



Assistive Technology and Emotions of Older People – Adopting a Positive and Integrated Design Approach

Ke Chen^(✉)

School of Design, Hunan University, Changsha, China
kechen@hnu.edu.cn

Abstract. With ageing, older people's need for assistive technology is increasing. Older people's emotional responses towards assistive technology is not fully understood. The present study is aiming to understand older Hong Kong people's emotions elicited by using assistive technology. A qualitative research method was adopted in the current study. Face-to-face interviews and focused groups were conducted with 50 community-dwelling older adults in Elderly Services Centers in Hong Kong. Results indicate that the assistive technology experienced by older people include mobile phones, walking aids, hearing aids, emergency alarm services and computers. Older people have both positive and negative emotional responses in regards to assistive technology. Assistive technology has the potential to provide safety and secure and reduce risks for older people. However, it may also elicit negative emotions such as anxiety, frustrating, prejudice and discrimination. To increase an optimal user experience, we need to pay more attention to older users' emotional and psychological needs besides usability, and to adopt a positive and integrated design approach during assistive technology development. Several design suggestions were provided based on the results.

Keywords: Assistive technology · Ageing · Stigma · Emotional design

1 Introduction

Population ageing is prevalent and impacting every aspect of life. Ageing is associated with increase in non-communicable diseases and functional impairment in hearing and vision perception, mobility and cognitive abilities. Assistive Technology (AT) could be used to partially compensate for functional declines and improve independence of older people. For instance, mobility aids such as walking stick, wheelchair, and handrails could enhance mobility of older people with movement difficulty [1]. E-home monitoring system could detect emergency situations at home, thus increased safety and independent living [2, 3]. Older people with hearing defect may gain benefits from hearing aids [4].

Successful implementation of this technology into older people's daily lives is depending on their acceptance and continued usage. However, assistive technology might elicit negative feelings or emotions, which may result in abandon the product. Older people

expressed the concern of feeling of stigmatization and perceived visibility or attention received when using contactless monitoring devices in public settings [2, 5]. They were unwilling to use ATs that would make them feel undignified and embarrassed, or signify the users as loss of function or frail [1, 5].

The human centered approach emphasizes understanding and satisfying the needs, requirements and capabilities of users. Current research and practice in development of AT is aiming primarily at usefulness and usability, i.e., effectiveness, efficiency and satisfaction, by adopting human factors engineering and ergonomics approach. Moreover, theories in understanding technology acceptance, such as Technology Acceptance Model [6], the Technology Acceptance Model 2 (TAM2) [7], and the Unified Theory of Acceptance and Use of Technology (UTAUT) [8] were mainly focused on the technique matters such as usefulness and ease of use. The desirability and emotional responses from users during the course from product acquisition to usage is overlooked [9, 10].

Usability might determine whether a product could be used while emotions determines whether people are willing to use. Product emotions result from appraise of the product and could be attributed to product function, aesthetics, and associated meanings [11]. The emotions elicited from product include surprise, amazement, disappointment, satisfaction, disgust, attracted to, indignation, admiration, boredom, and fascination, etc. Norman has classified the product emotions into three levels: the visceral level is relating to the appealing and physical features of the product; the behavioral level is relevant to interaction and usability with the product; and the reflective emotion is connected to social image, meaning, culture, and long-term user experience [12]. To increase the acceptance and usage rate as well as an optimal user experience, there is a definite need for AT designers to go beyond traditional focuses on usefulness and ease of use to further explore emotion, motivation and meaning associated with using assistive technology. The emotional and psychological responses that occur before, during and after assistive technology usage should be given more consideration.

The present paper intends to make a contribution to a better understanding older people's emotions elicited from using assistive technology in Hong Kong. Assistive technologies (AT) here refers to products, environments and/or services in order to maintain or enhance functional health, security, safety and quality of life. The results of the study could benefit AT designers and developers.

2 Methods

2.1 Research Design

A qualitative research method was adopted in the current study. Face-to-face interviews and focused groups were conducted with 50 community-dwelling older adults in Elderly Services Centers in Hong Kong. Focus groups were adopted to capture a broad and diverse range of individual attitudes and thoughts concerning assistive technology, and reasons for using or not using assistive technology, as well as barriers and facilitators influencing older people's acceptance of assistive technology. Individual interviews were based on the tentatively theoretical constructs identified by focus groups so as to

further explore personal usage experiences at a detail level. Invitation letters introducing the researcher as well as explaining the purpose of the study and the use of data were sent to local elderly centres which had participated in the phase I study. The centres were responsible for recruited members to participant in either individual interviews or focus group discussions. The sample size here was determined by theoretical saturation of data, which refers to the method where sampling continues until no new information or concepts are generated.

