

## FACTORS INFLUENCING THE INTENTION TO USE ASSISTIVE TECHNOLOGIES BY OLDER ADULTS

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**Abstract:** Society is ageing at an unprecedented pace worldwide creating implications for the health and social care. Gerontechnology has been recognized as a solution that increases and supports the independency and well-being of older adults at home. This article aims to identify the most critical success factors effecting the adoption of an assistive gerontechnology by older adults in Poland. The object of the authors' interest was Rudy robot, an AI-enabled mobile solution helping users remain physically healthy, mentally sharp, and socially connected. The data was collected among Polish citizens using the CATI technique between November and December 2020. The number of returned questionnaires amounted to 824. The authors used Generalized Least Squares (GLS) of Structural Equation Modelling (GLS-SEM) to verify the hypotheses. The obtained results confirmed statistically significant relationships between the variables of perceived usefulness of Rudy robot and attitude reflecting the willingness to use this technology, as well as between perceived ease of use and perceived usefulness of robot. However, relationship between perceived ease of use and inclination to use this technology in the future was not statistically significant. The conducted research confirmed that the functionality of the analysed Rudy robot for older-adult care positively influences their intension to use it in the future for their own needs or family members. The obtained results confirmed usefulness of robots as assistive technology helping older adults.

**Keywords:** assistive technologies, gerontechnology, technology acceptance model, robot, older adults.



## INTRODUCTION

As the World Health Organization projects, global population will become a super-aged society by 2050. Over the next decades, the number of people aged 65 years or over globally is predicted to increase from around 1 billion in 2021 to 1.4 billion in 2030 up to 2.1 billion in 2050 (World Health Organization, 2021a). In 2021 the proportion of older people accounted to about 13.5% of general population, however 1 in 6 persons will be 60 years of age or older by 2030 (World Health Organization, 2021b). The demographic changes have diverse implications for society and economy worldwide. Society is ageing at an unprecedented pace worldwide, which will accelerate in the future, particularly in developing countries of Eastern and South-Eastern Asia, Latin America and the Caribbean (United Nation, 2019). However, nowadays the process of population ageing is most advanced in the European Union. Moreover, the number of residents on the Old Continent is predicted to decline rapidly over the coming years. Europeans live longer than ever before and the age structure of society is rapidly changing, with proportion of people of working age shrinking and the number of older people expanding (Eurostat, 2020). The demographic old-age dependency ratio between older people and those of working-age is projected to grow significantly in the European Union in the coming decades. The proportion of older persons in the EU (aged 65 and over) is estimated to reach 25% of total population by 2030 and 30% by 2070, while the share of working-age persons (between the ages of 20 and 64) will reduce from 61% in 2030 to 56% in 2070. This means a shift from less than four working-age people for every person over 65 in 2010 to below two in 2070 (European Commission, 2021). Considering economic effects, more will be spent on pensions while the share of taxes will decrease. Population ageing has implications for public health and social care, as more people will have diseases related to the old age such as dementia, which is considered one of the greatest challenges for health and social care in the 21st century. Nowadays 50 million people worldwide suffer from dementia, but this number is predicted to triple by 2050 (European Parliament Technology Assessment, 2019). According to World Health Organization, at least 142 million older persons worldwide meaning 14% of world population, are unable to meet their basic need, while as much as one third of people over 65 need assistance with at least one activity of daily living for example eating, bathing, dressing (World Health Organization, 2021b). The number of people requiring extended care due to disability or functional limitation is likely to increase worldwide. In consequence, the lack of caregivers in social care and shortage of nursing staff leads to a greater responsibility falling on informal carers, who frequently leave the jobs to take care of their family members (European Parliament Technology Assessment, 2019). Along with ageing process, seniors have to face limitation of their movement and mobility. As people get older, rising health problems may lead to shrinking of their activity space and reduced participation in physical activity. As homes, everyday objects and communities, which are not originally designed considering seniors' need, become rather obstacles to movement, safety, independence and socializing (Tsai et al., 2015). Among emotional problems, the older people usually have to face ageism and outdated social norms, which result in their isolation and marginalization in both rural and urban communities (Grenade & Boldy, 2008; World Health Organization, 2021c). Even worse, last year was extremely difficult for elderly people as they had further reduced access to health care and social support due to pandemic caused by COVID-19. Moreover,

permanent restrictions have not only affected older people's daily routines, but also their ability to stay socially connected and how they are perceived. Older people facing changing regulations, are obliged to spend more time at home, which result in the lack of physical contact with other family members, friends and colleagues, temporary cessation of employment and other activities and finally increasing anxiety and fear of illness and death – their own and others. In result, COVID-19 has further exacerbated the problem of loneliness and social exclusion of older adults (Brooke & Jackson, 2020; Richardson et al., 2020).

Despite many challenges considering ageing population, older people can contribute into community bringing their long term experiences, knowledge and time. Staying fit and healthy is an important factor prolonging work participation and ensuring good life quality of seniors. New and creative solutions or technologies dedicated for older adults should be introduced not only to use their wisdom but also to provide opportunities for lifelong learning and meaningful engagement across the lifespan (World Health Organization, 2021b). One of the solutions enabling older people independent living are gerontechnologies, which aim to improve the life of ageing people and to facilitate their participation as full citizens in their own society. Various technologies have been researched in the context of elderly use, among others: Virtual Reality (Syed-Abdul et. al., 2019); robots (Broekens, Heerink & Rosendal, 2009; Chu et al., 2019; Heerink, Kröse, Evers & Wielinga, 2010); healthcare wearable devices (Wang, Tao, Yu & Qu, 2020; Li, Ma, Chan & Man, 2019); m-health technologies (Cajita, Hodgson, Lam, Yoo & Han, 2018); Internet of things (Maskeliūnas, Damaševičius & Segal, 2019); smart home (Arthanat, Wilcox & Macuch, 2019); intelligent wireless sensor system (IWSS) (Cohen, Kampel & Verloo, 2016), ICT technologies (Ha & Park, 2020); assistive applications on smartphones (Petrovčič, Peek & Dolničar, 2019); intelligent wireless sensor system (IWSS) (Cohen, Kampel & Verloo, 2016).

This article aims to identify the most critical success factors that can explain the adoption of a gerontechnology by older adults in Poland on example of RUDY robot. The paper is structured as follows: first, the literature review on gerontechnology and its application for the purpose of older adults care was conducted. Based on the literature review theoretical model and hypotheses are presented. After, the theoretical part of the article, research method and analysis are presented. Next, the findings are discussed. Final conclusions, practical implications, limitations and areas of opportunities of future research are outlined in the last part.

## LITERATURE REVIEW

The discipline of gerontechnology has emerged in response to the need to assist older adults in their daily lives and health care (Ha & Park, 2020). Gerontechnology as is an interdisciplinary academic and professional environment combining gerontology and technical sciences aiming to support sustainability of ageing society by creating technological solutions, including assistive technologies and universal design (Graafmans, Taipale & Charness, 1998). Assistive technologies are home-based systems or devices using ICT that support the independency and well-being of older adults (Bechtold & Sotoudeh, 2013; Bechtold, Capari & Gudowsky, 2017; Halicka, 2019; Halicka & Kacprzak, 2021; Haufe, Peek & Luijkx, 2019; Mostaghel & Oghazi, 2017). These solutions dedicated for older people, can at least partly compensate for their lower

functionality physical and mental as well (Piau, Campo, Rumeau, Vellas, & Nourhashemi, 2014; Petermans, 2017; Pressler & Ferraro, 2010). Gerontechnologies combine technologies to improve health, housing, mobility, and communication in order to prevent elderly social isolation and loneliness (Cohen, Kampel, & Verloo, 2016).

Facing global trend of aging population, gerontechnologies will play an increasingly important role in improving the life quality of the elderly (Petermans & Piau, 2017). It is also noteworthy that these technological tools have considerable potential commercial impact. In order to reduce the costs of social care, the concept of aging-in-place is becoming a solution that is being widely promoted among policymakers and representatives of health care institutions (Peek, Wouters, van Hoof, Luijkx, Boeije & Vrijhoef, 2014). Therefore, from the economic perspective, digital technologies, such as e-health and robotics, seem to have the potential to contribute to active and healthy ageing in a cost-effective manner compared with institutional care (American Association of Retired Persons, 2014). As most of seniors would like to spend the rest of their life at home as long as possible, aging at home rather than in an institution is now considered as a desired scenario (Cohen, Kampel & Verloo, 2016). Moreover, gerontechnologies can be applied indirectly for older people through the provision of support to caregivers (European Parliament Technology Assessment, 2019). Potential benefits of assistive technologies are mainly related with increased individual autonomy, comfort, monitoring and safety of older adults (Piau, Campo, Rumeau, Vellas, & Nourhashemi, 2014). Most often robotic technologies assist caregivers or help older people in routine actions in a form of robotic wheelchairs, shower chairs and technologies to prevent falls. Socially assistive robots are more advanced solution using AI, that not only support health care functions but also provide companionship and intellectual agility of seniors. Apart from physical health care, companion robots are also said to enhance mental well-being of older people, so that are often used in therapies for older people having problems with emotional contact and sleeping (Niefeld & Kasper, 2005; Pilotto et al., 2011). Chu et al. (2019) found that older adults had more positive attitude towards service-oriented robots than companion-oriented robots. It is projected that future application of robots seems to be promising, especially for older adults (Chu et. al., 2019).

