Ageism — an Invisible Challenge in User Research of Information Science?

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Abstract

Information behavior researchers focus on the human aspects of information interactions and tend to categorize participants with descriptive variables to uncover relationships between behaviors and study participants. Age is a common demographic variable in information science research. However, using age as the sole variable can lead to stereotypical perceptions and ageist beliefs. This study aims to explore the stereotypical assessment of the age group 60+ in relation to technical competence. Quantitative data on the assessment of different age groups were collected from 262 individuals through an online survey. The data were summarized using descriptive statistics. *t*-tests were used to reveal differences in demographics and the average estimation of age groups. The results show a strong indication of other-directed ageism, but no self-directed ageism for technical competence. Additionally, a strong sexist perception of femininity and technical competence became evident in the analysis. This result is a product of self-directed sexism, as female participants rated themselves lower in technical competence. The mean assessment of technical competence varies more between the age and gender groups than the results of social and organizational competence, indicating that stereotypical negative ideas of age and gender are present especially in technical competence. The findings of this study show stereotypical assessment of individuals based on the perceived age of the other person. This is particularly strong in the technical area and is reinforced by gender to the disadvantage of older adults. It remains a challenge to limit the effects of ageism and other forms of discrimination in the research design of user studies in HCI or information science. However, as a researcher investigating user behavior, it is important to identify and address them.

Keywords: user study, user research, ageism, age, older adults, information behavior, human-computer interaction, HCI

1 Introduction

In a literature review, Hillebrand (2022) examined empirical studies in information behavior research on the information needs and usage of information and communication technology (ICT) among older adults. Of the papers reviewed, 69% focused on health-related topics. The study confirmed that there is still limited research on older adults outside of health-relevant issues (Asla et al., 2006). Furthermore, the results support the deficit discourse on older adults that Vines et al. (2015) explored in human-computer interaction (HCI) and Lundh (2016) criticized in information behavior research with children. The central argument of the authors is that for both age groups, too much research focuses on what they cannot do yet or what they can no longer do. This results in an attributed helplessness for young and old, which is to be solved by technology development. For older adults, technology is seen as a solution or a reduction of risks associated with aging (Neven, 2011; Vines et al., 2015). Technology is expected to balance the limitations of biological aging, for instance, by using ICT to break down age-related isolation (e.g., Khosravi et al., 2016).

Aging is not always viewed positively in society. Social and cultural research is investigating how aging and death are perceived in society and the consequences that arise from this (e.g., Nelson, 2005; North & Fiske, 2012; Chonody et al., 2014). When age is perceived primarily as a negative variable, this can be fertile ground for ageism. Ayalon and Tesch-Römer (2018) defined ageism as the complex, often negative construction of (old) age. Older individuals are viewed as a homogeneous group. Ageism is a special form of discrimination because it (a) applies to all people and (b) is widespread and accepted in society. No other group than older adults is openly stereotyped, with people believing that they are not expressing negative stereotypes or prejudice but merely true statements about older adults (Nelson, 2011). These outward biases can become internalized and inflict self-directed ageism. The rejection and fears of one's own aging process and the lack of social

space in which this can be addressed can lead to technology being stigmatized for older adults and deliberately not used (Vassli & Farshchian, 2018).

Hillebrand's (2022) literature review indicates that ICT plays a significant role in the research area of aging and information behavior. Online health information seeking, smart technology for health promotion and monitoring, usability testing of health-related websites, online information seeking behavior, digital skills, cyber security, or e-book walls are topics researched in relation to older adults and information behavior. This kind of research is linked to ICT development, where the research area of information science and information behavior come together with HCI. User studies to evaluate ICT often take place in this discipline intersection. In user studies, participants are categorized using descriptive variables to uncover relationships between behaviors and study participants (Lundh, 2016). As ageism is neutralized in everyday life through social acceptance, the design of technology can embody social ageist views, which, in turn, cannot be immediately identified as ageist when using technology due to the overall acceptance of ageism. Even if diversity is built into research design, it can get lost in the reproducible demand of scientific processes, at the expense of the representative of the user's reality (Oudshoorn et al., 2016). According to Kuhn (1970), research paradigms are values, methods, and beliefs shared by a scientific community. Depending on the paradigm, the question of how objective a researcher can be differs. However, questioning one's own possible biases and assumptions is an important aspect of doing good research.

