Digital Assistive Technology as a Path Towards Successful Aging in the Baltic Sea Region

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ABSTRACT

Population aging is a major societal challenge worldwide, and the Baltic Sea region is no exception. This challenge has increased interest in successful aging through digital assistive technology (DAT). This paper seeks to shed more light on the potential impact of DAT on successful aging by offering deeper insight into the needs and expectations of older people as well as the barriers to and challenges in providing DAT solutions. Given the nature of the research questions, a qualitative approach was employed, and a multiple-case study was conducted in six Baltic Sea region countries: Latvia, Lithuania, Estonia, Russia, Denmark, and Finland. The central finding of the study revealed that older people and technology providers perceived DAT solutions as of utmost importance in supporting successful aging. The study also contributes to the discussion of the need for a more holistic and multidimensional approach to successful aging by proposing to incorporate the impact of technological advances into a conceptual framework that outlines more comprehensively the components of successful aging.

Keywords: Successful aging, Digital assistive technology (DAT), Older people, Needs and expectations, Barriers and challenges, Baltic sea region

INTRODUCTION

Population aging is a major societal challenge worldwide that has given rise to greater interest in successful aging and keeping older people healthy, active, and safe while living independently in their own homes. This greater interest can be observed in the United Nations' declaration of 2021–2030 as the Decade of Healthy Ageing to foster healthy aging by enabling older adults to live in supportive and safe living environments and to remain active and independent members of communities (World Health Organization, 2021). The European Union (EU) has also embraced successful aging by including in its strategy objectives, with specific policies, a goal for all its Member States to increase opportunities for older people to continue working and contributing to society in multiple ways and to stay healthy for a longer time (Cristea *et al.*, 2020).

However, evidence from empirical studies has shown that reaching old age without diseases and disabilities is very uncommon (Motta *et al.*, 2005). At the same time, digital assistive technology (DAT) has demonstrated great potential in maintaining older people's health, independent lifestyle, and quality of life (*e.g.*, Baraković *et al.*, 2020; Iancu and Iancu, 2017; Ollevier *et al.*, 2020; Peek *et al.*, 2016; Wang *et al.*, 2019). It can also reduce the burden of health care and social welfare services for the workforce (Marasinghe, 2016), which can lead to more targeted care with better quality (Marasinghe, 2016; Sood and McNeil, 2017; Wang *et al.*, 2016). DAT involves the use of information and communication technology (ICT) (Olphert *et al.*, 2009), but other technologies, such as robotics (Hosseini and Goher, 2017) and the Internet of Things (IoT) (Maswadi *et al.*, 2020), have recently been emphasized as well. Thus, in this study, we refer to DAT as all kinds of ICT-based products, applications, and services as well as IoT and robotics solutions for assisted living.

Despite the current availability of a wide range of DATs on the market, prior research has revealed a general belief that older people's needs for the technology are not yet well known (Soar et al., 2020). Therefore, the full potential of DAT is not being sufficiently exploited by businesses, which have not primarily focused on the development of technology products and services specifically for older adults (Arensberg, 2018). This gives the impression that businesses have been slow to recognize the impact of changing demographics and that their mechanisms are not sufficient to provide information on their older customers' real and latent needs (Prodromou and Lavranos, 2019; Soar et al., 2020). In addition, they do not fully identify the distinct buying behavior of this admittedly large and heterogeneous group of older end-users, perhaps because digital technology solutions are generally developed by young people and are consequently youth-oriented (Worthington et al., 2018). Another reason for the unexploited potential of DAT is that despite its having played a significant role in several successful interventions that target older people, the adoption of this technology has been limited (Hoque and Sorwar, 2017). A major barrier has been the "top-down" design processes that are often employed to develop DAT for older adults. These processes are based on technologists' or, at best, geriatricians' preconceptions of the needs of older people, with little regard for the users' perspectives and preferences (Wang et al., 2019).

Thus, considering the existing literature that recognizes DAT as a path to successful aging, it is apparent that more empirical studies are needed on the determining barriers and challenges from the perspective of technology providers, as well as on older end-users' needs and expectations. This paper addresses these concerns by presenting the findings of a multiple-case study conducted within the framework of the OSIRIS Interreg BSR project, which aimed to respond to the challenges of meeting the needs of aging populations and to support the development of the silver economy in the Baltic Sea region. The use of a qualitative approach enabled the authors to gain a deeper insight into the research questions in six countries in the Baltic Sea region: Latvia, Lithuania, Estonia, Russia, Denmark, and Finland.