Nevertheless, implementing health and social care technologies poses many organisational, economic and social challenges. First of all, the main obstacle is the access and use of the internet among older adults differing significantly between countries. For example, in Europe, much more internet users are in northern countries than southern ones. Lack of digital infrastructure in the health and social care sectors is considered as one of the main barriers for the implementing ITC solutions. Moreover, digital alienation among older people, health care workers and caregivers is another challenge, so the programmes of life-long learning to adapt to technologies should be implemented (European Parliament Technology Assessment, 2019). The potential of gerontechnologies has not been yet fully realized because of several economical and organisational barriers limiting their wide implementation like their complexity and high costs of installation and maintenance, the lack of evaluation and validation especially regarding cost-effectiveness and efficiency (Barlow, 2006). Moreover, socio-economic and psychological aspects are relevant for understanding how older people interact with and use technologies (Peek et al., 2019). Sociological barriers for elderly using technology tools are often related with low acceptance of end-users (Ellis & Allaire 1999), inadequate comprehension of seniors' needs and perception (Piau, Campo, Rumeau, Vellas, & Nourhashemi, 2014), threats to privacy (Caine, Fisk & Rogers 2006), security and safety (Miskelly, 2001), and ethical issues including

stigmatization and intrusiveness (Piau, Campo, Rumeau, Vellas, & Nourhashemi, 2014). In addition, implementation of robots carries the risks of substituting human assistance by technology and finally increasing user's sense of isolation (Niefeld & Kasper, 2005; Pilotto et al., 2011). Seniors with cognitive impairments have lower acceptance and interest of innovative technology, therefore they often demonstrate negative attitudes toward robots in comparison with other types of technologies such as wearable or mobile devices and environmental sensors (Thordardottir, Malmgren Fange, Lethin, Rodriguez Gatta & Chiatti, 2019; Hebesberger, Koertner, Gisinger & Pripfl, 2017; Wu, Wrobel, Cornuet, Kerhervé, Damnée & Rigaud, 2014). Despite the rapid development of technologies and progressive digitisation of society, the adaptation of new solution by older people still constitutes a great challenge and obstacle to technology implementation on wider scale (Niehaves & Plattfaut, 2014). Other serious concerns of end-users is the cost of assistive technologies, which is related with the economic state of the older people (Hoque, Sorwar, 2017) and their perception of whether the technology is actually 'worth buying' (Mertens, Wille, Theis, Rasche, Finken, Schlick, 2015; Sharma, Nah, Sharma, Katta, Pang, Yong, 2016). Even some elderly would have the will to use assistive technology, the perceived cost of technology would be one of the main barriers, so they would wait for prize drop (Cajita, Hodgson, Lam, Yoo & Han, 2018).

Although the implementation of assistive technologies in silver economy poses many challenges, these technologies seem to be useful and supportive tools solving many problems of aging society. Therefore, the technology acceptance by older people is essential and topical field frequently addressed in scientific research recently. Technology acceptance, which is related to attitude, perception and intention to use technology, is seen as a key concept in understanding the adherence and preference for technology-assisted intervention for older people (Ke, Lou, Tan, Wai & Chan, 2020). Most of the research concerning the impact of beliefs or attitudes on technology use intention by seniors, were based on Technology Acceptance Model (TAM) (Davis, 1985) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis & Davis, 2003). The authors usually examined the perceived usefulness and the perceived ease of use as important predictors for the gerontechnology adoption by the elderly (Ke, Lou, Tan, Wai & Chan, 2020; Mostaghel & Oghazi, 2017; Pan & Jordan-Marsh, 2010; Syed-Abdul et al., 2019). However, the models were often extended with additional constructs such as social norms, perceived enjoyment, expected performance, effort expectation, and trust (Chu et al., 2019; Quaasar, Hoque & Bao, 2018; Syed-Abdul et al., 2019). In order to identify determinants of technology acceptance and adoption by older adults, the researchers combined the TAM and the UTAUT models into the Senior Technology Acceptance Model (STAM). STAM model developed by Renaud and Van Biljon (2008) stated that facilitating conditions, perceived usefulness, and the ease of learning influenced the actual use of new technology, while Chen and Chan (2014a) identified usefulness, ease of use, facilitating condition, and self-efficacy as factors effecting the technology acceptance by older adults.

According to Zhou, Zhang, Tan, Tseng & Zhang (2020), the determinants of the user acceptance behavior can be classified into three dimensions: user individual characteristics, product technical features and environmental characteristics. The attributes of the individual characteristics are summarized as physical, psychological, economic conditions, knowledge and experience. Considering the psychological features of users, male and younger seniors are more often eager to adapt new technologies (Olson, O'Brien, Rogers & Charness, 2011; Pan & Jordan, 2010). Technical anxiety caused by low experience, economic status and knowledge about

modern technologies, have a significant negative impact on gerontechnologies adaptation by older adults (Hoque & Sorwar, 2017; Ke, Lou, Tan, Wai & Chan, 2020; Mitzner et al., 2019; Mostaghel & Oghazi, 2017; Pal, Funilkul, Vanijja & Papasratorn, 2018). Older adults' personal characteristics connected with trust and cognitive ability (Ha & Park, 2020; Mostaghel & Oghazi, 2017), and self-efficacy (Ma, Chan & Teh, 2020) have positive impact on behavioral intention towards technology usage. As far as technical characteristics of gerontechnologies are concerned, the researchers explored technical performance or performance expectancy (Li, Ma, Chan & Man, 2019; Talukder, Sorwar, Bao, Ahmed & Palash, 2020; Wang, Tao, Yu & Qu, 2020), effort expectancy and task-technology fit (Wang, Tao, Yu & Qu, 2020), and facilitating conditions (Ha & Park, 2020; Kim, Ferrin & Rao, 2019; Pai & Tu, 2011; Wang, Tao, Yu & Qu, 2020). As the research results revealed, the more complicated product, the higher technical anxiety towards geotechnologies among seniors (Ha & Park, 2020; Wang, Tao, Yu & Qu, 2020). In case of resident-robot, its behavioural engagement moderately influences attitudes towards technology and perceived usefulness (Ke, Lou, Tan, Wai & Cha, 2020; Zhou, Zhang, Tan, Tseng & Zhang, 2020). The environmental characteristics of gerontechnologies formulated as 'social influence' and 'subjective norm' constructs, are summarized as the influence of friends or institutions opinions about modern technologies (Cajita, Hodgson, Budhathoki & Han, 2017; Chen et al., 2011; Pan & Jordan-Marsh, 2010; Syed-Abdul et al., 2019; Wang, Tao, Yu & Qu, 2020). Seniors are more susceptible to social environmental influences from family members, friends, and institutions than young people (Zhou, Zhang, Tan, Tseng & Zhang, 2020). Summing up, most of analysed empirical research have proved that perceived usefulness, perceived ease of use, facilitating conditions, self-efficacy and anxiety had impact on older adults' attitude towards usage of general technology and their future intentions (Chen & Chan, 2014b; Chu et al. 2019; Thordardottir et al., 2019; Wu et al., 2014; Zhou, Zhang, Tan, Tseng & Zhang, 2020).

The analysis of available literature has revealed that along with aging society trend, technology acceptance has become popular scientific area in recent years. Nevertheless, further research in this area is needed to better understand the determinants of specific technologies acceptance by older people, especially in the context of design and use of new technological solutions by older people (Ha & Park, 2020; Rogers, Mitzner & Sanford 2014). Increasing older adults' intention to use technologies will bridge the digital divergence caused by aging and rise the penetration of emerging technology products by elderly (Ma, Chan & Teh, 2021). Identifying factors that optimize technology acceptance is essential to improve technology-assisted healthcare, facilitate independent living by older adults and finally solve the problem with the shortage of healthcare staff (Ke, Lou, Tan, Wai & Chan, 2020). Technology usage and adoption by elderly is especially significant in the context of disruptive robot technology, which is still poorly accepted by older people (Beer, Prakash, Mitzner & Rogers, 2011; Chu et al. 2019; Ke, Lou, Tan, Wai & Cha, 2020; Zhou, Zhang, Tan, Tseng & Zhang, 2020).

This article aims to identify the most critical success factors explaining the adoption of an assistive gerontechnology by older adults in Poland. The object of the authors' interest was robot RUDY, which is an AI-enabled mobile solution helping users remain physically healthy, mentally sharp, and socially connected. Rudy is used as a supportive tool for older adults to age in place (<https://infrobotics.com/#technology>).

## RESEARCH MODEL AND HYPOTHESES

The problem of technology acceptance by older adults has been the subject of academic interest in recent years and a number of theoretical models have been developed to explain factors of technology acceptance by older adults (Ma, Chan & Teh, 2020). The original model for studying technology acceptance, including gerontechnology, was model developed by Davis (1985) called Technology Acceptance Model and its modifications (TAM, TAM2, TAM3). Zhou, Zhang, Tan, Tseng & Zhang (2020) proved the importance of technology adoption models such as TAM or UTAUT on gerontechnology.

Considering the specificity of technology acceptance by older people, commonly used technology acceptance models have been adapted to the context of older people. For example, technology acceptance model elaborated by Chen & Chan (2014a) related to technologies used by older people is called as senior technology acceptance model (STAM). Tsai, Rikard, Cotten & Shillair (2019) proposed exploration, learning and acceptance of technology by seniors (STELA). The literature review on gerontechnology acceptance models has confirmed that most researchers consider the three main constructs of the TAM (perceived usefulness, perceived ease of use and attitude) in their models.