Little attention has been given to ageism in the information science area. The study presented here aims to change this. The empirical data collection explores stereotypical assessment of age groups in relation to technical competence. The research focuses on whether perceived age promotes ageist stereotypes in the context of technology competence of older adults. For this purpose, an online survey combined with photographs was conducted that asked participants to assess competencies of people depicted in a fictitious scenario. For the analysis, independent *t*-tests were performed based on age groups of the participating and depicted persons.

2 Research Background

According to Balázs (2013), research on ageism is often contradictory. As stereotypes are often formed unconsciously, it is critical to find reliable ways to research ageism in psychology and social sciences. Social science studies on ageism often use the stereotype content model, a questionnaire developed by Fiske et al. (2002), which focuses on competence but not specifically on technical competence.

HCI research on technological competence and older adults focuses more on acceptance, usage, and preference of technology, and less on social and cultural aspects that may influence these factors. Empirical studies in the field explore matters of usability, inclusive or universal design, which primarily means the physical ability and attitude to use technology (e.g., Chao et al., 2017). However, some articles in HCI research critically address the variable of age. For example, Dickinson, Arnott, and Prior (2007) analyzed age information in recent issues of three journals in the field and found that only two of the 39 studies included people over 60 in their sample. They concluded that HCI research relies too much on young, well-educated test subjects.

Similarly, Vines et al. (2015) analyzed three decades of research on aging published across the ACM Special Interest Group on Computer-Human Interaction (SIGCHI) community and found that aging in human-computer interaction is typically framed as a "problem" that can be managed by technology.

Petrie's (2018) study on ageism and sexism among young computer science students is one of the few empirical studies that looks at individuals and biases related to technical competence. She found a strong ageist belief among students regarding older users of technology, regardless of gender. Participants in the study perceived older men and women as similarly incompetent. This difference in perception of aging between genders and its impact is explored through the concept of the "double standard" (Bell, 1982). Petrie's method, which used a combination of photographs and survey, is similar to the research design used in this study. However, Petrie's approach was explicit, focusing solely on the technical competence assessment of the person depicted. Nevertheless, the results were age-sensitive, supporting the argument that negative assumptions about older generations and their use of technology are socially accepted (Nelson, 2011).

In the field of information behavior, there are few studies that explore ageism. Barrie et al. (2021) researched ageism as a central theme in interviews on a teaching program for older adults in a public library. Asla, Williamson, and Mills (2006) concluded that information needs of the oldest adults appeared to have diminished significantly except with regard to health information. They find it troubling that there are few studies that do not treat older adults as a homogeneous group. This study aims to expand on the few studies in the information research area by exploring ageism.

2.1 Ageism in Practice

In the 1960s, gerontologist Robert N. Butler introduced the term ageism. Initially defined as "a form of prejudice from one age group against another age group", the concept has evolved into a complex term that is inconsistently used across various research fields (Iversen, Larsen, & Solem, 2009). In their analysis, the authors identified 21 variants of ageism within four key dimensions, with definitions handling concepts, causes, or consequences of ageism on three possible levels: micro, meso, and macro. Ageism has three components on a micro level: cognitive (stereotypes), affective (prejudice), and behavioral (discrimination). It can be measured either implicitly or explicitly, and the choice between the two can affect research methods and the level of awareness in the investigation. Explicit methods involve a research process that is not hidden from the participants, while implicit methods attempt to explore unconscious processes.

The unconscious forms of discrimination stem from the cognitive process of categorization. Simplification makes it easier for humans to react more quickly and save processing capacity. On a micro level, the activation of a stereotype depends on the availability of cognitive resources, mindset, and goals (Pendry, 2014; Voss et al., 2018), and is a part of social grouping (Spears & Tausch, 2014). On a macro level, cultural attitudes towards age and death (Lev et al., 2018; Nelson, 2011) contribute to the social stigmatization of ageism.

To better understand the origins of ageism, research distinguishes between self- and other-directed ageism. Self-directed ageism covers internalized age biases (Voss et al., 2018), while other-directed ageism covers age biases towards other persons. Ayalon and Tesch-Römer (2017) argue that these two types of ageism can be researched separately but are inextricably linked.

As with other forms of discrimination and stereotypes, ageism exists in both negative and positive forms. Positive stereotyping is the expectation of a certain positive characteristic based on a perceived characteristic such as age. It differs from negative stereotyping in that the attributed characteristic is socially valued more positively. The consequences of a person not behaving according to the stereotype can be negative in both cases.

