous reconsideration of the bland language of AT's design. Costs are often offered as the excuse that jeopardises and limits innovation in this domain. However, the invisible costs of falls, lack of social participation, spiralling comorbidity and isolation are very tangible, albeit felt at individual rather than at the systemic economic level.

In this chapter, we have discussed co-design as a valid and practical design process to engage in the meaningful understanding of the users and their needs as they are experts. We have also looked at how cultures can frame differently the role of technology and technology inspired devices for the ageing population and we have also discussed materiality as an approach that can enhance our consideration of ATs as objects playing a normal, albeit very specialised, role in the life of their users. The three trends described are tools to imagine how the ATs market could accelerate and diversify and could provide emotionally and socially invested artefacts having impact that goes beyond the mere functional supports we have considered them to offer thus far.

References

1. Escalas J, White K, Argo J J, Sengupta J, Townsend C, Sood S, Van Boven L (2013) Self-identity and consumer behavior. Journal of Consumer Research 39(5): xv-xviii

2. Assistive technology (2018, May 18) Retrieved March 17, 2019, from https://www.who.int/en/news-room/fact-sheets/detail/assistive-technology
3. Consumer Focus (2010) Equipment for older and disabled people: an analysis of the market. London: Consumer Focus
4. Newell A (2003) Inclusive design or assistive technology. In Inclusive Design (pp. 172-181). Springer, London
5. British Standards Institute (2005) 7000-6: 2005 Design management systems-Managing inclusive design-Guide. London: Author
6. Dong H (2013) Global Perspectives and Reflections. Trends in Universal Design 38
7. Clarkson P J, Coleman R (2015) History of Inclusive Design in the UK. Applied ergonomics 46: 235-247
8. Hocking C (1999) Function or feelings: factors in abandonment of assistive devices. Technology and Disability 11(1, 2): 3-11
9. Verganti R (2009) Design driven innovation: changing the rules of competition by radically innovating what things mean. Harvard Business Press
10. Giacomin J (2014) What is human centred design?. The Design Journal 17(4): 606-623
11. Brown T, & Katz B (2011) Change by design. Journal of product innovation management 28(3): 381-383
12. Hassenzahl M, Diefenbach S, Göritz A (2010) Needs, affect, and interactive products–Facets of user experience. Interacting with computers 22(5): 353-362
13. Pullman M E, Gross M A (2004) Ability of experience design elements to elicit emotions and loyalty behaviors. Decision sciences 35(3): 551-578
14. Hekkert P, Mostert M, Stompff G (2003, June) Dancing with a machine: a case of experience-driven design. In Proceedings of the 2003 international conference on Designing pleasurable products and interfaces (pp. 114-119). ACM
15. Norman D A (2004) Emotional design: Why we love (or hate) everyday things. Basic Civitas Books
16. Phillips B, Zhao H (1993) Predictors of assistive technology abandonment. Assistive technology 5(1): 36-45
17. Dawe M (2006, April) Desperately seeking simplicity: how young adults with cognitive disabilities and their families adopt assistive technologies. In Proceedings of the SIGCHI conference on Human Factors in computing systems (pp. 1143-1152). ACM
18. Kintsch A, DePaula R (2002) A framework for the adoption of assistive technology. SWAAAC 2002: Supporting learning through assistive technology, 1-10
19. Lebbon C, Boess S (1998) Wellbathing-attitudes and well-being of older consumers in relation to bathing. In 3rd International TIDE Conference Quality of Life for the European Citizen, Helsinki, Finland
20. Luborsky M R (1993) Sociocultural factors shaping technology usage: Fulfilling the promise. Technology and Disability 2(1): 71
21. Polgar J M (2002) Using technology to enable occupation. Retrieved March, 12, 2003
22. Parette P, Scherer M (2004) Assistive technology use and stigma. Education and Training in Developmental Disabilities 217-226
23. Barnard Y, Bradley M D, Hodgson F, Lloyd A D (2013) Learning to use new technologies by older adults: Perceived difficulties, experimentation behaviour and usability. Computers in Human Behavior 29(4): 1715-1724
24. Epstein S (1994) Integration of the cognitive and the psychodynamic unconscious. American psychologist 49(8): 709
25. Reyna V F (2004) How people make decisions that involve risk: A dual-processes approach. Current directions in psychological science 13(2): 60-66