Functionality is one of the features of gerontechnology which has to be considered during the process of technology acceptance by elder adults (Beer, Prakash, Mitzner & Rogers, 2011). Pan & Jordan-Marsh (2020) confirmed that perceived usefulness, perceived ease of use are important predictive indicators for the internet adoption of the elderly. Research conducted by Syed-Abdul et. al. (2019) prove that older people consider that using technology should be easy, so their acceptance depends on its usefulness. Ezer, Fisk & Rogers (2009) also found that acceptance was influenced by the perceived advantages in the context of functionalities offered by robots. Syed-Abdul et al. (2019), who analysed factors influencing the intention to use VR among older population, confirmed that perceived usefulness and perceived ease of use were good predictors of future intention to use VR technology by respondents. In many technology acceptance models, the technology functionality is often considered as a performance expectancy. Results received by Peek et. al. (2016) indicated that technology acceptance by older adults was influenced by perception of the technology properties. Research conducted by Wang, Tao, Yu & Qu (2020) confirmed that performance expectancy of healthcare wearable devices found out to be the most important determinant of behavioural intention. According to Peek, Luijckx & Vrijhoef (2019) research, perceived usefulness of technology is more crucial determinant of pre-implementation acceptance, than post-implementation acceptance. Chu et al. (2019) confirmed that in case of ideal assistive robots for older adults' care, users' expectations did not significantly predict their preference of existing robots in terms of perceived usefulness. Arthanat, Wilcox & Macuch (2019) examined the key predictors to smart home adoption by older adults. Their results confirmed that one of smart home functionalities – security – had a significant impact on solution adoption by older people. The study of meta-analysis conducted by Zhou, Zhang, Tan, Tseng & Zhang (2020) on attributes influencing gerontechnology by older adults also proved that perceived usefulness and perceived ease of use had significant positive correlation with attitude toward gerontechnology usage. The above mentioned results are the basis of the following hypothesis:

**Hypothesis 1:** Perceived usefulness (PU) has a positive impact on attitude attitude reflecting the willingness to use the Robot Rudy

Syed-Abdul et al. (2019) during research on VR technology acceptance confirmed that the older adults are willing to use technology more often if learning and operation of technology is easier. Conci Pianesi & Zancanaro (2009) reported that in case of mobile phone technologies, perceived ease of use was an important factor in the early stage of technology adoption by elderly users. In qualitative research carried out by Cajita, Hodgson, Lam, Yoo & Han (2018), most of participants stated that they would be more likely to adopt m-health if it was easy to use. The ease of use construct in UTAUT technology acceptance models is defined as effort expectancy which refers to the ease related to technology use (Venkatesh, Thong & Xu, 2012). Previous studies have confirmed that effort expectancy has a positive relationship with users' technology acceptance (Hensel, Demiris & Courtney, 2006; Tao, Shao, Liu, Wang, & Qu, 2016). Wang, Tao, Yu & Qu (2020), who examined healthcare wearable devices (HWDs) acceptance by older people, confirmed that effort expectancy significantly affected behavioral intention. Maskeliūnas, Damaševičius & Segal (2019) identified many examples confirming that the success of IoT (Internet of Things) use by older people depended on the technology ease of use. The role of this factor becomes less important as the technology is used longer (Karapanos, 2013), but it is important at the initial technology adoption stage. Based on literature review, the following additional research hypothesis was formulated:

**Hypothesis 2:** Perceived ease of use (PEU) has a positive impact on attitude reflecting the willingness to use the Robot Rudy

Verification of STAM model proposed by Chen & Chan (2014a) confirmed that perceived ease of use (PEU) of gerontechnology had a positive impact on perceived usefulness. Chen & Chan (2014b), who investigated key factors that contribute to gerontechnology acceptance by older residents of Hong Kong, also supported the hypothesis that ease of use had a significant and positive influence on usefulness. It allowed to formulate the hypothesis:

**Hypothesis 3:** Perceived ease of use (PEU) has a positive impact on perceived usefulness (PU) to use the Robot Rudy

TAM, UTAUT technology acceptance models pay special attention to technical factors related to functionality and ease of use, neglecting social factors at the same time (Davis, 1989; Venkatesh, Morris, Davis & Davis, 2003). However, many studies confirm that social factors play an important role in technology adoption especially by older people (Peek et. al. 2016; Rogers, 2003). Moreover, in the framework of one dominant aging theory – socioemotional selectivity theory – as people get older, they attach more attention to the relational aspects of new technologies than to the technical elements (Carstensen, 1985).

Depending on the context and purpose of the study, researchers expand the initial model with additional variables and examine the relationships between them. Frequently appearing variables in technology acceptance models are: trust in technology, open-mindedness and demographic characteristics of respondents such as age and gender, which significantly determine acceptance of technologies.

Authors of the STAM model (Senior Technology Acceptance Model) proved that personal characteristics played more important role in prediction of users attitude than usefulness and ease of use (Chen & Chan, 2014a). Many research confirmed that individual attributes such as age and gender affect technology acceptance behaviour explicitly and directly (Chen & Chan, 2014a; Ma, Chan & Teh, 2021; Ha & Park, 2020; Mostaghel & Oghazi, 2017).

Being interested and open to new technological solutions determines the attitude of users towards new technologies. Open-minded people are willing to adapt new solutions without fear. Research conducted by Rossi, Staffa, Bove, Capasso & Ercolano (2017) and Rossi, Staffa, Bove, Capasso & Ercolano (2020) confirmed that the openness to experience is directly correlated with robot acceptance.

Older people's trust in gerontechnology is considered by many researchers (Sanders & Scott, 2020). Trust is an important factor reducing the risks and uncertainty associated with technology use (Kim, Ferrin & Rao, 2008; Pavlou, 2003; Salem, Lakatos, Amirabdollahian & Dautenhahn, 2015a). Many researchers found that perceived trust has a significant impact on enhancing older adults' acceptance of robots (Chu et al. 2019; Naneva, Sarda, Gou, Webb & Prescott, 2020; Salem, Lakatos, Amirabdollahian & Dautenhahn, 2015b). Within the Almere model elaborated by Heerink, Kröse, Evers & Wielinga (2010) trust to assistive robots is one of the factors influencing elderly users' acceptance and attitude towards socially assistive robots. Chu et. al., (2019) studied trust in two categories of robots: human-like and service-oriented robots. According to Lie, Lindsay & Brittain (2015) trust emerged as a key factor in the acceptance of home monitoring system tested by older adults.

Taking into account above results, the relationships between the analysed three main variables (ease of use, usefulness and attitude) was statistical verified. Moreover, the model included the controlled variables, such as: age, gender, level of technology knowledge (Question: Did you hear about Robot Rudy?), declared level of trust to technology and openness to new technologies.

Theoretical model that reflects the links between all the variables is presented on figure 1.

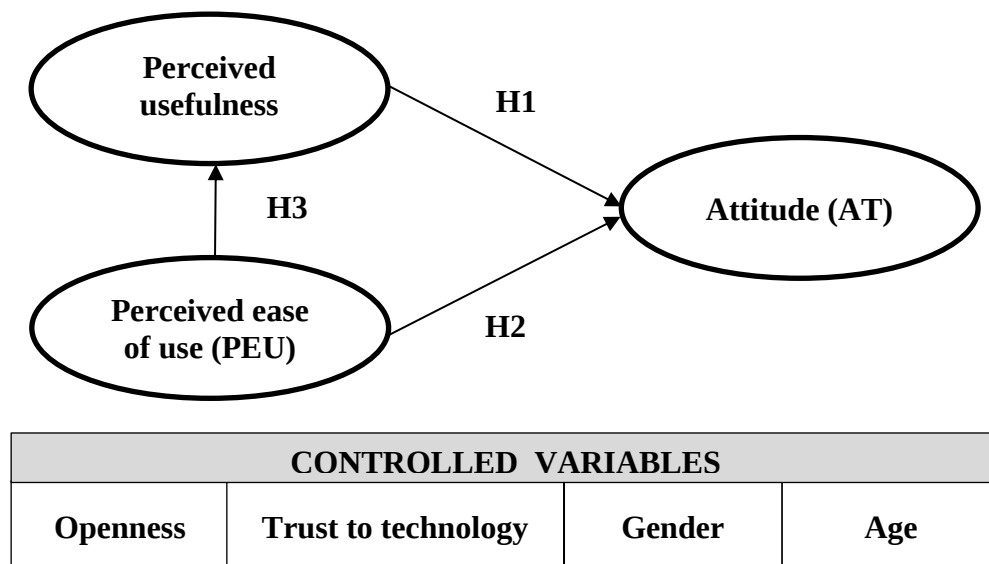


Figure 1. Conceptual model

## RESEARCH METHOD

### Data

Data was collected using the CATI (*Computer Assisted Telephone Interviewing*) technique. Telephone interviews were conducted with residents of Poland. The research was carried out by a research company between November and December 2020. Taking into account the type of gerontechnology under study and the fact that for a large part of the respondents this technology could be foreign and unknown, during the phone interviews (mainly conducted on the mobile phones) the image of Robot Rudy was sent to the respondents in the form of a text message. Only for a few respondents, the interviewer presented Robot Rudy in a descriptive form.

The interviews were carried out on the basis of structured questionnaire forms among 1521 Polish citizens, but finally 824 questionnaires without missing data were accepted for further analysis.

The structure of research sample was balanced in terms of respondents' gender and age. Within research sample, 450 of respondents (54.6%) were women, and 374 were men (45.4%). The gender structure of the respondents is similar to general population of Polish society, in which women constitute 51.6%, and men 48.4%. The study sample and its balanced gender structure determines the study results and enables to avoid research bias (Ma, Chan & Teh, 2021).

People over the age of 40 took part in the study for two reasons: these people have parents who need care or they may need care in the perspective of next 20-30 years. Young people were excluded from the study, as the problem of technologies adaptation aimed at improving the lives of the elderly, have not concerned them yet. Respondents aged 41-50 amounted to 26.7% (220 persons), 28.8% (237 persons) were 51–60 years old, 44.5% (367 persons) were over 60.

The respondents structure was diversified considering the levels of education. People with primary education constituted 3.8% (31 persons), with vocational education – 22.0% (181 persons), with secondary education – 45.2% (350 persons) and with higher education (university level) – 31.8% (262 persons). Respondents also represented different status by place of their residence. 19.1% of respondents (157 persons) indicated a village as their place of residence, 12.0% (99 persons) lived in a city with less than 20 thousand inhabitants, 15.5% (128 persons) – in a city with 21-50 thousand inhabitants, 18.2% (150 persons) – in a city with 51-150 thousand inhabitants, 9.1% (75 persons) – in a city with 151-250 thousand inhabitants and 26.1% indicated a city with more than 250 thousand inhabitants as a place of their residence.

Respondents' awareness of the surveyed technology was evaluated using the following question: Have you ever heard about Robot Rudy (<https://infrobotics.com/#Rudy>)? Only 6.1% of respondents answered positively to this question. The remaining 93.9% responded negatively. As the majority of respondents had not heard about Robot RUDY, before proceeding the interview, the interviewer described the robot appearance and functionality in relation to elder care.

### Measures

As the constructs included in the theoretical model could not be directly observed, a set of variables were used to analyses relationships between constructs. Based on the literature study, five items have been identified to measure the perceived usefulness of the studied technology

(PU), two — perceived ease of use the studied technology (PEU) and three — attitude reflecting the willingness to use the studied technology (AT).