Currently, there are no studies that research ageism in relation to technical competence. Further exploration of this relationship would be interesting for user studies that combine these two elements. Ageism is often socially accepted and rarely questioned, which is why its effects may manifest in the preparation and implementation of user studies for technical development. Therefore, this study aims to examine negative stereotypes on the micro and cognitive level in the relationship between chronological age and technical competence. An implicit approach is used to investigate whether technical competence, in comparison with other competences, produces particularly strong ageist assessments. While the research question focuses on other-directed ageism, a smaller part of the questionnaire addresses the issue of self-directed ageism to explore any link between self-directed ageism and other-directed ageism.

3 Method and Study Design

To the best of the author's knowledge, this is the first study to approach ageism in a multifaceted way. It examines not only whether age-discriminating assessments are given but also whether stereotypes about older adults are particularly strong in the area of technical competence. Additionally, the study explores not only other-directed ageism but also self-directed ageism and whether one influences the other. The collected data sample is used to explore the following research questions:

RQ1) Are the technical competencies of the depicted age groups rated differently than their social or organizational competencies?

RQ1a) Does the age or gender of the participants affect the rating of the three depicted age groups?

RQ2) How do the participants rate themselves for the three competencies?

RQ2a) Does the age or gender of the participants affect their self-assessment?

An online survey was conducted to answer the research questions. For this purpose, twelve photos were taken during the first global COVID-19 lockdown in May 2020. Photographs, sketches, or drawings are commonly used in ageism studies to represent an age group (Flamion et al., 2020; Balaz, 2013; Barrett & Cantwell, 2007; Cuddy et al., 2005). Since the author was unable to take the photos due to strict health restrictions at the time, employees from her workplace were asked to assist in collecting them. The instructions given were to take a picture of a family member with a personal computer. The resulting pictures were taken in different rooms of the participants' homes.

The photos were categorized into three age groups: four people aged between 18 and 40, four people aged between 40 and 60, and four people aged between 60 and 80. This grouping makes sense since 60 is a commonly used age cut-off for older age (Kessler & Warner, 2023; Kite & Wagner, 2004). The age groups of 40–60 and 18–40 were chosen to maintain an age gap of approximately 20 years between the groups. Each age group was represented by two females and two males.

The next step was to determine the scenario in which the online survey would take place. As an implicit approach was to be followed, unlike Petrie's study (2018), it was necessary to create a scenario where technical competencies played a role while remaining comprehensible. The selected scenario involves the participant pretending to be responsible for organizing a festival within a village or district, which fulfills the desired requirements. This scenario is accessible to a variety of participants, and different competencies can be required within it. The online survey was designed in German.

The author decided to request three competencies per person pictured, which seemed appropriate to avoid overwhelming the participants with twelve photos. These competencies should include social competence, in addition to technical competence, since cooperation between several people is necessary when organizing a festival, making the ability to work in a team relevant. Furthermore, the organizational competence of the individuals should be assessed, as organizing a festival requires skills like overseeing certain processes. To help participants with each competency, an example scenario was proposed. The exemplary tasks were:

a) social competence: ensuring a good atmosphere within the team
b) technical competence: wiring the sound system
c) organizational competence: taking over the guidance of the security team.

Although the literature on the subject recommends a scale with a maximum of seven options (e.g., Steiner & Benesch, 2018), a rating scale from 1 to 8 was chosen for the assessments. The pre-tests (for details, see the next section) mainly influenced this decision. To clarify which value represents the positive or negative attribute, the verbal attribute "very low" was added to 1, and the verbal attribute "very high" was added to 8. The choice of wording referred to the question phrase. Participants were asked to estimate the probability of entrusting the person depicted with the following tasks.

The survey was conducted using Lime Survey. Initially, participants were presented with a scenario in which they were responsible for organizing a neighbourhood event. They were given twelve individuals to assist with the event and asked to assess the likelihood of trusting each person with specific tasks. Next, 12 photos of people from three age groups were shown in random order. For each person, participants had to estimate their competencies in three areas.

To answer RQ1, participants were asked to estimate the age of the person depicted in the twelve photos. The photos were shown a second time, and participants were given three age categories to choose from: younger than 40, between 40 and 60, and older than 60. For RQ1a the age and gender of the participant were asked for at the end of the survey. To assess self-directed ageism (RQ2 and 2a), participants were asked to evaluate their own competence in the three areas.