This paper is structured as follows. The next section offers the theoretical background, focused on the concepts of successful aging and DAT. The third section introduces the research methodology, data collection process, and data analysis method. The fourth section presents and discusses the empirical findings. The fifth section concludes the paper and presents its limitations and suggestions for further research.

SUCCESSFUL AGING AND DAT

"Successful aging" is widely acknowledged as a highly complex and multidimensional phenomenon. Extensive research has been devoted to this concept (*e.g.*, Bülow and Söderqvist, 2014; Calasanti, 2016; Katz and Calasanti, 2015), and various definitions of it have been proposed in multiple studies (Cosco *et al.*, 2014). Rowe and Kahn (1998, p. 53), prioritizing highly critical health-related aspects of old age, defined successful aging as "the ability to maintain three key behaviors or characteristics: low risk of disease and disease-related disability; high mental and physical function; and active engagement with life."

This approach was criticized as potentially enticing people to achieve an unrealistic ideal of aging (Foster and Walker, 2015). According to Riley (1998, p. 151), it ignores social structures as essential aspects of successful aging: "Successful aging involves the interplay between lives and the complementary dynamic of structural change . . . [and is dependent] on structural opportunities in schools, offices, nursing homes, families, communities, social networks, and society at large.". Furthermore, Baltes and Baltes (1990) proposed integrating subjective (*i.e.*, self-reported) and objective (*i.e.*, observable) criteria for defining successful aging, and introduced a list of both types of criteria that are considered most in literature: physical and mental health, cognitive functioning, perceived personal control, social competence, longevity, productivity, and life satisfaction. This integration is important because considering only subjective criteria may lead to a disregard for improving environmental conditions that support successful aging (Baltes and Baltes, 1990). Moreover, current approaches to successful aging do not fully grasp the potential impact of technological advances that, coupled with improvements in health care and social welfare services for older people, can significantly upgrade their health status and life quality, as well as enhance their ability to function independently in their homes (Mostaghel, 2016).

Nowadays, in practice, a variety of improvements in older adults' lives are contingent upon DAT. An example is personal alarms, which alert relatives or health professionals and allow them to talk directly to senior citizens, discover what is wrong, and get suitable help to them quickly (*e.g.*, Stokke, 2016). Another example is telecare solutions that use sensors to monitor senior citizens' activities in their homes; if something out of the ordinary occurs, relatives, a neighbor, or health professionals are asked to check up on the older adult (*e.g.*, Majumder *et al.*, 2017). Technology can also increase cognitive reserves by encouraging older people to engage in cognitively stimulating tasks and learn new skills (Reuter-Lorenz and Park, 2014). Examples

of this are technologies that maintain or improve a particular aspect of cognitive functioning (*e.g.*, memory or attention) through a set of guided exercises or games.

In the current context of technology development for older adults, it has been recognized that efficient technologies are those that meet age-specific needs and expectations. However, this is difficult to achieve with a top-down method in the design process (Frennert, 2020; Peek *et al*., 2016; Wang *et al*., 2016). Therefore, it is important that technology designers persistently assess usability, the user experience, and technology acceptance by means of questionnaires, observations, or interviews (Berkowsky *et al*., 2017; Czaja *et al*., 2018; Khosla *et al*., 2013).

METHODOLOGY

Given the nature of the research questions and the study context, a qualitative methodological approach was employed to explore barriers and challenges from the perspective of technology providers as well as older end-users' needs and expectations. In terms of the research design, a multiple-case study and a cross-case comparison were chosen to allow for a detailed and holistic exploration of factors related to the complex and multidimensional research questions. Yin (1989, p. 23) defined a case study as "an empirical enquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used."

This study was carried out within the frame of the OSIRIS Interreg BSR project in six countries in the Baltic Sea region – Latvia, Lithuania, Estonia, Russia, Denmark, and Finland – from May to October 2019. Both primary and secondary data were collected from diverse sources of evidence, including various kinds of documentary materials such as statistical reports and interviews. However, the main method of data collection was interviewing face-to-face, and on the phone, as interviewing is accepted as the most common and a very powerful method of qualitative research (King and Horrocks, 2010; Kvale and Brinkmann, 2009). The overall logic of the multiple-case study was inductive, although the structured approach, using the same semi-structured interview guide, was employed in each of the six distinct studies. The aim was to ensure the comparability of the research results across data sources, reduce the amount of data collected, and simplify the analysis (Dijkstra, 1985).