Variables within two constructs: perceived usefulness and perceived ease of use were measured using a seven-point Likert scale to evaluate the degree to which a respondent agreed or disagreed with each of the items (1 = totally disagree; 7 = totally agree). Variables regarding the attitude constructs were measured using scale: 1 - definitely not, 2 - rather not, 3 - rather yes, 4 - definitely yes.

Elaborated on the basis of the literature review, the variables within particular constructs were subject to confirmatory factor analysis (CFA). The aim of the CFA was to verify and confirm the structure of the adopted factors. The parameter values were estimated using the generalized least squares (GLS) estimator, due to its lower sensitivity to normal-distribution assumptions. Variables for which the value of the regression coefficient was lower than 0.6, and for which the standardized residual covariances were greater than 2 were removed from the original set of observable variables.

Cronbach's alpha coefficients was used to verify the consistency of the items in the scale. It is assumed that Cronbach's alpha coefficient above 0.7 is acceptable, and if it is less than 0.7 it suggests that the item of the scale needs to be revised. For convergence validity two indicator were used: Avarage Variance Extracted (AVE) proposed by Fornell & Larcker (1981) and Composite Reliability (CR). Average Variance Extracted (AVE) is greater than 0.5, indicating that the measurement can better reflect the characteristics of each research variable in the model. When CR is greater than 0.7, it indicates that the inherent consistency of all measurement is higher (Hair, Black, Babin, Anderson & Tatham, 2013).

The scale reliability was reflected by Cronbach's alpha ranging from 0.749 to 0.945. Composite Reliability (CR), Average Variance Extracted (AVE) were also higher than expected, which confirmed the convergence validity of scale. Descriptive statistics, composite reliability and convergence validity for the constructs and items are presented in Table 1.

**Table 1.** Descriptive statistics, Cronbach's  $\alpha$ , Composite Reliability and Avarage Variance Extracted.

| Constructs and Items                                                                                                                                 | Mean (M) | Factor Loading | Cronbach's $\alpha$ | Composite Reliability (CR) | Avarage Variance Extracted (AVE) |
|------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------|---------------------|----------------------------|----------------------------------|
| <b>Perceived usefulness (PU)</b> (Mostaghel & Oghazi, 2017; Syed-Abdul et al., 2019; Chen & Chan, 2014a; Chen & Chan, 2014b; Hoque & Sorwar, 2017)   |          |                |                     |                            |                                  |
| PU1: If I had to, using Robot Rudy would improve my sense of security                                                                                | 5.18     | 0.865          | 0.945               | 0.925                      | 0.713                            |
| PU2: If I had to, using the Robot Rudy would give me more autonomy                                                                                   | 5.32     | 0.872          |                     |                            |                                  |
| PU3: If I had to, using the Robot Rudy would give me the ability to ask for assistance                                                               | 5.57     | 0.814          |                     |                            |                                  |
| PU4: If I had to use the Robot Rudy I would feel self-confident and independent                                                                      | 5.26     | 0.939          |                     |                            |                                  |
| PU5: If I had to use the Robot Rudy I would feel safer                                                                                               | 5.22     | 0.921          |                     |                            |                                  |
| <b>Perceived ease of use (PEU)</b> (Mostaghel & Oghazi, 2017; Syed-Abdul et al., 2019; Chen & Chan, 2014a; Chen & Chan, 2014b; Hoque & Sorwar, 2017) |          |                |                     |                            |                                  |
| PEU1: It would be easy for me to obtain the ability to use Robot Rudy                                                                                | 5.22     | 0.939          | 0.749               | 0.782                      | 0.650                            |
| PEU2: I would gain the ability to use the Robot Rudy without the help of others                                                                      | 4.81     | 0.647          |                     |                            |                                  |

| <b>Attitude (AT)</b> (Syed-Abdul et al., 2019; Chen & Chan, 2014a; Heerink, Kröse, Evers & Wielinga, 2020) |      |       |       |       |       |
|------------------------------------------------------------------------------------------------------------|------|-------|-------|-------|-------|
| AT1: I would be willing to use Robot Rudy to assist a member of my family                                  | 2.98 | 0.899 | 0.905 | 0.821 | 0.764 |
| AT2: I would be willing to use Robot Rudy myself as a person who needs it                                  | 3.10 | 0.900 |       |       |       |
| AT3: There is a need to construct Robots Rudy                                                              | 3.11 | 0.821 |       |       |       |

The highest rated robot functionalities were as follows: the Robot would enable their users to ask for assistance (mean = 5.57) and the robot would give me more autonomy (5.32). On average, respondents expressed a modest attitude towards assistive robot, since the mean scores (on a 1–4 scale) were 2.98 for willing to use Robot Rudy to assist a member of family, 3.10 for willing to use Robot Rudy yourself and 3.11 general need to construct Robot Rudy.

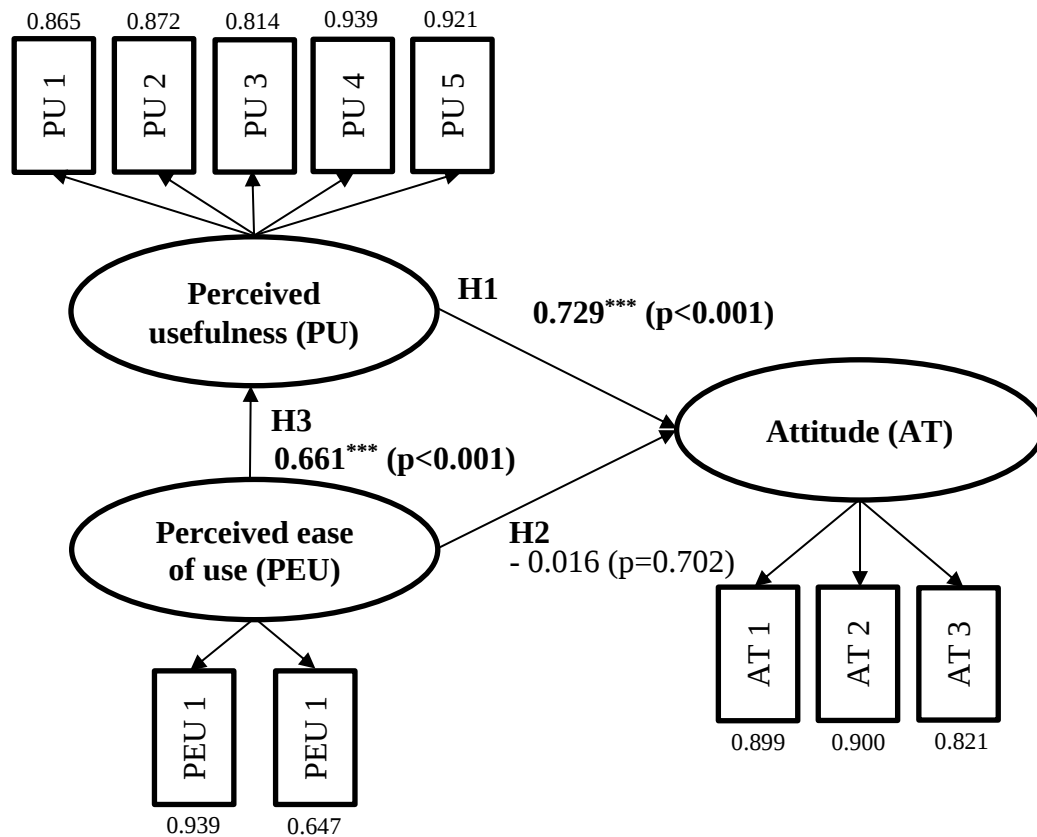
## RESULTS

The appropriateness of the measurement model was evaluated by using the Chi-Square statistics. The  $\chi^2$  value was statistically significant ( $\chi^2=81.927$ ,  $p<0.001$ ) indicating a good model fit to the data. Also, ratio chi-square divided by the degrees of freedom ( $\chi^2/df$ ) was used as a measure of model fit, with values of 3 or less indicates a good model fit. Ratio  $\chi^2/df$  achieved the value of 2.643 which proved the good fit of model as well. According to the Bollen (1989), several disparate indices had been taken into consideration to evaluate an overall model fit. The indices adopted to assess the SEM model fit and their desired values, are presented in Table 2.

**Table 2.** Model fit indices.

| Model fit indices                               | Level of acceptance           | Sources                                       | Ratio achieved |
|-------------------------------------------------|-------------------------------|-----------------------------------------------|----------------|
| Chi-Square/Degrees of freedom ( $\chi^2/df$ )   | desire < 3,<br>acceptable < 5 | Iacobucci, 2020                               | 2.643          |
| Comparative fit index (CFI)                     | 0.9,<br>0.95 desire           | Schumacker, Lomax,<br>2010; Hu, Bentler, 1999 | 0.939          |
| Root mean square error of approximation (RMSEA) | 0.05 (0.08)                   | Konarski, 2010;<br>Bollen, 1989               | 0.045          |
| The goodness-of-fit index (GFI)                 | >0.9                          | Jöreskog, Sörbom, 1979                        | 0.980          |
| The adjusted goodness-of-fit index (AGFI)       | >0.9                          | Jöreskog, Sörbom, 1979                        | 0.965          |
| Standardized Root Mean Residual (SRMR)          | <0.09                         | Hu, Bentler, 1999;<br>Browne et. Al., 2002    | 0.021          |

The hypotheses have been confirmed through the interpretation of the structural path coefficients. Relationships between perceived usefulness of Robot Rudy and attitude reflecting the willingness to use this technology and between perceived ease of use and perceived usefulness of Robot Rudy were statistically significant ( $p < 0.001$ ). Thus, these positive relationships confirmed hypotheses H1 and H3. Relationship between construct perceived ease of use and attitude reflecting the willingness to use this technology was not statistically significant ( $p = 0.702$ ). Hypothesis H2 was rejected (table 3). Fig. 2 presents the individual structural path estimates between constructs and variables.



Values on paths between latent variables are standardised regression coefficients and values at observable variable are factor loads.