3.1 Pre-test

To ensure the comprehensibility of the survey, pre-tests were conducted with employees of the Berlin School of Library Information Science, as well as with individuals from the author's personal network. Care was taken to use different types of devices and browsers to test the technical processes. A total of ten people were asked to complete the survey, and eight people were able to comply with this request. The pre-test had a major influence on the choice of the rating scale for the assessment of competencies. The majority of participants, when asked whether they preferred a numerical scale or a verbal scale, answered with the numerical variant. The decisive factor seemed to be that a rating with numbers felt less like a judgment about the person, and that numbers were also more common in other rating scenarios, such as restaurants or books.

The number of possible categories was also discussed with the pre-testers. All testers reported that it would be difficult to rate people based solely on first impressions, and that they would tend to give a neutral rating if it was clearly visible. This led to the decision that no odd number should be chosen in order to avoid such evasive ratings. Instead, the participants should have a differentiated choice on the negative and positive side, which is why four negative expressions and four positive ones were chosen.

3.2 Recruiting

Two restrictions were in place for participants in the survey. Firstly, they needed to confirm that they were at least 16 years old and that they did not know anyone pictured in the survey, as this could have potentially skewed the ratings. Since no particular demographic characteristics were deemed necessary for participation, the recruitment process proceeded as follows: The first group of participants was selected from the area around South Tyrol, where the author was in lockdown at the time of data collection. An Instagram profile was created for the survey to allow for contactless invitations. The survey account served as an anchor for the survey link, which could be shared on the platform, and following the account made it possible to receive friendly reminders throughout the weeks. The QR code of the survey was uploaded to the account so that people could share it with non-Instagram users. This, combined with personal canvassing by the author, resulted in 102 fully completed questionnaires. The second group of participants was recruited through a usability testing agency. The target was 100 people aged 18 and over who spoke German, and this resulted in 106 participants. Another 40 respondents were students in one of the author's university courses, and the smallest sample of 14 people were acquaintances of the author from Germany. Data collection was completed in November 2020, with a total of 262 surveys collected.

3.3 Methodological Limitations

A significant challenge in this study was to find a suitable task example for the technical competence. Although the example was plausible and appropriate within the scenario, it cannot be ruled out that all 262 participants imagined something different under a sound system.

The current study design provides insights about first impressions of age groups. Factors related to the images, such as the background, device used, or posture of the depicted persons, may have influenced the evaluation. In reality, it would be possible to collect more information about people in order to assign them the appropriate task. Therefore, this study design may promote stereotyping since participants can only draw on their prior knowledge and expectations about age groups. However, there are two reasons why this design is still valid. First, contextual information is present in everyday life, which enhances the ecological validity of the study design. Second, Cuddy and Norton (2005) presented additional competence information for the evaluation of older adults' personas in some cases, but not in others. In the results, the personas with additional competence information did not receive a higher competence rating in comparison to personas without additional information. This indicates that even with counteracting information, stereotypical beliefs can still prevail.

4 Data Analysis

The 262 data sets were analysed using SPSS. 179 participants identified as female, 77 as male and six as non-binary. The age range was 16 to 66 years old, with a median of 26.

4.1 Data Preparation and Outliners

In the data analysis, the variables age and gender occur twice: once for the participants and once for the persons in the photographs. The following abbreviations are used to describe the age of the depicted persons: AG1 refers to the four youngest people pictured (younger than 40 years), AG2 to the middle-aged group (40 to 60 years old), and AG3 to the four oldest adults in the photos (over 60 years old). The age range of the sample is from 16 to 66 years old, which is similar to the depicted age groups. However, the distribution in the age groups varies too much for the same segmentation. Therefore, the author decided to form two age groups that are approximately equal in size to ensure the validity of the comparison (see Table 1) by matching the median of the sample. The age group < 25 includes all participants

16 to 25 years old, while the age group > 25 includes all participants from 26 to 66. These groups were maintained for further calculations.

Table 1: Distribution of the participants two age groups

Groups	Frequency	Percent	Valid per.	Cum. Per.
< 25	**128**	48.9	48.9	48.9
> 25	**134**	51.1	51.1	100.0
Total	**262**	100.0	100.0	

For calculating the average ratings of the depicted age and gender groups, outliers were calculated after the recalculation of the group variables. No outliers were found. For calculations based on individual picture ratings (as seen in Table 3), outliers were excluded on a case-by-case basis.

