Technology anxiety and technology enthusiasm versus digital ageism

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Abstract

Background: Europe has called attention to the importance of the e-inclusion of older adults. Society is indicating that the developers, websites, and devices are causing age bias in technology. This affects living independently, the values of ethical principles associated with an older person, and digital ageism: which is an age-related bias in artificial intelligence systems.

Objective: This research attempts to investigate the instrument technology anxiety and enthusiasm, and assistive technology devices during the period 2019- 2021. This instrument may be a way to redress misconceptions about digital ageism. The assistive technology device that we will investigate in this study is the adoption of a service that is designed for online health consultations.

Method: The participants are part of the longitudinal Swedish National Study on Aging and Care. Technology anxiety and technology enthusiasm are two factors, which aim to measure technophilia (vs technophobia) in older adults. The age range is 63 -99 years of age in 2019 T1 and 66 -101 in 2021 T2. Wilcoxon rank test was conducted to investigate technology enthusiasm, technology anxiety, and how they changed with time. An Edwards Nunnally index was then calculated for both variables to observe a significant change in score from T1 to T2. Mann Whitney U test was used to investigate the variables sex and health status with technology anxiety & technology enthusiasm in T1 & T2. Age, Cognitive function MMSE, and digital social participation were investigated through a Kruskall-Wallis test. A logistic regression was conducted with the significant variable.

Results: Between 2019-2021, change in technology enthusiasm was based on less digital social participation (OR: 0.608; CI 95%: 0.476- 0.792). Technology anxiety was significantly higher due to age (OR: 1.086, CI 95%: 1.035-1.139) and less digital social participation (OR: 0.684; CI 95%: 0.522- 0.895). The want for online healthcare consultations was popular but usage was low.

Conclusion: Staying active on-line and participating digitally may be a way to reduce digital ageism. However, digital ageism is a complex phenomenon, which requires different solutions in order to include older people and reduce an inaccurate categorisation of this group in the digital society.

Keywords: technology anxiety, technology enthusiasm, digital ageism, artificial intelligence, older adults

INTRODUCTION

"The reality of an ageing Europe has called attention to the importance of e-inclusion for a growing population of senior citizens " (McLean, 2011). There are both cultural and theoretical aspects influencing the adoption of e-technologies, and assistive technology devices. These include approaches to living independently, values of ethical principles associated with an older person, and positive aging versus ageism.

In order to achieve successful implementations and proper working of e-health technologies such as software, websites, and working methods, user acceptance is vital. This is both from

the health care practitioners who at times need to adopt a teaching role toward the final user and from the older adults who are usually the ones these technologies are addressed to.

Technological challenges are prominent for older adults. In addition to that many older adults are underserved, especially when it comes to mental and physical health; society has indicated users, developers, websites, tools, and assistive devices are all causing age bias in technology.

User experience that is not tailored to the needs of older adults causes digital exclusion and ageist attitudes (Lagacé et al., 2015). Indications

Table 1: Usage of the internet by Swedish older adults 66- 101 in 2021 (N: total population, % of the population)

the last 3 months the news	N 362	%
no	58	16.0
yes	302	83.4
don't know	2	0.6
looked online for information/things	N 363	%
no	51	14.0
Yes	309	85.1
don't know	3	0.8
Listened to webradio	N 365	%
No	222	60.8
Yes	138	37.8
don't know	5	1.4
played games looked at films music	N 364	%
No	187	51.4
Yes	173	47.5
don't know	4	1.1
Booked trips (train, plane)	N 364	%
No	243	66.8
Yes	121	33.2
sold things online	N 363	%
No	329	90.6
Yes	34	9.4
Internetbanking	N 364	%
No	49	13.5
Yes	314	86.3
don't know	1	0.3

that health biases are stronger than age biases in healthcare professionals treating older adults (James & Haley, 1995). Digital ageism is portrayed in age-related bias in many artificial intelligence systems (AI).