2.2 Participants

The mean age of participants were 67.47 years old, and 44 out of 50 of them were female. A number of 24 of the older adults participated in four focus groups, and 26 respondents participated in individual interviews. Most participants had obtained primary education and above (64%), lived with family members (84%), and were of middle economic status (86%). Many of them were married (38%); the rest reported marital status as widowed (32%) or divorced/separated (30%). Fifty percent of the participants self-reported fair health conditions; 44% reported their health conditions to be excellent or good; only 6% reported poor or very poor health conditions.

2.3 Procedure

An interview guide was used by the interviewer to ensure that all principal questions were addressed in focused group and individual interviews. The principle questions were “*What assistive technologies do you know or currently in use in your daily life?*”, “*What do you think of the idea of using assistive technology?*” “*What do you like and dislike about assistive technology?*”, “*What are the main reasons for using those technology?*”, “*What are the main reasons for not using assistive technology?*”, “*What are the difficulties/barriers when you are using assistive technology?*”.

The qualitative data were transcribed and coded using NVivo 10 software package. The frequently mentioned words or any meaningful units were marked and extracted, and then labeled with codes. Through constant comparison between transcripts, similar codes were combined into analytic concepts. Concepts were then grouped by similarity at a more abstract and theoretical level, whereby themes were finally identified.

3 Results

Thematic analysis was employed to generate insights into older people’s feelings and emotions elicit from actual or anticipated use of assistive technology. The assistive technologies mentioned by older adults include mobile phones, walking aids, blood pressure monitor and blood glucose monitor hearing aids, emergency alarm services and computers.

Two themes were extracted from the emotional responses of older people towards various kinds of assistive technology (shown in Table 1). The positive emotions refer

to perceived or experienced emotional benefits of using AT; while the negative emotions refer to the psychological and or social costs of using AT.

Table 1. Emotions associated with using assistive technology

Themes	Definition	Examples
Positive emotions		
Safety and security	The extent that technology is perceived to be safe and secure	<p><i>“Mobility aids can make me feel safe when I need to go out”</i></p> <p><i>“Digital locating devices are good for older people with dementia, because they won’t be lost when they walk out alone”</i></p>
Useful and helpful	The AT is useful and would provide assistance for people in need	<p><i>“I have diabetes and hypertension; thus, I use blood pressure monitor and blood glucose monitor every morning”</i></p> <p><i>“Mobile phone is so useful, because we can easily find our children if there is any emergency”</i></p>
Negative emotions		
Anxiety	An individual’s apprehension when he or she is faced with the possibility of using AT	<p><i>“I feel apprehensive about using electronic things”</i></p> <p><i>“My mom did not want to use a mobile phone because she does not know how to charge the battery, and she is afraid of making a mess”</i></p>
Confusing and frustrating	The experience of using AT is unpleasant and frustrating	<p><i>“Computers and smartphones are too complicated for me, and I always make mistakes and need my children to help me figure out”</i></p> <p><i>“My experience with my mobile personal emergency phone was unpleasant, because I do not know how to use it”</i></p>
Denying necessity	Deny the need for using ATs	<p><i>“I do not use walking stick, but occasionally I will use umbrella for the same purpose”</i></p> <p><i>“I am in good health currently, when I became older I would consider the assistance technologies”</i></p>
Prejudice and discrimination	Concern that using AT is associated with discrimination and negative reactions	<p><i>“I would not use emergency alarm service because I am not as weak as that”</i></p> <p><i>“I am not that old to use those stuff”</i></p> <p><i>“I would only use the mobility stick when I really can’t be able to walk”</i></p>

Older people expressed some positive and favorable emotions with actual use of assistive technology. Older people were feeling more secure and safe with the usage of AT. Some of the participants mentioned that using a walking stick would *“make me feel more secure”* because it reduces the risk of falls or accidents. Moreover, not only the older adults themselves, with AT their caregivers and family members would also feel more secure (*“my daughter brought me this mobile phone with personal emergency services, without the phone, she is worried about me when I am out alone...”*).

The positive emotional response from older adults is also attributed to the perceived instrumental benefits of actual use of AT, which helped users to achieve independence and valued outcomes. For example, older people with high blood pressure and diabetes found biochemical parameter monitor useful for self-monitoring. Mobile phones could help them to communicate with family members and friends whenever and wherever. Those instrumental benefits match older people's concern of independence and would lead to feeling of satisfaction.