Due to their small sample size, the six non-binary individuals were excluded from gender calculations. The group is described separately in the results section.

Regarding age estimation by participants, eleven people were assigned to the correct age group. One male from AG2 was assigned to AG1 by the majority of the sample. This is noted again in the relevant results section.

5 Results

The following sections present the evaluations that contributed to answering the research questions: first, whether the perceived age of the age groups influences the assessment of the three competencies; second, how the age and gender of the participants relate to their assessments. Additionally, the results section discusses unexpected findings related to gender biases. The second part of the results evaluates the participants' self-assessment and examines how the demographic variables of age and gender influenced their assessments. Participants were offered a scale with four negative categories (1 [very low] – 4) and four positive categories (5 – 8 [very high]) for the assessment.

5.1 Assessment of the Depicted Age Groups

Table 2 shows the mean assessment for all competencies by all participants across the three depicted age groups. The average score for technical compe-

tence (TC_AG1/2/3) decreases by approximately 1.0 from the youngest to the oldest age group. For social competence (SC_AG1/2/3), the score slightly increases towards the oldest age group. The average scores for organizational competence (OC_AG1/2/3) are the same for all age groups, with differences in decimal digits.

Table 2: All participants mean assessment for the three competencies of the three depicted age groups

Measure	TC_AG1	TC_AG2	TC_AG3	SC_AG1	SC_AG2	SC_AG3	OC_AG1	OC_AG2	OC_AG3
Mean	5.68	4.84	3.90	4.86	4.51	5.19	5.29	5.64	5.06
N	262	262	262	262	262	262	262	262	262
Std. dev.	1.008	0.922	1.154	0.922	1.125	1.173	0.964	0.969	1.053

The largest gaps between individual average scores are found in technical competence. This suggests that, for this competency in particular, perceived age leads to more varied ratings than for the other two competencies.

Table 3: Rating of each depicted person for the technical competence

Ranking technical competence					
Groups	Gender	N	Minimum	Maximum	Mean
AG2*	m	260	3	8	6.48
AG1	m	262	2	8	6.26
AG1	m	262	2	8	6.22
AG1	f	262	1	8	5.14
AG1	f	262	1	8	5.11
AG2	m	262	2	8	5.00
AG3	m	262	1	8	4.81
AG3	m	262	1	8	4.62
AG2	f	262	1	8	4.03
AG2	f	262	1	8	3.89
AG3	f	262	1	8	3.76
AG3	f	262	1	8	2.39

* The person in first place was the only person who was assigned to the incorrect age group by the majority of the sample. 70% of the participants estimated him to be younger than 40.

To understand the origin of the declining average, Table 3 shows the ratings for technical competence given by each person. The three youngest men from AG1 and AG2 received the highest scores for technical competence.

Next in line were the women from AG1, and all men from AG2 and AG3. The lowest average scores were given to all the women from AG2 and AG3. This descending average rating along the age scale is not as clearly discernible in either social or organizational competence.

To determine whether the age of the participants had an influence on the ratings, an independent *t*-test was performed with the two age groups of the participants and the three depicted age groups (Table 4). There was no significant evidence of differences in scores for the age groups in the assessment of technical competence for the depicted age groups. The age of the participants does not seem to significantly affect the ratings of the subjects.

*Table 4: Results of t-test of all three competencies by the two age groups of the participants to the three depicted age groups. **p < 0.05. ***p < 0.01*

Group Statistics						
Measure	Groups	N	Mean	Std. Deviation	T value	Sig. (2-tailed)
TC_AGE1	< 25	128	5.79	1.038	1.666	0.097
	> 25	134	5.58	0.973		
TC_AGE2	< 25	128	4.87	0.922	0.456	0.649
	> 25	134	4.82	0.926		
TC_AGE3	< 25	128	3.85	1.271	-0.569	0.570
	> 25	134	3.93	1.033		
SC_AGE1	< 25	128	4.83	0.987	-0.492	0.623
	> 25	134	4.88	0.858		
SC_AGE2	< 25	128	4.51	1.204	0.031	0.976
	> 25	134	4.51	1.050		
SC_AGE3	< 25	128	5.13	1.277	-0.914	0.362
	> 25	134	5.26	1.065		
OC_AGE1	< 25	128	5.34	1.005	0.849	0.397
	> 25	134	5.24	0.925		
OC_AGE2	< 25	128	5.75	0.964	1.815	0.071
	> 25	134	5.53	0.965		
OC_AGE3	< 25	128	5.12	1.146	0.842	0.400
	> 25	134	5.01	0.957		

The differences in results presented in Table 3 cannot be attributed to the age of the participants. No significant differences were found for social or organizational competence between the two age groups of participants.