The problem often is how AI understands age, chronic and multi-comorbidity. Learning algorithms are highly dependent on the quality of the input data that they are trained on. So when using Electronic health care records, for example, if the data is incomplete, or contains selection bias or any other issues, uncertainty arises (Hoffman & Podgurski, 2020). Furthermore, other biases arise when collecting online data, which is often today retained and analysed (Gupta et al., 2022). If an older person is not often online there is fewer data to work with, in consequence, there is a much higher chance of bias in the event of analysis of this type of sparse data.

Artificial intelligence is promising with regard to healthcare. AI can address clinical decision-making, deliver lower healthcare costs and aid health results, and screen and help solve problems caused by diseases affecting people. The focus in healthcare is delivering equal allocation, equal performance, and outcomes (Hoffman & Podgurski, 2020). It is agreed that AI has today generated efficiencies but also biases that exist with regard to ethnicity, gender, socio-economic status, and age. When ageist attitudes are underlying technology the effects of the advancement need to be carefully regarded. It seems that the problem is seeping through our information society and also through big data (Chu et al., 2022). Ageism is related to lowered health for older adults, increased healthcare costs, and overall bad adaptability of the high number of older adults in comparison to other age groups. Not being able to follow the trends of technology becomes a problem then in sustainable and successful aging (Lythreatis et al., 2022). Each sector in AI has the same problem, which is that AI decision-making can have discriminatory results if the system learns from discriminatory data, or is trained on the bias (Zuiderveen Borgesius, 2018).

Older people and healthcare professionals are expected to use digital tools (Alexopoulou et al., 2022). The tools should function as a way to create independence and be healthily active. In fact, the concept of ageing in place is highly facilitated when older adults are adept at newer technologies. Older adults are a population group that is often part of the digital divide. There are many levels to the digital divide as we progress with time (Leavitt, 2002). The first level, which is access to the internet (and services) began in the 1990s.

The second level refers to the skills needed to use the technology well (DiMaggio et al., 2001). It is actually better termed digital inequality, which focuses on access to support of the technology, mediums used, and skills available (Hargittai, 2001). These vary a lot per person and in turn exclude users if the skills necessary are not there. The third level is the beneficial outcomes of using the internet (Scheerder et al., 2017). The increase in smartphone usage has led to more older adults getting the benefits of e-services; however, it is directly related to digital capability (Wei et al., 2011). Digital ageism has grown within these divides.

Older adults use internet services, websites, and assistive technology devices differently depending on the countries and regions they live in. The Netherlands indicated in 2019 that there was a significant difference in older adults who started using the Internet (11.6%) compared to those who stopped (3.1%) (Berner et al., 2019).

Table 1: Usage of the internet by Swedish older adults 66-101 in 2021 (N: total population, % of the population) (cont.)

Looked up health information	N 361	%
No	143	39.6
Yes	216	59.8
don't know	2	0.6
medical records	N 362	%
No	216	59.7
Yes	146	40.3
Used mobile banking /e legitimate	N 364	%
No	48	13.2
Yes	315	84,9
Don't know	1	0.3
Booked health appointment online	N 362	%
No	303	83.7
Yes	59	16.3
GPS, google maps	N 360	%
No	183	50.8
Yes	174	48.3
don't know	3	0.8
Used Swish (money transfer application)	N 361	
No	93	25.8
Yes	268	74.2
Video phonecalls, facetime	N 364	
No	183	50.3
Yes	180	49.5
don't know	1	0.3
Whats app, Facebook	N 365	
No	180	49.3
Yes	183	50.1
don't know	2	0.5

Compared to Italy, Swedish older adults display a positive attitude toward information communication technology (ICT) devices, as well as more frequent usage of the Internet (Zambianchi et al., 2019). Furthermore, according to the digitalisation policy in Sweden, the digital divide is not so prominent (Alexopoulou & Åström, 2022). Having said that however, older adults who lack digital competencies confront serious problems with ongoing digital transformations. Much was noted with the COVID-19 pandemic; new tel-ehealth solutions and how to function only digitally went into focus (United Nations, 2020).