**Figure 2.** Measurement model.

**Table 3.** Results of the test hypotheses.

| Relationship between Constructs | Estimate | Standard Error | Capability Ratio | p     | Hypothesis Testing |
|---------------------------------|----------|----------------|------------------|-------|--------------------|
| H1: PU→AT                       | 0.344    | 0.021          | 16.767           | ***   | Support            |
| H2: PEU→AT                      | -0.011   | 0.028          | -0.383           | 0.702 | Reject             |
| H3: PEU→PE                      | 0.923    | 0.060          | 15.489           | ***   | Support            |

$\chi^2 = 81,927$ ; degrees of freedom (df) = 31;  $\chi^2/df = 2,643$ ;  $p < 0.001$ ; root-mean-square error of approximation (RMSEA) = 0.045; goodness-of-fit index (GFI) = 0.980; \*\*\* the adopted level of statistical significance was 0.001

The Mann-Whitney U test was used to verify relationships between all analysed variables and respondents' gender. Statistically significant differences were found in the level of assessment variables PU3 and PU4 between respondents of different genders (PU3:  $Z = -2.812$ ;  $p^{**} < 0.05$ ; PU4:  $Z = -3.367$ ;  $p^{**} < 0.05$ ). Analysis of mean rank confirmed that women assess higher the functionality of Robot Rudy reflecting the ability to ask for assistance (PU3) and making them feeling self-confident and independent (PU4) than man (table 4).

A non-parametric ANOVA Kruskal-Walls test was used to examine statistically significant differences in assessment of all analysed variables across age groups. Only in case of variable PU3 (If I had to, using the Robot Rudy would give me the ability to ask for assistance) such

statistically significant difference was found (chi-square = 9.664, df = 2;  $p^{**} < 0.05$ ). Differences in mean ranks across age groups confirmed that older respondents at the age between 51-59 year and above 60 years old, assessed this functionality of Robot Rudy at higher level than younger respondents – at the age of 41-50 years old (table 4).

During the research, two additional grouping variables were taken into account. One variable reflected the level of respondents' trust to Robot Rudy, second reflected respondents' openness to new technology. Results of ANOVA Kruskal-Wallis test confirmed that there is statistically significant differences in grading all analysed variables and the level of trust and openness. Respondents who declared higher levels of trust and openness to new technologies gave higher scores to the analysed variables relating to functionality, ease of use and attitude reflecting the willingness to use the studied technology (table 4).

**Table 4.** Asymptotic significance.

| Constructs and Items                                                                    | Gender  | Age     | Did you hear about Robot Rudy? | I would be able to trust Robot Rudy | I am open to new technological solutions |
|-----------------------------------------------------------------------------------------|---------|---------|--------------------------------|-------------------------------------|------------------------------------------|
| AT1: Would you be willing to use Robot Rudy yourself to assist a member of your family? | 0.142   | 0.494   | 0.005**                        | 0.000***                            | 0.000***                                 |
| AT2: Would you be willing to use Robot Rudy yourself as a person who needs it?          | 0.528   | 0.757   | 0.000***                       | 0.000***                            | 0.000***                                 |
| AT3: Do you think there is a need to construct Robots Rudy?                             | 0.376   | 0.188   | 0.030                          | 0.000***                            | 0.000***                                 |
| PU1: If I had to, using Robot Rudy would improve my sense of security                   | 0.011   | 0.024   | 0.404                          | 0.000***                            | 0.000***                                 |
| PU2: If I had to, using the Robot Rudy would give me more autonomy                      | 0.015   | 0.098   | 0.844                          | 0.000***                            | 0.000***                                 |
| PU3: If I had to, using the Robot Rudy would give me the ability to ask for assistance  | 0.005** | 0.008** | 0.173                          | 0.000***                            | 0.000***                                 |
| PU4: If I had to use the Robot Rudy I would feel self-confident and independent         | 0.001** | 0.145   | 0.928                          | 0.000***                            | 0.000***                                 |
| PU5: If I had to use the Robot Rudy I would feel safer                                  | 0.089   | 0.160   | 0.859                          | 0.000***                            | 0.000***                                 |
| PEU1: It would be easy for me to obtain the ability to use Robot Rudy                   | 0.269   | 0.054   | 0.097                          | 0.000***                            | 0.000***                                 |
| PEU2: I would gain the ability to use the Robot Rudy without the help of others         | 0.898   | 0.368   | 0.263                          | 0.000***                            | 0.000***                                 |

\*\*\* the adopted level of statistical significance was 0.001

\*\* the adopted level of statistical significance was 0.05

## DISCUSSION

The conducted research confirmed that the functionality of the analysed technology Robot Rudy for older adults care positively influences their attitude about its future use - for their own needs or their family members. The positive relationship between the technology functionality and the users' attitudes towards using the analysed technology, confirmed by the study, is consistent with the results of other authors. In research conducted by Chen & Cha (2014a) perceived usefulness had a significantly positive effect on attitude toward using technology. In the opinion of Mitzner et al. (2019) the positive attitudes toward using technology by older adults are associated with the technology usefulness and how the technology can support their activities and enhance

convenience. Research conducted by Ma, Chan & Teh (2021) confirmed that older adults' usage intention toward information technology was based on technology usefulness in the context of improving their life quality. All measured functionalities of Robot Rudy in our study were assessed at a very similar level. The average rate varied from 5.18 (Robot Rudy would improve my sense of security) to 5.57 (Robot Rudy would give me the ability to ask for assistance).

The authors' results are different from the results obtained by Chu et al. (2019), who confirmed that in case of ideal assistive robots for older adults care, users' expectations did not significantly predict their preference of existing robots in terms of perceived usefulness. In the case of the authors' research, the analysed robot is a technology used currently with specific appearance and functionality. In the conducted research, however, taking into account the low level of familiarity of the respondents with the analyzed gerontechnology- Robot Rudy, the vast majority of them had the opportunity to see the robot through a text message sent by the interviewer. Simply seeing the technology may have influenced the declared evaluation of the technology's functionality, ease of use and users' attitudes.

As in most technology acceptance models, the results of the present study also confirmed that the perceived ease of use (TAM model) or effort expectancy (UTAUT model) of technology have impact on the perceived usefulness of the technology (TAM model) or performance expectancy (UTAUT model) (Chen & Chan, 2014a; Chen & Chan, 2014b; Hoque & Sorwar, 2017).

However, our study proved that there is no relationship between perceived ease of use of technology and attitudes towards its future use in elderly care. The results based of qualitative research of Cajita, Hodgson, Lam, Yoo & Han (2018) also indicated that perceived ease of use and perceived usefulness did not influence solely the intention of the older adults to use m-health. Similarly, results achieved by Ha & Park (2020) revealed that perceived ease of use was relatively lower than attitude towards technology using or perceived usefulness (Ha & Park, 2020). On the other hand, the obtained results are contrary to the findings of other authors. Results gained by Chen & Chan confirmed that perceived ease of use positively affected perceived usefulness and attitude toward using technology as well (Chen & Chan, 2014a). According to the results achieved by Ma, Chan & Teh (2021), the acceptance of information technology by older adults was considerably related with ease of use. Study conducted by Hoque & Sorwar (2017), who analysed factors affecting adaptation of m-health services by older adults, confirmed that performance expectancy had a significant impact on the users' intention to adopt m-health services.

Assessments of relationships between ease of use and propensity to technology adaptation vary and depend on many factors. This diversity often results from a greater role attributed to the technology functionality under study than ease of use. In addition, the strength of the relationship between the constructs is influenced by many other factors, such as the type of technology, its level of dissemination, and users' skills resulting from previous experience, age, level of technological education or willingness to learn.

Age was a controversial moderator in the past studies (Ma, Chan & Teh, 2021) connected with the gerontechnology acceptance. Research conducted by Ha & Park confirmed (2020) that age was significant factor predicting technology acceptance. Research conducted by Mostaghel & Oghazi (2017) show that all the age-related attributes are important to perception of technology ease of use and its usefulness. In the study by Heerin, Kröse, Evers & Wielinga (2010), older adults were less willing to use robots than their younger counterparts. Among the demographic

characteristics within research conducted by Ha & Park, age ( $r = -0.241$ ) and education ( $r = 0.941$ ) were significantly associated with technology acceptance (Ha & Park, 2020). According to Ma, Chan & Teh (2021), age of the respondents measured directly on a chronological scale, was not an appropriate indicator.

Results of systematic literature review conducted by Naneva, Sarda, Gou, Webb & Prescott, (2020) indicated that the age of participants was not significantly associated with their affective attitudes toward social robots. In the present study authors' confirmed similarly to Chen & Chan (2014) that age effects on other constructs were not significant. Only in case of functionality reflecting the ability to ask for assistance statistically significant difference was found. In this case, older respondents (at the age between 51-59 year and above 60 years old) assessed this functionality at higher level comparing younger respondents – at the age of 41-50 years old. Results achieved by Chen & Chan (2014a) also proved that age was found to be negatively associated with perceive ease of use, perceived usefulness and attitude towards using gerontechnology, but the age effects on perceived usefulness and attitude were not significant.

Gender of respondents is often a control variable in technology acceptance research. The results of other authors are often ambiguous and characterised by variability depending on the technology type tested. Chen & Chan (2014a) found that males were more likely to use gerontechnology than females, however there were no gender differences with regard to attitudes towards technology.

Research on trust in assistive technologies seems important given that people are more likely to rely on technologies when those technologies are trustworthy (Schwaninger, Güldenpfennig, Weiss & Fitzpatrick, 2021; Salem, Lakatos, Amirabdollahian & Dautenhahn, 2015). Trust between the user and the robot was identified as important in human-robot interaction and in human-human interactions in therapy (Langer, Ronit Feingold-Polaka, Mueller, Kellmeyer & Levy-Tzedde, 2019). The study confirmed that the declared trust in Robot has a positive effect on variables reflecting their perceived ease of use, functionality and attitude of technology.

The results of present study proved that openness to new technological solutions had a statistically significant effect on all study variables. Similar results indicating a relationship between openness and robot acceptance were obtained by Rossi et al. (2020).