Participants also expressed negative feelings in regards to AT. Anxious reactions were mentioned by the interviewees when interacting with new and digital technologies, like mobile phones and computer-related technology (*"I feel apprehensive about using electronic things"*). It seems that the user interface and operational process of electric technologies are too complicated for older participants, they were afraid of making mistakes and had frustrating experience (*"Computers and smartphones are too complicated for me, and I always make mistakes and need my children to help me figure out"*).

Negative emotions associated with AT were also associated with deformed social image of the users. The assistive nature of AT is always associated with declined ability and defeat. It was found that there was generally a negative prejudice or some discrimination attached to the use of assistive technology like emergency alarm services and walking sticks; and when asked why participants did not want to use such technologies, they responded *"I am not that old to use"* and *"I do not need stuff like that."* Some participants would deny the need of AT despite the benefit and would use other everyday common product to replace AT (*"I do not need a walking stick, I could use my umbrella instead"*).

4 Discussion

The study investigated older people's emotional responses towards assistive technology. The results are in accordance with previous studies that older people have both positive and negative attitudes towards AT [2, 5, 13]. The study shows that the assistive technologies that older people had currently experienced were mainly focused on physical capacity compensation, in particular in the domains of mobility, safety, hearing and communication. It is found that the AT has the potential to enhance functional benefits via increasing independence and reducing risks for older people. Those instrumental benefits elicit positive emotional reactions like safety and secure. These positive emotions were also reported in previous studies relating AT usage among older people [2, 14]. Older people are preferring to ageing in place, that is to stay at home for as long as possible, whereby AT has the potential to maintain independence and help achieve the aim.

Negative emotions elicited by AT include anxiety, frustration and unpleasant, deny of need, and prejudice and discrimination. Although AT has physical and functional benefits, the assistive nature of AT might conflict with older people's psychological and social needs whereby the assistive technology might signify fragile, disability and reinforce ageism and isolation feelings. In our study, one participant voice out that he preferred to use umbrella or shopping trolley as mobility aids instead of walking stick

or crane. This result is in accordance with the study of Claes et al. [2], which shows that although majority of the older people perceived the usefulness of home monitoring devices, they would only consider to actual use in later life or when their health has deteriorated. In the studies of Kelly et al. [4] and Parette and Scherer [15], older people also expressed cosmetic concern of using AT. To avoid to be seen as weak and to maintain social image and self-esteem, older people would deny their needs for AT, reduce the frequency or reject AT usage, although AT would provide benefits [15].

Moreover, older people had frustrating and unpleasant experience with digital technology due to complexity. Ageing is associated with declining in working memory and focusing of attention, therefore, older people may need more time and hand-on practice in learning new knowledge and skills [16]. Digital technology with complicated human-interface may confuse older users and result in cognitive overloading and anxious. The over-complexity of technology for older people was also reported from previous studies [1, 17, 18]. Without enough technical and human support for learning and usage, older people always had frustrating and unpleasant feelings with interacting with modern digital technology [13].

Product emotions are related to individuals concern [11, 19]. If the concern and the product features were matched, pleasant emotions will occur; otherwise, mismatch will result in unpleasant emotions. The results of study demonstrate that current Assistive Technology practice adopted a problem-driven approach whereby reducing risks and compensating for declined physical capacity was the main focus. However, social and psychological well-being of older adults were undervalued. Although current AT provides functional benefits for older adults but it also elicits negative prejudice and ageist stereotype, which may result in social exclusion and decreased self-esteem. It seems that by making use of AT, older adults' functional needs were met at the expense of compromising social and psychological benefits. Promoting a better quality of life in older adults, their feelings, motivations, and values have to be addressed [10]. Therefore, in order to maximize the benefits of AT usage and improve the well-being of older people, there is a need to turn the everyday assistive technology into desired, pleasant, and appealing objects by adopting a positive and integrated design approach into assistive technology development.

5 Positive and Integrated Design Approach

Positive and integrated design approach is aiming at increase people's well-being and enables human flourishing, through experiencing positive affect and pursuing personal goals [20]. The idea of positive design approach emphasizes design for happiness, including pleasure, personal significance and virtue of individuals [20]. This approach is different from current AT practice which is problem-driven aiming to eliminate or reduce physical and functional deficiencies, because eliminating deficiencies is not enough in the pursuit of quality of life and well-being of older people. Therefore, positive and integrated approach is advocated in AT development.

Based on the emotional themes evoked by using AT in older adults, some design guidelines were suggested here to align with the needs of older adults.