26. Bright A K, Coventry L (2013, May) Assistive technology for older adults: psychological and socio-emotional design requirements. In Proceedings of the 6th International Conference on Pervasive Technologies Related to Assistive Environments (p. 9). ACM
27. Shinohara K, Tenenberg J (2009) A blind person's interactions with technology. Communications of the ACM 52(8): 58-66
28. Shinohara K, Wobbrock J O (2011, May) In the shadow of misperception: assistive technology use and social interactions. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 705-714). ACM
29. Pape T L B, Kim J, Weiner B (2002) The shaping of individual meanings assigned to assistive technology: a review of personal factors. Disability and rehabilitation 24(1-3): 5-20
30. Elliott G C, Ziegler H L, Altman B M, Scott D R (1982) Understanding stigma: Dimensions of deviance and coping. Deviant behavior 3(3): 275-300
31. Kraskowsky L H, Finlayson M (2001) Factors affecting older adults' use of adaptive equipment: review of the literature. The American Journal of Occupational Therapy 55(3): 303-310
32. Wessels R, Dijcks B, Soede M, Gelderblom G J, De Witte L (2003) Non-use of provided assistive technology devices, a literature overview. Technology and disability 15(4): 231-238
33. Federici S, Borsci S (2016) Providing assistive technology in Italy: the perceived delivery process quality as affecting abandonment. Disability and Rehabilitation: Assistive Technology 11(1): 22-31
34. Spinelli G, Massimo M, Martin W (2018) Objects of Desire and of Disgust: Analysis and Design of Assistive Technologies. Design4Health2018, Sheffield 4-6 September 2018
35. Department of Work and Pensions. Office for Disability Issues. Official Statistics. Disability facts and figures (2014) https://www.gov.uk/government/publications/disability-facts-and-figures/disability-facts-and-figures.
36. Metz D H (2000) Mobility of older people and their quality of life. Transport policy 7(2): 149-152.
37. Cook A M, Hussey S (2001) Assistive technologies: Principles and practice
38. Pullin G (2009) Design meets disability. MIT press
39. Ravneberg B (2012) Usability and abandonment of assistive technology. Journal of Assistive Technologies 6(4): 259-269
40. Herriott R, Cook S (2014, May) Inclusive Design for Assistive Technology. In Universal Design 2014: Three Days of Creativity and Diversity: Proceedings of the International Conference on Universal Design, UD 2014 Lund, Sweden, June 16-18, 2014 (Vol. 35, p. 175). IOS Press
41. Williamson T, Kenney L, Barker AT, Cooper G, Good T, Healey J, Heller B, Howard D, Matthews M, Prenton S, Ryan J, Smith C (2015) Enhancing public involvement in assistive technology design research. Disability and Rehabilitation: Assistive Technology 10(3): 258-265
42. Blanco T, Berbegal A, Blasco R, Casas R (2016) Xassess: crossdisciplinary framework in user-centred design of assistive products. Journal of Engineering Design 27(9): 636-664
43. Dickey R, Shealey S H (1987) Using technology to control the environment. The American Journal of Occupational Therapy 41(11): 717-721
44. Craig A, Tran Y, McIsaac P, Boord P (2005) The efficacy and benefits of environmental control systems for the severely disabled. Medical Science Monitor 11(1): RA32-RA39
45. Noyes J M, Haigh R, Starr A F (1989) Automatic speech recognition for disabled people. Applied Ergonomics 20(4): 293-298