Basic attitudes and positive usages of technology by older adults are possibly a way to alleviate digital ageism. The tools to measure exactly these by older adults are however scarce. Technophobia is a well-established term, which suggests discomfort and anxiety toward technology.

Technophilia is the opposite, which goes so far as to be an "acquired need generated by a dominant need for its effects" (Martínez-Córcoles et al., 2017); for example a need for the newest and latest products. Older adults are often not considered within these terms but they are not a homogenous group and should be considered. The usability and acceptability may be a question of fear toward the new technology. It may be seen as part out of their control and yet the knowledge yet more recently there is a need for it (Osiceanu, 2015). What may be of value is to determine whether the anxiety is coming from the technology itself, or other factors in the environment.

Given the abovementioned scenario, this research attempts to investigate an instrument measuring technology enthusiasm and anxiety and the usage of an assistive technology device over time. This instrument may be a way to help redress misconceptions about digital ageism.

The questionnaire is based on the attitudes of older adults toward their use of technology. Participation is defined as active involvement in digital society through the internet or e-technologies. Change in score in technology anxiety and technology enthusiasm is examined during 2019-2021, controlling for the following variables: digital social participation (DSP), age, cognitive function, gender, and health; and investigating the adoption of the assistive technology service "Nätläkare" that is designed for online health consultations.

METHOD

Data was collected through questionnaires from 2019 and 2021. The participants are all part of the Swedish National Study on Aging and Care (SNAC). This is a longitudinal, comprehensive, and interdisciplinary study that investigates the health and living of older adults since 2001. Our study sample was based on one of the participating regions in this study, Karlskrona Blekinge (SNAC-B). More information on the study of SNAC can be found elsewhere (Lagergren et al., 2004).

The age range of the sample was 63 to 99 years (every age represented) in 2019 (T1) and the same sample in 2021 (T2) but three years later, so 66 to 101 years of age. The total sample was N:365. Health status was a question regarding whether at that point in time, the older adult felt that his or her health was, choosing from a 5-point Likert scale ranging from bad health to great health. This was dichotomised from a five subjective health Likert scale into good health and bad health. Living alone or with someone was a one-off question, also dichotomised.

Table 2: Swedish older adults use of computer, laptop, tablet, smartphone, and those who never use either

N: total older adults (% thereof)	Once day	rarer than that	Never use it
Used computer last 3 months 2021	114 (35.3%)	80 (24.8%)	129 (39.9%)
Laptop	124 (36.9%)	95 (28.3%)	117 (34.8%)
Tablet	115 (35.0%)	65 (19.7%)	149 (44.3%)
Smartphone	**282 (81.0%)**	20 (5.7%)	46 (13.2%)

The authors began by studying the online behaviour of older adults, questions that were given were asked through examples of what people were doing online. Such as reading online news, playing games, chatting or video calling, with a yes no don't know as the three options to answer from. The different questions can be found in *Table 1*. The time spent on a stationary computer, a laptop, and a smartphone in the last three months, was asked, both in T1 and T2.

Technology anxiety and technology enthusiasm are two factors that comprise the instrument: Older People's Attitudes toward Technology (TechPH) by Anderberg et al. (2019). This instrument was developed and validated, and it is currently used in the SNAC study as a means to investigate and evaluate older persons' attitudes toward and usage of the technology. There are six questions with two-factor loadings, and this study, it has a Cronbach's Alpha of 0.779 for Technology enthusiasm and 0.583 for technology anxiety.

Digital social participation is measured by a questionnaire that consists of six questions, asking about older adults' social and societal connectedness. This instrument was developed by Anderberg et al. (Anderberg et al., 2021). The questions vary from how the internet contributes to keeping a social network, reconnecting to old memories, and feeling less isolated. The scoring is a Likert scale and ranges from 1 (disagree) to 5 (totally agree). The Cronbach's alpha of the six questions is on the data from 2019 (0.906) and 2021 (0.905).

The IT questionnaire, is a survey that asks closed multiple choice questions regarding the current health status of the older adult, the usage of the Internet, through what means, what type of online activity, and digital social participation. The data was collected once in 2019 and the same questions were asked in an addition to COVID-19 questions, with regard to loneliness and health.