The limitations of the conducted research are particularly related to the respondents' declared assessments of the functionality and ease of use of the robots, which does not always reflect their real later behaviours.

The research technique using CATI also provided limited insight to the respondents about the technology under study. They expressed their opinions based on the image of the technology, without having in-depth knowledge of its functionality. Only individual experience with the use of the technology would allow for more in-depth research results.

The relationships between the technology acceptance variables are often dependent on the technology itself and its functionality. Lack of willingness to use technology often results, on the one hand, from the lack of perceived benefits from its use and, on the other hand, from limited confidence in the ability to acquire the skills to use it. To familiarize the elderly with new technologies, it is necessary to develop information channels that present the functionality of technologies and the benefits of their use in the context of improving safety, independence and supporting care at their own home.

In the context of the studied variables, the characteristics related to the openness of older people to new solutions should be analyzed in more detail. Although the results obtained did not

confirm the relationship between the age of the respondents and the studied variables, in future research the age of the respondents should be referred not to the chronological scale but to the physical and psychophysical age of the respondents.

Conducted research was also an element of building public awareness of Poles in the potential use of gerontechnology by the elderly and improve their comfort and quality of life.

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## REFERENCES

- Arthanat, S., Wilcox, J., & Macuch, M. (2019). Profiles and Predictors of Smart Home Technology Adoption by Older Adults. *OTJR. Occupation, Participation, and Health*, 39(4), 247–256. <http://doi.org/10.1177/1539449218813906>
- American Association of Retired Persons. (2014). What makes a community livable? AARP PPI. Retrieved from <https://www.aarp.org/livable-communities/info-2014/aarp-ppi-survey-what-makes-a-community-livable.html> [20.04.2021].
- Barlow J (2006). *Building an evidence base for successful telecare implementation* – updated report of the Evidence Working Group of the Telecare Policy Collaborative chaired by James Barlow.
- Bechtold, U., Capari, L., & Gudowsky, N. (2017). Futures of ageing and technology – comparing different actors' prospective views. *Journal of Responsible Innovation*, 4, 157-176. <http://doi.org/10.1080/23299460.2017.1360721>
- Bechtold, U., & Sotoudeh, M. (2013). Assistive technologies: Their development from a technology assessment perspective. *Gerontology*, 11, 521-533. <http://doi.org/10.4017/gt.2013.11.4.015.00>
- Beer, J. M. Prakash, A. Mitzner, T.L., & Rogers, W.A. (2011). Understanding Robot Acceptance Technical Report HFA-TR-1103 Atlanta, GA: Georgia Institute of Technology School of Psychology Human Factors and Aging Laboratory, Retrieved from <https://smartech.gatech.edu/bitstream/handle/1853/39672/HFA-TR-1103-RobotAcceptance.pdf>, [21.04.2021].
- Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88(3), 588–606. <http://doi.org/10.1037/0033-2909.88.3.588>
- Bentler, P.M., & Chou, C.P. (1987). Practical issues in structural modelling. *Sociological Methods & Research*, 16(1), 78-117. <http://doi.org/10.1177/0049124187016001004>
- Bollen, K. A. (1986). Sample Size and Bentler and Bonett's Nonnormed Fit Index. *Psychometrika*, 51, 375–377. <https://doi.org/10.1007/BF02294061>
- Bollen, K.A. (1989). *Structural Equations with Latent Variables* New York, NY: John Wiley and Sons.
- Broekens, J., Heerink, M. & Rosendal, H. (2009). Assistive social robots in elderly care: A review. *Gerontechnology*, 8, 94–103. <http://doi.org/10.4017/gt.2009.08.02.002.00>
- Brooke, J., & Jackson D. (2020). Older people and COVID-19: Isolation, risk and ageism, *Journal of clinical nursing*, 29(13-14), 2044-2046. <http://doi.org/10.1111/jocn.15274>
- Browne, M. W., MacCallum, R.C., Kim, Ch-T., Andersen, B. L., & Glaser, R. (2002). When fit indices and residuals are incompatible. *Psychological methods*, 7(4), 403-421. <https://doi.org/10.1037/1082-989x.7.4.403>

- Caine, K.E., Fisk, A.D., & Rogers, W.A. (2006). Benefits and privacy concerns of a home equipped with a visual sensing system: a perspective from older adults. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 50(2), 180–184. <http://doi.org/10.1177/154193120605000203>
- Cajita, M. I., Hodgson, N.A., Budhathoki, C., & Han, H. R. (2017). Intention to Use mHealth in Older Adults with Heart Failure. *Journal of Cardiovascular Nursing*, 32(6), E1–E7. <http://doi.org/10.1097/JCN.0000000000000401>
- Cajita, M. I., Hodgson, N. A., Lam, K. W., Yoo, S., & Han, H. R. (2018). Facilitators of and Barriers to mHealth Adoption in Older Adults With Heart Failure. *Computers, informatics, nursing: CIN*, 36(8), 376–382. <http://doi.org/10.1097/CIN.0000000000000442>
- Carstensen, L.L. (1995). Evidence for a life-span theory of socioemotional selectivity. *Current Directions in Psychological Science*, 4(5), 151–156. <https://www.jstor.org/stable/2018235.6>
- Chen, K., & Chan, A.H.S. (2014a). Gerontechnology acceptance by elderly Hong Kong Chinese: a senior technology acceptance model (STAM). *Ergonomics*, 57(5), 635–652. <http://doi.org/10.1080/00140139.2014.89585519>
- Chen, K., & Chan A.H.S. (2014b). Predictors of gerontechnology acceptance by older Hong Kong Chinese. *Technovation*, 34(2), 126–135. <https://doi.org/10.1016/j.technovation.2013.09.010>
- Chen, M., Lu, T., Chen, K., & Liu, C.E. (2011). A TAM-based study on senior citizens digital learning and user behavioral intention toward use of broadband network technology services provided via television. *African Journal of Business Management*, 5, 7099–7110. <http://doi.org/10.5897/AJBM10.1213>
- Chu, L., Chen, H-W, Cheng, P-Y., Ho, P., Weng, I-T., Yang, P-L., Chien, S-E., Tu, Y-C., Yang, C-C, Wang, T-M., Fung, H. H. & Yeh, S-L. (2019). Identifying Features that Enhance Older Adults' Acceptance of Robots: A Mixed Methods Study. *Gerontology*, 65, 441–450. <http://doi.org/10.1159/000494881>
- Cohen, C., Kampel, T., & Verloo, H. (2016). Acceptability of an intelligent wireless sensor system for the rapid detection of health issues: findings among home-dwelling older adults and their informal caregivers. *Patient preference and adherence*, 10, 1687–1695. <http://doi.org/10.2147/PPA.S113805>
- Conci, M., Pianesi, F., & Zancanaro, M. (2009) Useful, Social and Enjoyable: Mobile Phone Adoption by Older People. In: Gross T. et al. (eds) Human-Computer Interaction – INTERACT 2009. *Lecture Notes in Computer Science*, 5726. Springer, Berlin, Heidelberg. [http://doi.org/10.1007/978-3-642-03655-2\\_7](http://doi.org/10.1007/978-3-642-03655-2_7)
- Davis, F. D. (1985). *A technology Acceptance model for empirically testing new and-user information systems: theory and results*. Unpublished Doctoral dissertation, MIT Sloan School of Management, Cambridge, MA.
- Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <http://doi.org/10.2307/249008>
- Ellis, R.D., & Allaire, J.C. (1999). Modeling computer interest in older adults: the role of age, education, computer knowledge, and computer anxiety. *The Journal of the Human Factors and Ergonomics Society*, 41(3), 345–355. <http://doi.org/10.1518/001872099779610996>
- Ezer, N., Fisk, A. & Rogers, W. (2009). *Attitudinal and intentional acceptance of domestic robots by younger and older adults*. In C. Stephanidis (Eds.), *Universal Access in Human-Computer Interaction Intelligent and Ubiquitous Interaction Environments*. Berlin: Springer.
- European Commission (2021). The 2021 Ageing Report. Underlying Assumptions & Projection Methodologies, Retrieved from [http://https://ec.europa.eu/economy-finance/ip142\\_en](http://https://ec.europa.eu/economy-finance/ip142_en) [24.06.2021].
- European Parliament Technology Assessment (2019). Technologies in care for older people. Retrieved from [https://eptanetwork.org/images/documents/minutes/EPTA\\_report\\_2019.pdf](https://eptanetwork.org/images/documents/minutes/EPTA_report_2019.pdf), [25.05.2021].
- Eurostat (2020), *Ageing Europe - statistics on population developments*, Retrieved from [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Ageing\\_Europe\\_-\\_statistics\\_on\\_population\\_developments](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Ageing_Europe_-_statistics_on_population_developments) [26.06.2021].
- Fornell, C., & Larcker, D. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 18(1), 39–50. <http://doi.org/10.2307/3151312>