5.1 Aesthetic Features

According to Norman, the physical features of the product would initiate people's immediate emotional reacts [12]. Older people also care about the image they presented to others. The appearance of AT should avoid looking at traditional medical devices and minimize the perception of the assistive nature.

Desmet had adopted an emotional-driven approach in a children's wheelchair design [19], whereby wheelchair was interpreted as a playful outdoor transportation facilitator which encourage go out and explore instead of rehabilitation. Wheelchair users – the children and their parents – were participated in the design process and their emotional demands were assessed.

Given that assistive nature of product might elicit negative stereotype and signify fragile and weakness, the aesthetic features of AT should be free from stigma and be perceived by as neutral, pleasant and attracted. In the current study, older people used umbrella or shopping trolley as walking aids, which gives designers a direction that the appearance of AT could look as everyday normal objects to avoid deviance.

5.2 Usability

The AT should be easy to use. Ease of use impact on the technology acceptance and usage directly and indirectly through perceived usefulness [21]. Many older people have unpleasant interacting experience with digital technology because these devices were too complicated to operate and consume too much cognitive efforts. Whereas, informational and emotional supports were not provided.

The interface designers need to make allowances for cognitive capacities of ageing audiences. For example, physical changes in vision, hearing, and finger dexterity may lead to preferences for devices with larger fonts, sounds within certain frequency ranges, and layouts that require less precise finger movement [22]. Cognitive changes, such as reduced working memory capacity, declines in information processing speed, and ability to disregard unwanted information, create a need for technological interfaces that have fewer distractions, provide memory cues, and are simple to learn and understand.

5.3 Well-Being Promoting

The application domain of AT should go beyond compensation for physical defeat and activities of daily living. Social and psychological well-being of older people also need the intervention of AT. Social isolation is more pronounced among older people accompanied by a decline in health or increased impairment [23]. The key defense against social isolation is to improve communication and to develop a network of social support. Social robots and internet-based communication technology has been developed for older adults addressing social needs [24, 25]. AT which is fun, entertaining, joyful, educational and could boost happiness and well-being would be a new direction for development. There is also a consensus that using technology alone is insufficient to meet the needs of older people. Other supports, like information, training and supports should be also provided and integrated into technology usage cycle [2, 13]. The use of

AT should increase comfort, productivity and vitality. The interaction between AT should be empowering and help older people obtain sense of control and enhance self-esteem and self-confidence.

6 Conclusion

The present paper aimed to get a better understanding older people's emotions elicited from using assistive technology through a qualitative method, and tried to incorporate the positive and integrated design approach into assistive technology development to address emotional requirements. It is highlighted that in addition to functionality and usefulness, the emotional dimensions of AT usage should be considered during design process.

There are several limitations of the current study. Firstly, the health conditions and functional capacities were diverse among older people. The participants of the current study were recruited from community with good and/or fair self-reported health conditions, and many of them did not have the actual experience with AT usage. The emotional reactions to AT they voiced out might be different from older people who were more physically dependent. In future studies, a sample with diverse health conditions could be recruited. For example, older people living in elderly centres and those who cannot independently complete daily activities of living could be recruited. Moreover, the emotions and needs from main care givers of older people could be investigated as well. Because study also reveals that the negative stereotype of using AT also impact family members [19]. Secondly, subjective and objective instruments could be used to measure emotions elicited by a specific AT product or a design prototype of AT. For instance, the Product Emotion Measurement (PrEmo) is a questionnaire measured 14 emotions towards a specific product [19]. Other objective indicators like electrical signals produced by muscles, eye movement, and/or electroencephalography, could be used jointly with subjective responses in assessing human emotions.

References

1. Yusif, S., Soar, J., Hafeez-Baig, A.: Older people, assistive technologies, and the barriers to adoption: a systematic review. *Int. J. Med. Inf.* **94**(Supplement C), 112–116 (2016). <https://doi.org/10.1016/j.ijmedinf.2016.07.004>
2. Claes, V., Devriendt, E., Tournoy, J., Milisen, K.: Attitudes and perceptions of adults of 60 years and older towards in-home monitoring of the activities of daily living with contactless sensors: an explorative study. *Int. J. Nurs. Stud.* **52**(1), 134–148 (2015). <https://doi.org/10.1016/j.ijnurstu.2014.05.010>
3. Free, C., Phillips, G., Watson, L., Galli, L., Felix, L.M., Edwards, P., Patel, V., Haines, A.: The effectiveness of mobile-health technologies to improve health care service delivery processes: a systematic review and meta-analysis. *PLOS Med.* **10**(1) (2013). <https://doi.org/10.1371/journal.pmed.1001363>
4. Kelly, T.B., Tolson, D., Day, T., Mccolgan, G., Kroll, T., Maclaren, W.: Older people's views on what they need to successfully adjust to life with a hearing aid. *Health Soc. Care Commun.* **21**(3), 293–302 (2013)