46. Jiang H, Han Z, Scucces P, Robidoux S, Sun Y (2000) Voice-activated environmental control system for persons with disabilities. In Proceedings of the IEEE 26th Annual Northeast Bioengineering Conference (Cat. No. 00CH37114) (pp. 167-168). IEEE
47. Aguilera F, Ataeefar A, Brothers R, Castellano M, Ginart A, Grangeia G, Noel Y (1992, October) A personal computer based environmental control system for the disabled. In 1992 14th Annual International Conference of the IEEE Engineering in Medicine and Biology Society 4: 1533-1534 IEEE
48. Geggie C (2003) Voice control of environmental control systems. ACNR 3(4)
49. Hawley M S (2002) Speech recognition as an input to electronic assistive technology. British Journal of Occupational Therapy 65(1): 15-20
50. Judge S, Robertson Z, Hawley M, Enderby P (2009) Speech-driven environmental control systems–a qualitative analysis of users' perceptions. Disability and Rehabilitation: Assistive Technology 4(3): 151-157
51. Greenhalgh T, Wherton J, Sugarhood P, Hinder S, Procter R, Stones R (2013) What matters to older people with assisted living needs? A phenomenological analysis of the use and non-use of telehealth and telecare. Social science & medicine 93: 86-94.
52. Polak, P (2007) Design for the other ninety percent, in Kim, C.R. (ed.). Design for the Other Ninety Percent (pp 19–25). New York: Cooper-Hewitt.
53. Chamberlain, P.,Wolstenholme, D., Dexter, M. and Seals, E (2015) The State of the Art of Design in Health: An Expert-Led Review of the Extant of the Art of Design Theory and Practice in Health and Social Care. Sheffield: Sheffield Hallam University.
54. Kouprie, M., & Visser, F. S. (2009) A framework for empathy in design: stepping into and out of the user's life. Journal of Engineering Design 20(5):437-448.
55. Van de Poel, I. (2012) Can we design for well-being? In P. Brey, A. Briggle, & E. Spence (Eds.), The good life in a technological age (pp. 295–306). New York: Routledge.
56. Spinelli, G., Micocci, M., & Ajovalasit, M. (2017) Behavioural strategies of older adults in the adoption of new technology-based products: the effects of ageing and the promising application of smart materials for the design of future products. In Tsekleves, E., & Cooper, R. (Eds.). Design for Health. Design for Social Responsibility Series (pp 358-374). Taylor & Francis.
57. Sanders, E. B. N., & Stappers, P. J. (2008) Co-creation and the new landscapes of design. Co-design, 4(1): 5-18.
58. Visser, F. S., Stappers, P. J., Van der Lugt, R., & Sanders, E. B. (2005) Contextmapping: experiences from practice. CoDesign, 1(2): 119-149.
59. White, S., & Pettit, J. (2007) Participatory approaches and the measurement of human well-being. In Human Well-Being (pp. 240-267). UK: Palgrave Macmillan.
60. Buse, C., Martin, D. and Nettleon, S. (2018) Conceptualising 'materialities of care: making visible mundane material culture in health and social care contexts' Sociology of Health & Illness. 40(2): 243–255.
61. Lindsay, S., Jackson, D., Schofield, G., & Olivier, P. (2012) Engaging older people using participatory design. In Proceedings of the SIGCHI conference on human factors in computing systems (pp. 1199-1208). New York: ACM.
62. Xie, B., Druin, A., Fails, J., Massey, S., Golub, E., Franckel, S., & Schneider, K. (2012) Connecting generations: developing co-design methods for older adults and children. Behaviour & Information Technology 31(4): 413-423.
63. Davidson, J. L., & Jensen, C. (2013) Participatory design with older adults: an analysis of creativity in the design of mobile healthcare applications. In Proceedings of the 9th ACM Conference on Creativity & Cognition (pp. 114-123). ACM.