A key feature of the interviews was a semi-structured format with open-ended questions. Semi-structured interviews allow the interviewees a degree of freedom in explaining their thoughts and highlighting areas of particular interest and allow the interviewers to question some responses in greater depth (Horton *et al*., 2004). A two-part interview guide was designed to obtain a comprehensive picture of what is actually happening in the silver economy market. The first part focused on the needs and expectations of older people, and the second part collected data from representatives of technology providers. In total, 423 interviews with older people and 143 with public and private providers of digital products and service solutions for assisted living,

took place in the six countries. The collected data were cleaned, and sensitive issues, such as compliance with the General Data Protection Regulation (GDPR) and ethics, were considered in the data handling and analysis. The data were handled anonymously, and all sensitive data were excluded.

Thematic analysis was used to analyze the interview data from all six studies, as it allows for data-driven, inductive analysis. Braun and Clark (2006, p. 79) defined thematic analysis as "a method for identifying, analysing, and reporting patterns (themes) within data" that organizes and describes the data set in rich detail. The analysis was conducted in two stages. In the first stage, the data were coded independently for each case to achieve an understanding of each region's specific conditions without using any pre-existing theoretical framework. The collected interview data were read and re-read to organize them into meaningful groups and to identify individual codes (Tuckett, 2005). The entire data set for each case was coded manually. Initially, coding and collating the data enabled discovery and forming of overarching themes related to the research questions without considering themes that might have been identified in previous research (Braun and Clarke, 2006). Once a preliminary understanding and themes had been developed, the second stage of the analysis consisted of identifying and defining general themes by comparing them across the cases. Relevant studies were consulted solely to enhance the analysis by increasing the sensitivity to the more subtle features of the cases' data (Tuckett, 2005). This was followed by report writing, introducing, in the process, a set of fully worked-out themes.

FINDINGS AND DISCUSSION

Recognizing DAT as a path to successful aging, the findings discussed in this section contribute to the understanding of older people's needs and expectations as well as the barriers and challenges that providers of technology solutions and services in the market of the Baltic Sea region face. The findings, including the general themes, interview quotations, paraphrases, and summaries are presented in Table 1.

Older People's Needs and Expectations

The first finding is that older people felt more safe and secure while using DAT, which supports the results of many previous studies. For example, Soar *et al.* (2016) found that safety is a critical concern of older people with declining memory in both indoor and outdoor activities and that technology can play an important role in their safety, fall prevention, and finding of their home and other locations. Furthermore, the findings of this study do not support the argument that the use of technology solutions may involve trade-offs with regard to privacy, social stigmatization, and changes to a familiar living environment (Townsend *et al.*, 2011). There was no evidence that older people felt any violation of their privacy when they were being monitored.

A general disclosure of the respondents in all the regions was that older people often felt lonely or distant and disconnected from others but preferred to stay at home as long as possible, even though many of them lived in remote areas without close access to essential services. This finding also suggests

Table 1. Summary of empirical findings.

General Themes & Interviews' Quotations, Paraphrases, and Summaries

Older people's needs and expectations

- *Safety and security*

Finland: The commonly held viewpoint is that various DAT solutions offer safety and security.
"*It makes you feel safe when you have your mobile phone with you outside.*"
"*Safety-related things, various alarm systems. If you need help, you can get it easily, or there's some alarm that says, for example, that your washing machine is on.*"
Estonia: Many older adults favor having an alarm button for a sense of safety. All the respondents had mobile phones, either older ones with buttons or smartphones.
"If I'm going to develop health problems, some remote monitoring device would be of great help.... I would monitor heart rate and blood pressure."
"Memory is getting worse. I could use a device to help remember tasks that need to be taken care of.... Smart watches for reminding [me of] medicines, for example."
"Security services.... There are a lot of thieves who are looking to steal something during these rough times."
Lithuania: Older adults mentioned DAT solutions that allow real-time health monitoring as valuable for them, such as portable bracelets for data collection and patient social networking and health monitoring devices to monitor sleep, nutrition, and leisure.
Crime prevention was also identified as a topical issue, and the need to develop innovative technological solutions to ensure the physical security of older people was emphasized.
Latvia: The interest in using DAT was stronger among older people with very poor health than among older adults with better health.