Another demographic variable collected about the participants was their gender identification. An independent *t*-test was conducted to determine whether the gender of the participants had an influence on the rating of the

individuals depicted in the study. The two gender groups, female and male, were tested against the three depicted age groups (tab. 5). Since the gender groups differed in size, Levene's Test for Equality of Variances was used. For all calculations based on binary gender (male and female), equal variance is assumed.

*Table 5: Results of t-test for the evaluation of all three competencies by the two gender groups of the participants to the three depicted age groups. **p < 0.05. ***p < 0.01*

Measure	Groups	N	Means	Std. dev.	T value	Sig. (2-tailed)
TC_AGE1	female	179	5.75	1.010	2.178	0,030**
	male	77	5.46	0.972		
TC_AGE2	female	179	4.86	0.927	0.960	0.338
	male	77	4.74	0.821		
TC_AGE3	female	179	3.95	1.117	1.564	0.119
	male	77	3.71	1.146		
SC_AGE1	female	179	4.86	0.898	0.657	0.512
	male	77	4.78	0.891		
SC_AGE2	female	179	4.49	1.095	0.115	0.909
	male	77	4.48	1.094		
SC_AGE3	female	179	5.32	1.170	2.918	0,004***
	male	77	4.87	1.060		
OC_AGE1	female	179	5.29	0.950	0.364	0.716
	male	77	5.24	0.969		
OC_AGE2	female	179	5.66	0.958	0.708	0.479
	male	77	5.57	0.941		
OC_AGE3	female	179	5.16	1.023	2.253	0,025**
	male	77	4.84	1.003		

5.1.1 Non-binary Participants and Age Groups

The proportion of participants who do not identify as female or male is small and cannot be directly compared. Therefore, only the average score is evaluated for these respondents (Table 6).

Table 6: Non-binary participants mean assessment for the three depicted age groups of all three competencies

Group	Measure	TC_AG1	TC_AG2	TC_AG3	SC_AG1	SC_AG2	SC_AG3	OC_AG1	OC_AG2	OC_AG3
Non-binary	Mean	6.38	5.79	4.58	5.92	5.38	5.46	6.08	5.71	4.92
	N	6	6	6	6	6	6	6	6	6
	Sdt. Dev.	0.932	1.536	1.96	1.472	2.09	1.926	1.158	1.661	2.053

Regarding technical competence, the six non-binary participants estimated the scores for the three age groups as depicted in the entire sample. The scores decreased by approximately one point from the youngest to the oldest age group. For social competence, the youngest group received the highest rating, with the other two groups receiving similar scores. Organizational competence showed the same pattern as technical competence but did not prevail in the overall ranking (see Table 2).

5.2 Assessment of the Depicted Gender Groups

Since the gender of the participants had a greater impact on the results than their age, and the ranking of technical competence showed a biased pattern for gender (see Table 3), the author decided to take a closer look at the evaluations of the gender groups, even though this was not part of the original research interest.

First, the average rating of the two gender groups was considered. Subsequently, *t*-tests were used to determine whether the differences were related to the reported gender or age of the participants. However, since the survey did not plan to explore the gender-biased aspect, the perceptions of gender were not collected. It can only be assumed that the participants' assessment matches the actual gender with which the depicted persons identify.

Table 7: All participants mean assessment of the two depicted gender groups in all three competencies

Measure	TC_female	TC_male	SC_female	SC_male	OC_female	OC_male
Mean	4.05	5.56	4.82	4.88	5.17	5.49
N	262	262	262	262	262	262
Std. dev.	1.070	0.904	1.034	0.948	0.977	0.878

Table 7 shows that the mean difference between the two gender groups is highest in technical competence, lowest in social competence, and slightly higher in organizational competence. To determine if the differences are correlated with the age of the participants, an independent *t*-test was conducted with two age groups and the two depicted gender groups (Table 8). The assessment of competence for the depicted gender groups does not show any significant differences in the scores of the age groups.