In 2021 the questionnaire was further extended, and questions were added as to the acceptance and usage of google home, robot home cleaners & outdoor grass cutters, lamps, and alarms that are monitored at a distance. The online doctor service, "Nätläkare", comprised three questions, the first whether the older adult used the service at all, and the other two questions referring to whether they would consider using videoconfer-

encing or text messaging with healthcare professionals in the future.

Statistical analyses

The data was analysed using SPSS version 28.01.01. The Edwards-Nunally index (EN) was used with the following formula:

$$XT2 < (cronbach's\ alpha * (Xt1-mean) + mean - 1.960 * standard\ error).$$

This calculates a change in the score of technology anxiety and technology enthusiasm of the older adult over time and avoids the regression to the mean. A Mann-Whitney U test was used to investigate the variables sex, living alone/with someone, and health status with EN TechAnxiety in T1 & T2. This is to investigate whether there is a difference between the observations, H0 being gender, living with someone/not, and subjective health is the same across Technology anxiety/enthusiasm. Age, Cognitive function MMSE, and digital social participation were all investigated through a Kruskall Wallis test, to see if they altered the scores of TechAnxiety and TechEnthusiasm.

The three questions about the service online doctor were investigated through a cross-tabulation table; indicating how many people use the service over time and if they feel positive toward it or not. The two last questions ask whether the person would consider a videoconference and text messaging with a doctor. A logistic regression was then used to test the significance of whether the variables affected the change of TechAnxiety and Tech Enthusiasm scores over time, with the significant variables of the univariate analyses.

Ethical considerations

Written and informed consent was collected from all participants in SNAC-B. This study was approved by the Research Ethics Committee of Lund University (LU- 64000) with EPM Dnr (2020- 04378).

Results

Table 1 indicates what the older adult is doing online. Most people are using online banking, reading the news, and looking up information. Making medical calls (16.3%) is low, compared to looking up their medical records (40.3%). Many older adults use the internet to book travel, such as trains and buses (33.2%). Listening to music or playing games was popular (47.5%), as well as social media such as Facebook (50.1%) but listening to the web radio was lower (34.6%). Many older adults had gotten in touch with emergency numbers (51.6%), and video were around (49.5%). 48.3% used the Internet for maps and GPS.

In *Table 2*, the use of a computer, laptop, tablet, or smartphones over the last three months

Table 3. Cross tabulation of Technology Enthusiasm and Technology Anxiety with the online service "Nätläkare" ('consulting a doctor online')

	Questions and percentage		Pearson chi square
	No	Yes	
Have you ever used the service 'Nätläkare'			
TechAnxiety no change in score	164 (54.1%)	4 (1.3%)	
TechAnxiety change in score	130 (42.9%)	5 (1.7%)	NS
Videoconference with doctor			
TechAnxiety no change in score	123 (40.9%)	44 (14.6)	
TechAnxiety change in score	74 (24.6%)	60 (19.9%)	p < 0.001
Text messaging with doctor			
TechAnxiety no change in score	137 (45.5%)	31 (10.3%)	
TechAnxiety change in score	87 (28.9%)	46 (15.3%)	p < 0.001
Have you ever used the service 'Nätläkare'?			
TechEnthusiasm no change in score	238 (78.5%)	8 (2.6%)	
TechEnthusiasm change in score	56 (18.5%)	1 (0.3%)	NS
Videoconference with doctor			
TechEnthusiasm no change in score	145 (48.2%)	99 (32.9%)	
TechEnthusiasm change in score	52 (17.3%)	5 (1.7%)	p < 0.001
Text messaging with doctor			
TechEnthusiasm no change in score	169 (56.1%)	75 (24.9%)	
TechEnthusiasm change in score	55 (18.3%)	2 (0.7%)	p < 0.001

is asked. The table has also the development in time (2019-2021) of those who have never used either of the abovementioned tools. Smartphones are the highest in usage.