- **Social connectedness**

Lithuania and Denmark: Loneliness and social isolation were acknowledged as major risk factors of the morbidity and mortality of older adults, and most of the interviewees saw technology as a possible solution.
"*Loneliness is a huge problem, and quality of life would increase if we could do something here, for example with technology.*"
Estonia: "*I don't know how to solve loneliness. Perhaps if somebody would visit every now and then? Hobby groups, maybe, from the city or the parish would help, maybe. I miss little kids or a pet, but I'm afraid to take one as he or she might outlive me.*"

- **Digital literacy**

Lithuania: Older people may also lack motivation to learn about modern digital technologies, and some of them even fear the digitalization trend. For example, the fear was described as a psychological anxiety that older people would never learn to properly use modern technologies.
Finland: The majority of the respondents considered themselves behind when it came to the use of DAT. The older the respondents were, the likelier they were to have challenges in using DAT. The older adults also said they were not interested in learning how to use digital devices and applications, as it felt meaningless.

Continued.

Table 1. Continued.

General Themes & Interviews' Quotations, Paraphrases, and Summaries

"It doesn't feel meaningful to me. It's hard to learn at this age when you've never had that sort of thing before."

Estonia: *"Unfortunately, all of these [technology] products are connected to smart phones, which are getting more and more difficult to use for older people.… I don't want any smart devices, they're too complicated."*

"Technology nowadays is very complex for older people. Screens are very bright, and everything is touch sensitive … For me personally, everything that has touch screen is uninviting. A lot of services are meant to be used over the internet."

Russia: It was indicated that older people could not search for relevant information by themselves. Their main motivation seemed to be the need to solve urgent issues or find information on a specific need instead of receiving more comprehensive information for the longer term.

Denmark: Interviews with health services professionals revealed that the use of assistive digital products and services should start at the earlier stages of older people's lives, which would make it easier for them to learn and adopt technologies and, through this, improve their digital literacy.

"We need to introduce welfare technology earlier, so it is a natural part of everyday life before the senior citizens get too old."

- **Technology awareness**

Estonia: The respondents disclosed that information about new services and products does not reach older end-users quickly enough. It was pointed out that the biggest concern is the digital awareness of older adults. The solution could be to offer courses at day care centers, where older people can learn more about using digital technologies.

Russia: The same concern regarding poor information was raised here.

"Children and grandchildren teach their parent how to use digital devises, there are no special services, or they are not popular.… They don't even know about the existence of some services."

Barriers and challenges in providing DAT solutions and services

- **Week collaboration with end-users**

Denmark: The need for collaboration between older end-users and technology providers was highlighted. The following extract from an interview with a business representative shows how this collaboration can be built:

"If you combine the training and delivery of assistive technology solutions, you can get more senior citizens motivated to use technology and, through this, improve their independent living conditions."

Finland: The business representatives pointed out the need for stronger collaboration among the public, private, and third sectors:

"I think about this every day … about better cooperation between the public, private, and third sectors. Each of them has their own communication channels through which they mostly communicate. Everyone should think more about the elderly and their needs in the midst of all this [communication]."

Continued.

Table 1. Continued.

General Themes & Interviews' Quotations, Paraphrases, and Summaries

- **Low motivation towards silver market**

Finland: The service industry for older adults here is recognized as a strongly growing one, but its image is not considered strong. The Finnish service providers mentioned the need to rebrand digital assistive services for older end-users for the following reason:
"The availability of technological aids, and the availability of health care services for older people, tend to be relegated a bit to secondary importance."
Latvia: Representatives of service providers here acknowledged that the field is not considered attractive or a high priority, although the market development of technology solutions and services for older adults provides good opportunities to create both new products and new services and export them to new markets. In the next decade, this market segment is expected to grow moderately mainly in the private sector, although it is not expected to play an extremely important role.
Russia: In contrast, the service providers here found the older end-user market segment profitable although some financial challenges were identified, especially for companies developing innovative products and services to improve quality of life and solve social problems. Nevertheless, a lack of focus on the silver market by technology service providers was revealed, partly because the population aged 55 and over is a very broad and heterogeneous user group with diverse health conditions, among other conditions.