*Table 8: Results of t-test of two age groups of participants to the two depicted gender groups. **p < 0.05. ***p < 0.01*

Measure	Groups	N	Means	Std. dev.	T value	Sig. (2-tailed)
TC_female	< 25	128	4.10	1.164	0.644	0.520
	> 25	134	4.01	0.974		
TC_male	< 25	128	5.58	0.940	0.297	0.766
	> 25	134	5.54	0.872		
SC_female	< 25	128	4.77	1.103	-0.791	0.430
	> 25	134	4.87	0.964		
SC_male	< 25	128	4.87	1.024	-0.186	0.852
	> 25	134	4.89	0.872		
OC_female	< 25	128	5.25	1.032	1.404	0.162
	> 25	134	5.08	0.918		
OC_male	< 25	128	5.55	0.923	1.064	0.288
	> 25	134	5.44	0.833		

The differences in results shown in Table 6 cannot be attributed to the age of the participants. The following analysis investigates whether the gender of the participants can account for the variations in ratings among the different gender groups.

*Table 9: Two gender groups of participants to the two depicted gender groups. **p < 0.05. ***p < 0.01*

Measure	Groups	N	Means	Std. dev.	T value	Sig. (2-tailed)
TC_female	female	179	4.10	1.029	1.796	0.074
	male	77	3.85	1.060		
TC_male	female	179	5.61	0.916	1.491	0.137
	male	77	5.43	0.840		
SC_female	female	179	4.89	1.001	2.095	0,037**
	male	77	4.60	1.041		
SC_male	female	179	4.89	0.938	0.620	0.536
	male	77	4.81	0.858		
OC_female	female	179	5.24	0.962	2.309	0,022**
	male	179	4.95	0.923		
OC_male	female	179	5.49	0.881	0.018	0.985
	male	77	5.49	0.804		

The independent *t*-tests (Table 9) show that there is no difference in how technical competence is rated between gender groups. However, for social

and organizational competencies, participants who identify as female rate their own gender group significantly higher, both with a small effect (SC, eta squared/η^2 = .02; OC, η^2 = .02).

5.2.1 Non-binary Participants and Depicted Gender Groups

The six individuals who do not identify as male or female rated males higher for technical competence. For the other two competencies, females received slightly higher evaluations (Table 10). The difference in technical competence rating between males and females was the largest, which is consistent with the results in Table 7. However, the results for the other two competencies were opposite to those in Table 7.

Table 10: Non-binary participants mean assessment for the two depicted gender groups of all three competencies

Group	Measure	TC_female	TC_male	SC_female	SC_male	OC_female	OC_male
non-binary	Mean	5.33	5.83	5.61	5.56	5.64	5.50
	N	6	6	6	6	6	6
	Std. dev.	1.506	1.274	1.385	1.948	1.658	1.687

5.3 Self-assessment

According to Table 11, participants rated themselves highest in organizational competence, followed by social competence, and lowest in technical competence. The self-assessment ranged between 5 to 6 points, including decimal points.

Table 11: Participants mean self-assessment in all three competencies

Measure	N	Minimum	Maximum	Mean	Std. dev.
SelfTC	262	1	8	5.19	1.607
SelfSC	262	1	8	5.48	1.493
SelfOC	262	2	8	5.87	1.461

An independent *t*-test reveals no significant differences in self-assessment based on the age of the participants for any competence (Table 12). The average self-assessment of the age groups does not vary considerably between participants younger as 26 or older.

*Table 12: Participants self-assessment for all three competencies divided by two age groups. **p < 0.05. ***p < 0.01*

Measure	Groups	N	Means	Std. Deviation	T value	Sig. (2-tailed)
SelfTC	< 25	128	5.11	1.671	-0.764	0.446
	> 25	134	5.26	1.546		
SelfSC	< 25	128	5.48	1.602	0.037	0.971
	> 25	134	5.48	1.386		
SelfOC	< 25	128	5.78	1.425	-1.005	0.316
	> 25	134	5.96	1.494		

Table 13 displays the mean average of self-assessments based on stated gender. Females rated themselves lowest in technical competence and highest in organizational competence. Male participants rated themselves highest in technical competence and lowest in social competence. The mean differences between individual competencies for males did not vary as much as among female participants. Non-binary participants rated themselves highest in social competence, followed by technical competence and organizational skills.