- Graafmans, J., Taipale, V., & Charness, N. (eds.) (1998). *Gerontechnology. A sustainable investment in the future*. Amsterdam: IOS Press.
- Grenade, L., & Boldy, D. (2008). Social isolation and loneliness among older people: issues and future challenges in community and residential settings. *Australian Health Review*, 32, 468-478. <http://doi.org/10.1071/AH080468>
- Ha, J., & Park, H.K. (2020). Factors Affecting the Acceptability of Technology in Health Care Among Older Korean Adults with Multiple Chronic Conditions: A Cross-Sectional Study Adopting the Senior Technology Acceptance Model. *Clinical Interventions in Aging*, 2(15), 1873–1881. [doi.org/10.2147/CIA.S268606](http://doi.org/10.2147/CIA.S268606)
- Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., & Tatham, R.L. (2013). *Multivariate Data Analysis*. Technometrics, 49, 103-104.
- Halicka, K. (2019). Gerontechnology—The assessment of one selected technology improving the quality of life of older adults. *Engineering Management in Production and Services*, 11, 43–51. <http://doi.org/10.2478/emj-2019-0010>
- Halicka K., & Kacprzak D. (2021), Linear ordering of selected gerontechnologies using selected MCGDM methods, *Technological and Economic Development of Economy*, 27 (4), 921–947, <https://doi.org/10.3846/tede.2021.15000>
- Hargittai, E. (2010). Digital na(t)ives? Variation in internet skills and uses among members of the “net generation. *Sociological Inquiry*, 80, 92–113. <http://doi.org/10.1111/j.1475-682X.2009.00317.x>
- Haufe, M., Peek, S. T. M., & Luijkx, K. G. (2019). Matching gerontechnologies to independent-living seniors’ individual needs: Development of the GTM tool. *BMC Health Services Research*, 19, 26 <http://doi.org/10.1186/s12913-018-3848-5>
- Hebesberger, D., Koertner, T., Gisinger, C., & Pripfl J. (2017). A long-term autonomous robot at a care hospital: A mixed methods study on social acceptance and experiences of staff and older adults, *International Journal of Social Robotics*, 9(3), 417–429. <http://doi.org/10.1007/s12369-016-0391-6>
- Heerink, M., Kröse, B., Evers, V., & Wielinga, B. (2010). Assessing Acceptance of Assistive Social Agent Technology by Older Adults: The Almere Model. *International Journal of Social Robotics*, 2, 361–375. <http://doi.org/10.1007/s12369-010-0068-5>
- Hensel, B. K., Demiris, G., & Courtney, K. L. (2006). Defining obtrusiveness in home telehealth technologies: a conceptual framework. *Journal of the American Medical Informatics Association: JAMIA*, 13(4), 428–431. <http://doi.org/10.1197/jamia.M2026>
- Hoque, R., & Sorwar, G. (2017). Understanding factors influencing the adoption of mHealth by the elderly: An extension of the UTAUT model. *International Journal of Medical Informatics*, 101, 75–84. <http://doi.org/10.1016/j.ijmedinf.2017.02.002>
- Hu, Li-tze, & Bentler, P. M (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives, *Structural Equation Modeling: A Multidisciplinary Journal*, 6, 1–55. <http://doi.org/10.1080/10705519909540118>
- Iacobucci, D. (2020). Structural equations modeling: Fit Indices, sample size, and advanced topics. *Journal of Consumer Psychology*, 20, 90-98. <http://doi.org/10.1016/j.jcps.2009.09.003>
- Jöreskog, K. G., & Sörbom, D. (1979). *Advances in Factor Analysis and Structural Equation Models*. Cambridge: Abt Books, MA.
- Karapanos, E. (2013). User Experience Over Time. *Studies in Computational Intelligence*, 436, 57-83. Berlin, Heidelberg: Springer. [http://doi.org/10.1007/978-3-642-31000-3\\_4](http://doi.org/10.1007/978-3-642-31000-3_4)
- Ke, C., Lou, V.W.Q., Tan, K.C.K., Wai, M.Y., & Chan, L.L. (2020), Changes in technology acceptance among older people with dementia: the role of social robot engagement. *International Journal of Medical Informatics*, 141, 104241. <https://doi.org/10.1016/j.ijmedinf.2020.104241>

- Khosravi, P., & Ghapanchi, A.H. (2016). Investigating the effectiveness of technologies applied to assist seniors: A systematic literature review. *International Journal of Medical Informatics*, 85(1), 17-26. <https://doi.org/10.1016/j.ijmedinf.2015.05.014>
- Kim, D.J. Ferrin D.L., & Rao, H.R. (2008). A trust-based consumer decision-making model in electronic commerce: the role of trust, perceived risk, and their antecedents. *Decision Support Systems*, 44(2), 544-564. <https://doi.org/10.1016/j.dss.2007.07.001>
- Kim, E.H., Gellis, Z.D., Bradway, C.K., & Kenaley, B. (2019). Depression care services and telehealth technology use for homebound elderly in the United States. *Aging Mental Health*, 23, 1164–1173. <https://doi.org/10.1080/13607863.2018.1481925>
- Langer, A., Ronit Feingold-Polaka, R., Mueller, O., Kellmeyer, P., & Levy-Tzedek, S. (2019). Trust in socially assistive robots: Considerations for use in rehabilitation. *Neuroscience and Biobehavioral Reviews*, 104, 231-239. <https://doi.org/10.1016/j.neubiorev.2019.07.014>
- Li, J., Ma, Q., Chan, A.H.S., & Man, S.S. (2019). Health monitoring through wearable technologies for older adults: smart wearables acceptance model. *Applied Ergonomics*, 75, 162–169. <https://doi.org/10.1016/j.apergo.2018.10.006>
- Lie, A.L.S. Lindsay, S., & Brittain, K. (2015). Technology and trust: older people's perspectives of a home monitoring system. *Ageing and Society*, 36(7), 1501-1525. <https://doi.org/10.1017/S0144686X15000501>
- Ma, Q., Chan, A.H.S., & Teh, P.-L. (2020). Bridging the Digital Divide for Older Adults via Observational Training: Effects of Model Identity from a Generational Perspective. *Sustainability*, 12, 4555. [doi.org/10.3390/su12114555](https://doi.org/10.3390/su12114555)
- Ma, Q., Chan A-H. S., & Teh, P-L. (2021). Insights into Older Adults' Technology Acceptance through Meta-Analysis. *International Journal of Human-Computer Interaction*, 37(11), 1049-1062, <https://doi.org/10.1080/10447318.2020.1865005>
- Maskeliūnas, R., Damaševičius, R., & Segal, S. (2019). A Review of Internet of Things Technologies for Ambient Assisted Living Environments. *Future Internet*, 11, 259. <https://doi.org/10.3390/fi11120259>
- Mertens, A.W., Wille, M., Theis, S., Rasche, P., Finken, L., Schlick, C.M. (2015). Attitudes of Elderly People towards Assistive System: Influence of Amortization Barriers on the Adherence in Technically Assisted Rehabilitation and the Difusion of Health Technologies. In Proceedings of the 19th Triennial Congress of the IEA, Melbourne, Australia, 9–14 August 2015, 9, p. 14.
- Miskelly, F.G. (2001). Assistive technology in elderly care. *Age Ageing*, 30(6), 455–458. <https://doi.org/10.1093/ageing/30.6.455>
- Mitzner, T.L., Savla, J., Boot, W.R., Sharit, J., Charness, N., Czaja, S.J., & Rogers, W.A. (2019). Technology Adoption by Older Adults: Findings from the PRISM Trial. *Gerontologist*, 59, 34–44. <https://doi.org/10.1093/geront/gny113>
- Mostaghel, R., & Oghazi, P. (2017). Elderly and technology tools: a fuzzysset qualitative comparative analysis. *Quality & Quantity*, 51, 1969–1982. <https://doi.org/10.1007/s11135-016-0390-6>
- Naneva, S., Sarda Gou, M., Webb, T.L., & Prescott, T.J. (2020). A Systematic Review of Attitudes, Anxiety, Acceptance, and Trust Towards Social Robots. *International Journal of Social Robotics*, 12, 1179-1201. <https://doi.org/10.1007/s12369-020-00659-4>
- Niehaves, B., & Plattfaut R. (2014). Internet adoption by the elderly: employing IS technology acceptance theories for understanding the age-related digital divide. *European Journal of Information Systems*, 23(6), 708–726. <https://doi.org/10.1057/ejis.2013.19>
- Niefeld, M.R., & Kasper, J.D. (2005). Access to ambulatory medical and long-term care services among elderly Medicare and Medicaid beneficiaries: organizational, financial, and geographic barriers. *Medical Care Research and Review*, 62, 300-19. <https://doi.org/10.1177/1077558705275418>
- Olson, K.E., O'Brien, M.A., Rogers, W.A., & Charness, N. (2011). Diffusion of technology: frequency of use for younger and older adults. *Ageing International*, 36(1), 123–145. <https://doi.org/10.1007/s12126-010-9077-9>