64. Mawson, S., Nasr, N., Parker, J., Davies, R. and Mountain, G. (2013) Developing a personalised self- management system for post stroke rehabilitation: Utilising a user-centred design methodology. Disability and Rehabilitation. Assistive Technology 9(6): 521–528.
65. Nasr, N., Leon, B., Mountain, G., Nijenhuis, S. M., Prange, G., Sale, P., & Amirabdollahian, F. (2016) The experience of living with stroke and using technology: opportunities to engage and co-design with end users. Disability and rehabilitation: assistive technology 11(8): 653-660.
66. Craven, M. P., De Filippis, M. L., & Dening, T. (2014). Quality of life tools to inform co-design in the development of assistive technologies for people with dementia and their carers. In International Workshop on Ambient Assisted Living (pp. 394-397). Springer.
67. Hwang, A. S., Truong, K. N., Cameron, J. I., Lindqvist, E., Nygård, L., & Mihailidis, A. (2015). Co-designing ambient assisted living (AAL) environments: unravelling the situated context of informal dementia care. BioMed research international, 2015. Volume 2015, Article ID 720483, 12 pages.
68. Craig, C., Gwilt, I., Langley, J. and Partridge, R. (2013) Thinking through design and rehabilitation, in Encarnacao,P.et al.(eds), AssistiveTechnology: From Research to Practice (pp 798-803). Amsterdam: IOS Press.
69. Reed, H., Langley, J., Stanton, A., Heron, N., Clarke, Z., Judge, S.& Tindale, W. (2015) Head-Up; An interdisciplinary, participatory and co-design process informing the development of a novel head and neck support for people living with progressive neck muscle weakness. Journal of medical engineering & technology 39(7): 404-410.
70. Steen, M., Manschot, M., & De Koning, N. (2011) Benefits of co-design in service design projects. International Journal of Design 5(2): 53-60.
71. Williams, R. (1988) A vocabulary of culture and society. London: Fontana.
72. Botero, A., & Hyysalo, S. (2013) Ageing together: Steps towards evolutionary co-design in everyday practices. CoDesign 9(1) 37-54.
73. De Couvreur, L., Dejonghe, W., Detand, J., & Goossens, R. (2013). The role of subjective well-being in co-designing open-design assistive devices. International Journal of Design 7(3): 57-70.
74. Leong, T. W., & Johnston, B. (2016) Co-design and robots: a case study of a robot dog for aging people. In International Conference on Social Robotics (pp. 702-711). Cham: Springer.
75. Szebeko, D., & Tan, L. (2010) Co-designing for Society. Australasian Medical Journal, 3(9).
76. Borgerson, J. (2005) Materiality, Agency, and the Constitution of Consuming Subjects: Insights for Consumer Research Advances in Consumer Research 32: 439-443
77. Hamlett, J. and Hoskins, L. (2013) Comfort in small things? Clothing, control and agency in county luna-tic asylums in nineteenth- and early twentieth-century England. Journal of Victorian Culture. 18(1): 93–114.
78. Latimer, J. (2018) Afterword: materialities, care, 'ordinary affects', power and politics in Buse, C., Martin,D. and Nettleton,S. (editors) Materialties of Care. Encountering Health and Illness Through Artefacts and Architecture (pp. 136-147). Oxford: Wiley Blackwell.
79. Miller, D. (ed) (2005) Materiality. Durham: Duke University Press.
80. Woodward, S. (2015) Objects, interviews, material imaginings and 'unsettling' methods: interdisciplinary approaches to understanding materials and material culture, Qualitative Research. 16(4): 359-74.
81. Buse, C. and Twigg, J. (2018) Dressing disrupted: negotiating care through materiality of dress in the context of dementia. in Buse, C., Martin,D. and Nettleton,S. (editors) Materi-