In the univariate analyses, cognitive function and living alone/ were not significant with technology anxiety or technology enthusiasm. The authors used the significant variables from the univariate analyses, and conducted logistic regressions with the EN index of significant change in score in Technology enthusiasm and technology anxiety (*Tables 4-5*).

Table 4 indicated that people are more anxious if they were less digitally active and higher in age. With technology enthusiasm, when it decreased over time it was significant with not being as digitally socially active, and not wanting to have video conference calls with their doctor.

DISCUSSION
Technology anxiety is on the increase with age, and over time it is influenced by less DSP. Technology enthusiasm is something that decreases with time if there is less DSP, and older adults are then less open to new services such as videoconferencing with their doctor.

Digital ageism is a complex phenomenon, which requires different solutions in order to include as many older people as possible in the digital society in a positive way for them. Staying active online and participating digitally may be a way to reduce digital ageism, so far that the stereotypes portraying the older adult as not willing and/or unable may diminish.

As mentioned, a negative bias is prevalent, and in general people under 65 years of age are the ones that are analysing, working with, and creating the type of technology and the new type of e-technology for older adults to use. Digital practices do not include older adults or many at least include an inaccurate categorisation of this group (Rosales & Fernández-Ardèvol, 2020). If older adult is excluded from the design and development of technologies, this can then make them decide to not participate digitally. Furthermore, if they are not using so much technology fewer data is collected on older adults making it less encompassing for AI and fewer algorithms to choose from. Older internet users are underrepresented in the data sets that inform algorithms on digital platforms for example (Rosales & Fernández-Ardèvol, 2020). Studies have shown that individual-level older adults, do not exist in awareness of those who bridge and translate the digital language for them; many younger people lack awareness of older adults' difficulties (Manor & Herscovici, 2021).

In this sample, the older adults using the internet are 76.7%. Those who are slower in the uptake of participating or being online, have been indicative of ageism (Chu et al., 2022). It has been noted that many older adults have late contact with the internet, due to not working with computers. Some countries today report that it is constantly moving toward leisure–oriented usage (Rochat et al., 2021). What seems to be taken into consideration in the last years is that AI do not take into account the use, interests, and values of older adults and has just reinforced and amplified disadvantages (Chu et al., 2022) and these reduce the quality of the products and services for the older adults.

Until 2019, many services focused on health, health decline, help, and isolation; today it is suggested to move onto leisure, fun, and culture and inspect the roles digital technologies have

Table 4. Logistic regression with independent variable: Video text with doctor, health, digital social participation (DSP), age and gender, and the dependent variable change in score of Technology anxiety

Technology Anxiety	Coeff	OR	CI 95%	Significance
N 294 Tech Anxiety				
Video conference with doctor	0.439	1.551	0.860- 2.797	NS
Text messaging with doctor	0.293	1.340	0.704- 2.551	NS
DSP	0.297	1.346	1.071-1.692	p < 0.05
Age	(-0.039)	0.966	0.925- 0.999	p < 0.05
Health good	0.205	1.227	0.712- 2.117	NS

in an older person's life (Sayago, 2019). EU institutions recognise digital literacy and access as important factors in the enjoyment of citizenship rights (Shaping Europe's Digital Future | Shaping Europe's Digital Future, n.d.); strengths and virtues are in focus rather than weaknesses and pathologies. In Sweden, the digitally engaged older adult signifies more active citizenship where self-reliance is in focus (Alexopoulou & Åström, 2022). The social democratic welfare regimes have a larger share of older adult internet users. The high amount of public services that are online services in fact teach the older adult to be comfortable with using these services (Alexopoulou et al., 2022).

Many of the negative views of older people are how they are represented and viewed in society. Many underlying ideas such as older adults being frail, incapable of keeping up, or that they are 'deserving' (Binstock, 2010) are all negatively connotated. These biases make sure that older adults may not easily try new applications or venture into new technology. This is partly what makes digital ageism more alarming today. Ageism tends to become a self-fulfilling prophecy. Many create internalised stereotypes of themselves. An older adult will start enacting the inability to participate online, making it much more difficult for him or her and eventually excluding themselves naturally from available e-technologies.