- Pai, J.C., & Tu, F.M. (2011). The acceptance and use of customer relationship management (CRM) systems: An empirical study of distribution service industry in Taiwan. *Expert Systems with Applications*, 38, 579–584. <https://doi.org/10.1016/j.eswa.2010.07.005>
- Pan, S., & Jordan-Marsh, M. (2010). Internet use intention and adoption among Chinese older adults: From the expanded technology acceptance model perspective, *Computers in Human Behavior*, 26, 1111–1119. <https://doi.org/10.1016/j.chb.2010.03.015>
- Pal, D., Funilkul, S., Vanijja, V., & Papasratorn, B. (2018). Analyzing the Elderly Users' Adoption of Smart-Home Services. *IEEE Access* 6, 51238–51252. <https://doi.org/10.1109/ACCESS.2018.2869599>
- Pavlou, P.A. (2003). Consumer acceptance of electronic commerce: integrating trust and risk with the technology acceptance model. *International Journal of Electronic Commerce*, 7(3), 69-103. <https://www.jstor.org/stable/27751067>
- Pan, S., & Jordan-Marsh, M. (2010). Internet use intention and adoption among Chinese older adults: From the expanded technology acceptance model perspective. *Computers in Human Behavior*, 26 (5), 1111–1119. <https://doi.org/10.1016/j.chb.2010.03.015>
- Peek, S.M., Wouters, E.M., van Hoof, J., Luijkx, K.G., Boeije, H.R., & Vrijhoef H.M. (2014). Factors influencing acceptance of technology for aging in place: A systematic review. *International Journal of Medical Informatics*, 83, 235–248. <https://doi.org/10.1016/j.ijmedinf.2014.01.004>
- Peek, S.T., Luijkx, K.G., Rijnaard, M.D., Nieboer, M.E., van der Voort, C.S., Aarts, S., van Hoof, J., Vrijhoef, H.J., & Wouters, E.J. (2016). Older Adults' Reasons for Using Technology while Aging in Place. *Gerontology*, 62(2), 226-37. <https://doi.org/10.1159/000430949>
- Peek, S.T.M., Luijkx, K.G., Vrijhoef, Nieboer, H. J.M., Aarts, M. E S., van der Voort, C. S., Rijnaard, M. D. & Wouters E. J. M. (2019). Understanding changes and stability in the long-term use of technologies by seniors who are aging in place: a dynamical framework. *BMC Geriatrics*, 19, 236. <https://doi.org/10.1186/s12877-019-1241-9>
- Petermans, J., & Piau, A. (2017). Gerontechnology: Don't miss the train, but which is the right carriage? *European Geriatric Medicine*, 8, 281-283. <https://doi.org/10.1016/j.eurger.2017.06.011>
- Petrovčič, A., Peek, S., & Dolničar, V. (2019). Predictors of Seniors' Interest in Assistive Applications on Smartphones: Evidence from a Population-Based Survey in Slovenia. *International Journal of Environmental Research and Public Health*, 16(9), 1623. <https://doi.org/10.3390/ijerph16091623>
- Piau, A. Campo, E. Rumeau, P., Vellas, B., & Nourhashemi, F. (2014). Aging society and gerontechnology: A solution for an independent living?. *The Journal of nutrition, health & aging*, 18(1), 97-112. <https://doi.org/10.1007/s12603-013-0356-5>
- Pilotto, A., D'Onofrio, G., Benelli, E., ZanESCO, A., Cabello, A., Margelí, M.C., Wanche-Politis, S., Seferis, K., Sancarolo, D., & Kiliyas, D. (2011). Information and communication technology systems to improve quality of life and safety of Alzheimer's disease patients: a multicenter international survey. *Journal of Alzheimer's Disease*, 23, 131-41. <https://doi.org/10.3233/JAD-2010-101164>
- Pressler, K. A., & Ferraro, K.F. (2010). Assistive device use as a dynamic acquisition process in later life. *Gerontologist* 50(3), 371–381. <https://doi.org/10.1093/geront/gnp170>
- Renaud, K., & Van Biljon, J. (2008). Predicting Technology Acceptance and Adoption by the Elderly: A Qualitative Study. In *Proceedings of the 2008 Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists on IT Research in Developing Countries: Riding the Wave of Technology*, Wilderness, South Africa, 6–8 October 2008, 210–219.
- Quaosar, G.M.A.A., Hoque, M.R., & Bao, Y. (2018). Investigating factors affecting elderly's intention to use m-healthservices: An empirical study. *Telemedicine and e-Health*, 24(4), 309–314. <https://doi.org/10.1089/tmj.2017.0111>
- Rogers, E.M. (2003). *Diffusion of Innovations*, ed 5. New York: Free Press.
- Richardson, S.J., Carroll, B.C., Close, J., Gordon, A.L., O'Brien, J., Quinn, T.J., Rochester, L., Sayer, A.A., Shenkin, S.D., van der Velde, N., Woo, J., & Witham, M.D. (2020). Research with older people in a world

- with COVID-19: identification of current and future priorities, challenges and opportunities, *Age and Ageing*, 49(6), 901–906, <https://doi.org/10.1093/ageing/afaa149>
- Rogers, W.A., Mitzner, T.L., & Sanford J.A. (2014). A research framework to guide design of technologies for successful aging with disabilities. *Gerontechnology*, 13(2), 272–272. <https://doi.org/10.4017/gt.2014.13.02.095.00>
- Rossi, S., Conti, D., Garramone, F., Santangelo, G., Staffa, M., Varrasi, S., & Di Nuovo, A. (2020). The Role of Personality Factors and Empathy in the Acceptance and Performance of a Social Robot for Psychometric Evaluations. *Robotics*, 9(2), 39. <https://doi.org/10.3390/robotics9020039>
- Rossi, S., Staffa, M., Bove, L., Capasso, R., & Ercolano, G. (2017). User's Personality and Activity Influence on HRI Comfortable Distances. In *Proceedings of the 9th International Conference on Social Robotics*, ICSR, Tsukuba, Japan, 22–24 November 2017, Cham: Springer International Publishing, 167–177.
- Salem, M., Lakatos, G., Amirabdollahian, F., & Dautenhahn, K. (2015a). Towards Safe and Trustworthy Social Robots: Ethical Challenges and Practical Issues. In A. Tapus, E. André, J. C. Martin, F. Ferland, M. Ammi (Eds.) *Social Robotics. ICSR 2015. Lecture Notes in Computer Science*, 9388. Springer, Cham. [https://doi.org/10.1007/978-3-319-25554-5\\_58](https://doi.org/10.1007/978-3-319-25554-5_58)
- Salem, M., Lakatos, G., Amirabdollahian, F., & Dautenhahn, K. (2015b). Would you trust a (faulty) robot? Effects of error, task type and personality on human–robot cooperation and trust. In *Proceedings of 10th annual ACM/IEEE international conference on human robot interaction*. ACM, pp. 141–148.
- Sanders, D., & Scott, P. (2020). Literature review: technological interventions and their impact on quality of life for people living with dementia. *BMJ Health Care Informatics*, 27, 100064. <https://doi.org/10.1136/bmjhci-2019-100064>
- Schumacker, R. E. (2010). *A beginner's guide to structural equation modeling* (3rd ed.). New York, NY: Routledge Academic.
- Schwaninger, I., Guldenpfennig, F., Weiss, A., & Fitzpatrick, G. (2021). What Do You Mean by Trust? Establishing Shared Meaning in Interdisciplinary Design for Assistive Technology. *International Journal of Social Robotics*. <https://doi.org/10.1007/s12369-020-00742-w>
- Sharma, R., Nah, F.F.H., Sharma, K., Katta, T.S.S.S., Pang, N., Yong, A. (2016). Smart Living for Elderly: Design and Human-Computer Interaction Considerations. In *Human Aspects of IT for the Aged Population. Healthy and Active Aging. ITAP*, 112–122. [https://doi.org/10.1007/978-3-319-39949-2\\_11](https://doi.org/10.1007/978-3-319-39949-2_11)
- Syed-Abdul, S., Malwade, S., Nursetyo, A.A., Sood, M., Bhatia, M., Barsasella, D., Liu, M.F., Chang, C.C., Srinivasan, K., Raja, R., & Yu-Chuan J.L. (2019). Virtual reality among the elderly: A usefulness and acceptance study from Taiwan. *BMC Geriatrics*, 19(1), 223. <https://doi.org/10.1007/s12369-020-00742-w>  
<https://doi.org/10.1186/s12877-019-1218-8>
- Talukder, M.S., Sorwar, G., Bao, Y., Ahmed, J.U., & Palash, M.A.S. (2020). Predicting antecedents of wearable healthcare technology acceptance by elderly: A combined SEM-Neural Network approach. *Technological Forecasting and Social Change*, 150. <https://doi.org/10.1007/s12369-020-00742-w>  
<https://doi.org/10.1016/j.techfore.2019.119793>
- Tao, D., Shao, F., Liu, S., Wang, T., & Qu, X. (2016). Predicting Factors of Consumer Acceptance of Health Information Technologies: A Systematic Review. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 60(1), 598–602. <https://doi.org/10.1007/s12369-020-00742-w>  
<https://doi.org/10.1177/1541931213601137>
- Thordardottir, B., Malmgren Fange, A., Lethin, C., Rodriguez Gatta, D., & Chiatti, C. (2019). Acceptance and use of innovative assistive technologies among people with cognitive impairment and their caregivers: A systematic review. *BioMed Research International*, 1–18. <https://doi.org/10.1155/2019/9196729>
- Tsai, L.T.; Portegijs, E., Rantakokko, M., Viljanen, A., Saajanaho, M., Eronen, J., & Rantanen, T. (2015). The association between objectively measured physical activity and life-space mobility among older people. *Scandinavian Journal of Medicine & Science in Sports*, 25(4), 368–e373. <https://doi.org/10.1111/sms.12337>

- Tsai, H-Y-S., Rikard, R. V., Cotten S. R. & Shillair, R. (2019). Senior technology exploration, learning, and acceptance (STELA) model: from exploration to use – a longitudinal randomized controlled trial, *Educational Gerontology*, 45(12), 728–743. <https://doi.org/10.1080/03601277.2019.1690802>
- United Nations (2019), *World Population Ageing*, New York. Retrieved from <https://digitallibrary.un.org/record/3846855>, [20.05.2021].
- Venkatesh, V., Morris, M., Davis, G., & Davis F. (2003). User acceptance of information technology: toward a unified view. *MIS Quartely*, 27(3), 425–478. <https://doi.org/10.2307/30036540>
- Venkatesh, V., Thong, J.Y.L., & Xu X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology, *MIS Quarterly*, 36, 157–178. <https://doi.org/10.2307/41410412>
- Wang, H., Tao, D., Yu, N., & Qu, X. (2020). Understanding consumer acceptance of healthcare wearable devices: An integrated model of UTAUT and TTF. *International Journal of Medical Informatics*, 139, 104156. <https://doi.org/10.1016/j.ijmedinf.2020.104156>
- World Health Organization (2021a). *Aging*. Retrieved from [https://www.who.int/health-topics/ageing#tab=tab\\_1](https://www.who.int/health-topics/ageing#tab=tab_1), [18.05.2021].
- World Health Organization (2021b). *Dacade of Healthy Aging: baseline report. Summary*. Retrieved from <https://www.who.int/publications/i/item/9789240017900>, [19.05.2021].
- World Health Organization (2021c). *Global report on ageism*. Geneva. Retrieved from <https://www.who.int/publications/i/item/9789240016866>, [19.05.2021].
- World Health Organization (2021d). *Older people & COVID-19*. Retrieved from <https://www.who.int/teams/social-determinants-of-health/demographic-change-and-healthy-ageing/covid-19> [22.04.2021].
- Wu, Y.H., Wrobel, J., Cornuet, M., Kerhervé, H., Damnée, S., & Rigaud, A.S. (2014). Acceptance of an assistive robot in older adults: A mixed-method study of human-robot interaction over a 1-month period in the living lab setting. *Clinical interventions in aging*, 9, 801–811. <https://doi.org/10.2147/CIA.S56435>
- Zhou, J., Zhang, B., Tan, R., Tseng, M.-L., & Zhang, Y. (2020). Exploring the Systematic Attributes Influencing Gerontechnology Adoption for Elderly Users Using a Meta-Analysis. *Sustainability*, 12, 2864. <https://doi.org/10.3390/su12072864>

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