alties of Care. Encountering Health and Illness Through Artefacts and Architecture (pp. 97-109). Oxford: Wiley Blackwell.
82. Ahmed, S. (2014) The Cultural Politics of Emotion. Second Edition. Edinburgh: Edinburgh University Press.
83. Spinelli G. Micocci M. and Martin W. 2018a. Objects of desire and of disgust: Analysis and Design of Assistive Technologies. Design4Health2018, Sheffield 4-6 September 2018.
84. Spinelli G., Micocci M. and Martin W. 2018b. Objects of Desire, Objects of Disgust. British Society of Gerontology 47th Annual Conference - Ageing in an Unequal World: Shaping Environments for the 21st Century. 4-6 July 2018, Manchester, UK.
85. Puig de la Bellascasa, M. (2011) Matters of care in technoscience: assembling neglected things. Social Studies of Science. 41(1): 85-106.
86. Mynatt, E., Melenhorst, A.-S., Fisk, A.D, Rogers, W.A. (2004) Aware technologies for aging in place: understanding user needs and attitudes. Pervasive Computing. 3 (2).
87. Throsby, D. 2001. Economics and Culture. Cambridge: Cambridge University Press.
88. Storey, J. (2001) Cultural theory and popular culture. Third editionn. England: Pearson Education Limited.
89. Eagleton, T. (2000). The idea of culture. Oxford: Blackwell.
90. Gay, P.D., Hall, S., Janes, L., Mackay, H. and Negus, K. (1997) Doing Cultural Studies: The Story of the Sony Walkman. London: Sage.
91. Williams, R. (1988) A vocabulary of culture and society. London: Fontana.
92. Kroeber, A.L. and Kluckhohn, C. (1952) Culture : A Critical Review of Concepts and Definitions. U.S.A.: Museum of Cambridge Massachusetts.
93. Statistics Canada. 2011. Conceptual Framework for Culture Statistics 2011. Statistics Canada. Retrieved from https://www150.statcan.gc.ca/n1/en/pub/87-542-x/87-542-x2011001-eng.pdf?st=10sbfza5
94. Kasnitz, D.; Shuttleworth, R.P. (2001) Introduction: Anthropology in Disability Studies. Disability Studies 21(3): 2-17.
95. McElroy, A.; Townsend, P.K. (2009). Medical Anthropology in Ecological Perspective. 5th edn. Westview Press.
96. Kagawa-Singer, M.; Dressler, W.M., George, S.M.; Elwood, W.N. (2014) The cultural framework for health: An Integrative Approach for Research and Program Design and Evaluation. National Institutes of Health.
97. Burke, N.J., Villero, O., & Guerra, C. (2012) Passing through meanings of survivorship and support among Filipinas with breast cancer. Qualitative Health Research. 22(2): 189-198.
98. Hocking, C. (1999) Function or feelings: factors in abandonment of assistive devices. Technology and Disability. 11(1, 2): 3-11.
99. Belk, R. W. (1988) Possessions and the extended self. Journal of consumer research. 15(2): 139-168.
100. Holt, D.B. (2004) How Brands Become Icons: The Principles of Cultural Branding. Cambridge. MA: Harvard Business School.
101. Krippendorff, K. (1989) On the essential contexts of artifacts on the proposition that "design is making sense (of things)". Design Issues 5(2): 9-39.
102. Dewey, J. 1934. Art as experience. New York: Capricorn books.
103. Wang, Y. 2016. Chinese cultural features for new product design development. PhD Thesis. Brunel University London. Retrieved from https://ethos.bl.uk/OrderDetails.do?did=1&uin=uk.bl.ethos.681203.

104. Marcus, A., Aykin, N.M., Chavan, A.L., Prabhu, G.V., Kurosu, M. (1999). SIG on one size fits all? Cultural diversity in user interface design. In: CHI Extended Abstracts, pp. 342.
105. Sparke, P. (2004) An Introduction to Design and Culture: 1900 to the Present. 2nd edn. Oxon: Routledge.
106. Appledaily (2017) Sales of aging products increased by 1.5 times. ApplyDaily News. Retrieved from https://tw.lifestyle.appledaily.com/daily/20170618/37686865/
107. FIND team. (2017) A Report of Senior Citizens' Shopping Behaviour in Taiwan. Institute for Information Industry. Available at https://www.iii.org.tw/Press/NewsDtl.aspx?nsp_sqno=1917&fm_sqno=14
108. Lin, L. (2017) A Study on Intention of Adopting Living Aids for Aged People. (Master dissertation). Available from National Digital Library of Theses and Dissertations in Taiwan.