- **Bureaucracy of public authorities**

Finland and Denmark: Private service providers identified as a barrier the administrative bureaucracy of public authorities, with their strict rules and tendering systems. The tendering processes are time-consuming and difficult to manage, and the municipal decisions regarding the chosen service provider are usually based on pricing instead of quality. The service providers described their collaboration with municipalities in the development of products and services as difficult, as they have no guarantee that the municipalities will invest in and use such products and services.
"We are not sure when selling the developed product to the municipalities or regions, even though they have taken part in the development. Their financing and investment process[es] are difficult to deal with."
Russia: Collaboration between municipalities and private service providers was perceived as bureaucratic and producing many difficulties.

that loneliness can be alleviated by adding technology to the older people's everyday life, for example, through social robots or communication devices. This is in line with several studies that showed the importance for older adults of being able to communicate with their family members and friends through new communication technologies (Scandurra and Sjölinder, 2013). This has led to the emergence of a new term, "social technology" (Chopik, 2016).

Another very common finding in all six countries is poor digital literacy caused by a lack of knowledge and skills, weak interest, a sense of meaninglessness, and even negative attitudes towards digital technology devices

and solutions, mainly among older age groups. Digital literacy is a frequently mentioned barrier in literature (Weck *et al.*, 2020), and older people are described as having limited support and opportunities to learn how to use new digital devices or applications and to enhance their technology uptake. Prior research provided an understanding of the barriers to learning caused by physiological aging among learners and of the frustrations associated with slow learning in this group. Psychologically, older internet users may believe that they have poor technological capacity and may lack self-confidence such that they may resist learning (Chiu *et al.*, 2019). The interviewees also indicated that the poor user-friendliness of digital devices undeniably limits their technology use.

The findings further showed that older people in all six countries are missing out on DAT mostly due to a lack of technology awareness, which was also highlighted in literature. For example, Cook *et al.* (2016) showed that lack of awareness of the available technology may result in the non-use of such technology by older people.

Barriers and Challenges Facing by Technology Providers

In all six case studies, collaboration between older end-users and technology providers was widely acknowledged as a key facilitating factor of the positive impact of technological advances on successful aging. Additionally, engaging other stakeholders was seen as beneficial, similar to the finding by Holopainen *et al.* (2018) of a strong need for committed and seamless collaboration among all stakeholders – business, academia, society, and public authorities – to provide better health and well-being products and services for communities. Furthermore, studies have highlighted that collaboration is particularly important between older adults, technology providers, and the elder care system to support the positive attitudes of older technology users towards acceptance and quicker uptake of DAT (Weck *et al.*, 2020). However, collaboration with public authorities is not always efficient and well organized, and the respondents in some of the case countries acknowledged that administrative bureaucracy is the most significant barrier to such collaboration.

Finally, the business respondents saw as a barrier to providing DAT in many of the case countries the perception that providing digital technology solutions and services to older people is not "sexy," alluring, or even profitable. Nevertheless, it was widely advocated that these business activities will considerably grow in the coming two decades.

CONCLUSION

This paper aimed to shed more light on the potential impact of DAT on successful aging from the perspectives of both older people and technology providers. Using a qualitative approach, the authors gained a deeper insight into the needs and expectations of older people and the barriers and challenges in providing DAT. The central finding of this multiple-case study conducted in six countries in the Baltic Sea region is that older people and technology providers perceived DAT solutions as of utmost importance in

supporting successful aging. This contributes to the discussion of the need for a more holistic view of successful aging and for a multidimensional approach, which is more comprehensive and informative and does not focus on single health outcomes (Calasanti, 2016). The findings generate the authors' optimism about the future role of technological advances in the understanding of successful aging and about the fate of their proposal to incorporate this objective criterion into an integrated conceptual framework that outlines more comprehensively the components of successful aging existing in the literature (*e.g.*, Baltes and Baltes, 1990; Rowe and Kahn, 1998). In the light of practical implications, the needs and expectations of older people are feasible to meet in the states of the Baltic Sea region by adopting and effectively using DAT regardless of the various barriers and challenges addressed in this study. There is clear evidence of the growing market potential and unlimited business opportunities of technology solutions for older adults in the region.

In terms of the research design, the findings of this study are restricted by two main constraints. First, the generalizability of the findings is limited to the context of the six case countries that do not cover the entire Baltic Sea region. Thus, care should be taken not to make too broad interpretations and arguments after comparing the data among the case countries. Another limitation is that the research questions were investigated in the DAT domain but without specifying any particular technological services or products. These limitations open avenues for further research. It would be of particular interest to extend the scope of this research to other countries in the Baltic Sea region and to focus on specific types of DAT solutions. It would also be valuable to investigate the factors that affect older people's specific needs and expectations as well as the technology providers' barriers and challenges in bringing new products and services to the market.

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