5. Bright, A.K., Coventry, L.M.: Assistive technology for older adults: psychological and socio-emotional design requirements. In: *Pervasive Technologies Related to Assistive Environments*, p. 9 (2013)
6. Davis, F.D.: Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q. Manage. Inf. Syst.* **13**(3), 319–339 (1989)
7. Venkatesh, V., Davis, F.D.: Theoretical extension of the technology acceptance model: four longitudinal field studies. *Manage. Sci.* **46**(2), 186–204 (2000)
8. Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D.: User acceptance of information technology: toward a unified view. *MIS Q. Manage. Inf. Syst.* **27**(3), 425–478 (2003)
9. Mallin, S.S.V., Carvalho, H.G.D.: Assistive technology and user-centered design: emotion as element for innovation. *Proc. Manuf.* **3**(Supplement C), 5570–5578 (2015). <https://doi.org/10.1016/j.promfg.2015.07.738>
10. Xu, W.: Enhanced ergonomics approaches for product design: a user experience ecosystem perspective and case studies. *Ergonomics* **57**(1), 34–51 (2014). <https://doi.org/10.1080/00140139.2013.861023>
11. Desmet, P.: A multilayered model of product emotions. *Des. J.* **6**(2), 4–13 (2003). <https://doi.org/10.2752/146069203789355480>
12. Donald, A.N.: *Emotional design: why we love or hate everyday things* (2004)
13. Chen, K., Chan, A.H.: Use or non-use of gerontechnology—a qualitative study. *Int. J. Environ. Res. Public Health* **10**(10), 4645–4666 (2013). <https://doi.org/10.3390/ijerph10104645>
14. Pressler, K.A., Ferraro, K.F.: Assistive device use as a dynamic acquisition process in later life. *Gerontologist* **50**(3), 371–381 (2010)
15. Parette, P., Scherer, M.: Assistive technology use and stigma. *Educ. Train. Dev. Disabil.* **39**(3), 217–226 (2004)
16. Erber, J.T.: *Aging and Older Adulthood*, vol. 2. Wiley-Blackwell, Chichester (2010)
17. Heinz, M., Martin, P., Margrett, J.A., Yearns, M., Franke, W.D., Yang, H.I., Wong, J., Chang, C.K.: Perceptions of technology among older adults. *J. Gerontol. Nurs.* **39**(1), 42–51 (2013)
18. Chen, K., Chan, A.H.S.: Gerontechnology acceptance by elderly Hong Kong Chinese: a senior technology acceptance model (STAM). *Ergonomics*, 1–18 (2014). <https://doi.org/10.1080/00140139.2014.895855>
19. Desmet, P.M.A., Dijkhuis, E.: A wheelchair can be fun: a case of emotion-driven design. In: *Designing Pleasurable Products and Interfaces*, pp. 22–27 (2003)
20. Desmet, P.M.A., Pohlmeier, A.E.: Positive design: an introduction to design for subjective well-being. *Int. J. Des.* **7**(3) (2013)
21. Chen, K., Chan, A.H.S.: Predictors of gerontechnology acceptance by older Hong Kong Chinese. *Technovation* **34**(2), 126–135 (2014). <https://doi.org/10.1016/j.technovation.2013.09.010>
22. Farage, M.A., Miller, K.W., Ajayi, F., Hutchins, D.: Design principles to accommodate older adults. *Glob. J. Health Sci.* **4**(2), 2–25 (2012)
23. McConatha, D.: Aging online: toward a theory of e-quality. In: Morrell, R.W. (ed.) *Older adults, health information, and the World Wide Web*, pp. 21–41. Lawrence Erlbaum Associates, Mahwah (2002)
24. Klamer, T., Allouch, S.B.: Acceptance and use of a social robot by elderly users in a domestic environment. In: *4th International Conference on-NO PERMISSIONS Pervasive Computing Technologies for Healthcare (PervasiveHealth)* (2010)
25. Näsi, M., Räsänen, P., Sarpila, O.: ICT activity in later life: internet use and leisure activities amongst senior citizens in Finland. *Eur. J. Ageing* **9**(2), 169–176 (2012)