In fact, it should be noted that older adults are more prone to positivity contrary to negative bias. This means that they remember positive stimuli and events more than negative ones, based on age. In research conducted older adults were remembering slogans of advertisements that were emotionally meaningful (Carstensen, 2019). Negative events are more remembered by younger adults and also retold in social contexts. The positivity effect is the shift from negativity bias to positivity bias that emerges in midlife to late adulthood. This could be helpful when creating a service for older adults, such as life-story, cognitive-focused interventions, or better sleep applications. In addition, new technology should in fact be self-explanatory, so it should be developed so that it is not difficult to learn to use/adapt to.

Technological, social, and individual biases interact and reinforce each other, and many digital platforms exclude older adults, to begin with (Chu et al., 2022). For e-technologies to thrive they need to start with trust, confidence, and quality. Biases also arise from the context in which the technology is used. If there is digital ageism, much has to do with how and the type of e-technology that is being utilised. It is noted in this study that there much more smartphone compared to other tools. The older adult is still slow in the uptake of using different tools/services/entertainment.

However, if there is positive input from adverts or people, this can make the older adult already remember the topic. Many health care needs base themselves on younger older adults. Those higher in age did not try and use a video consult or text messaging with their healthcare centres and doctors. It is still more attractive for younger older adults (65-74).

Being higher in age is indicative of someone who is less digital and more anxious. This corroborates with another study conducted using DSP and investigating psychological health (Ghazi et al., 2022). Making the last twenty years better are becoming more important than living longer ('Longevity Briefing: April 2022', 2022). This is where participating digitally is a means to ensure a longer healthier life. In places like Sweden, which has 33% eGovernment tools (Valokivi et al., 2021), it may be important to be able to do administration and online banking, conduct social calls online, etc. These are all closely related to technology enthusiasm. The new ways to stay up to date with the chronic diseases that people live with may be valuable, but age tempers with the need to have energy influencing technology anxiety which will make the older adult not want/be able to go online.

For older adults, it has been shown often that learning how to use online information and where to get new knowledge on how to handle chronic illnesses benefits the older adult and the health care professional (Jandoo, 2020). Yet this may only be for younger older adults. With digital ageism it may be important to really focus on the first age group to work on digital (health) solutions, considering technology anxiety increases with age.

Limitations and future research
Further studies should investigate the extremely negative values of digital social participation and

Table 5. Logistic regression with independent variable: Video text with doctor, health, digital social participation (DSP), age and gender, and the dependent variable change in score of Technology enthusiasm

Logistic regression	Coeff	OR	CI 95%	Significance
N 294- TECH enthusiasm				
Video conference with doctor	(-1.140)	0.320	0.113-0.909	p < 0.05
Text messaging with doctor	(-1.500)	0.223	0.048- 1.044	NS
DSP	(-0.608)	0.545	0.398- 0.744	p < 0.001
Age	0.006	1.006	0.958- 1.057	NS
Gender (male)	(-0.567)	0.567	0.296- 1.087	NS
Health good	(-0.056)	0.945	0.474- 1.886	NS

Notes: OR: odds ratio, CI: 95% confidence intervals
DSP is digital social participation, scoring high is higher participation

technology anxiety and enthusiasm. It may provide interesting results to evaluate what increases digital social participation, and evaluate the same variables that influence change in usage. In this study, cognitive function was not significantly associated with technology enthusiasm or anxiety. It would however be useful to rep-licate our findings in other studies. Specific internet activities can be addressed in a more encompassing way, where older adults might share their positive encounters with internet usage. This will increase the amount of data available on older adults and possibly at least reduce the uncertainty and bias in algorithms, especially AI algorithms, which are becoming more adopted in general society.

In order to focus on better digital literacy and access to assistive technologies and Internet tools by older adults, it may be a suggestion to educate the ones working with the AI algorithms about positive aging. It is necessary to create trust, confidence, and quality in the tool itself.

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