Table 13: Participants average self-assessment in all three competencies divided by gender

Groups	female	male	non-binary
Total	179	77	6
Measure	Mean		
SelfTC	4.89	5.88	5.00
SelfSC	5.59	5.23	5.33
SelfOC	6.02	5.64	4.50

Performing an independent *t*-test (Table 14) on the two binary gender groups reveals a significant difference in scores for females (M = 4.89, SD = 1.50) and males (M = 5.88, SD = 1.60, $t(264) = -4.74$, $p = .00$, two-tailed). The mean difference between the two groups was moderate (mean difference = −.9, 95% CI: −.1.4 to −.58; $\eta^2 = .1$). Participants who identify as female rate themselves significantly lower in terms of technical competence compared to those who identify as male. However, the two genders rate themselves similarly in terms of social skills. Female participants rate themselves significantly better than male participants in terms of organizational skills with a small effect ($\eta^2 = .01$).

*Table 14: Binary participants self-assessment in all three competencies. **p < 0.05. ***p < 0.01*

Measure	Groups	N	Means	Std. Deviation	T value	Sig. (2-tailed)
SelfTC	female	179	4.89	1.501	-4.743	0,000***
	male	77	5.88	1.597		
SelfSC	female	179	5.59	1.444	1.773	0.077
	male	77	5.23	1.572		
SelfOC	female	179	6.02	1.426	1.980	0,049**
	male	77	5.64	1.441		

6 Discussion

To the best of the author's knowledge, this study is the first to address stereotypical assessments of technical competence in older adults using an implicit approach. The assessments of 262 individuals in an online survey reveal a strong ageist perception of older adults and technical competence. Among the three competencies considered, technical competency in connection with older adults stands out particularly due to the divergent average ratings between the three age groups depicted (see Table 2 and 3). Therefore, RQ1 can be answered with a yes; the assessment of technical competence generated stronger negative ratings for depicted age groups than social or organizational competence.

The first performed *t*-test explored whether participants' age had a significant effect on the difference in scores between the age groups depicted. This was not the case (see Table 4). With a second *t*-test, it was shown that female participants rated the oldest age groups significantly higher in social and organizational competences, and the youngest age group significantly higher in technical competence than males (see Table 5). The female rating pattern supports the impression that being young is automatically linked to a better understanding of technology, while being older and perhaps having more experience can have a positive impact on social and organizational skills.

This suggests that the question of whether the age or gender of the participants affected the rating (RQ1a) is answered by the fact that participants' own gender had a greater influence on their perceptions of the age groups depicted than their age. A negative perception about age and technical com-

petence was already apparent among the six non-binary participants (see Table 6).

In summary, the average rating (Table 2) for technical competence shows that the negative stereotypical perception of the oldest age group depicted is shared by all participants in the sample.

A surprisingly interesting outcome of the data analysis related to RQ1 turned out to be the perceived gender. (Older) Females were rated on average as more technically incompetent than the males (see Table 7), therefore, two supplementary *t*-tests were performed to explore this matter deeper.

The first test examined whether age had a significant effect on the difference in scores between the depicted gender groups. The *t*-test revealed no significant differences for the two age groups of participants (see Table 8). With a second *t*-test, it was demonstrated that female participants rated females significantly higher for social and organizational skills, but this positive effect was absent in the assessment of technical competence (see Table 9). This finding complements the result of the first research question: The average assessment of the two gender groups depicted differed within all three competencies, and most significantly and negatively in technical competence. Additionally, participants' gender had a greater influence on their perceptions of the depicted gender groups than their age. This negative perception of older females is particularly noteworthy given the larger proportion of participants identifying as female. The six non-binary individuals rated males higher for technical competence. For the other two competencies, perceived females received better evaluations (see Table 10).

Regarding self-assessments (RQ2), participants in this study did not consider technical assignment as their strongest attribute. They rated themselves highest in organizational competence, followed by social competence, and lowest in technical competence (see Table 11). For RQ2a, the average self-assessment of age groups did not vary considerably between participants younger than 26 or older for any competence (see Table 12). However, when broken down by gender, it becomes apparent that the self-assessment order stems from two significant divergent self-assessments between female and male participants. Female participants rate themselves significantly lower in technical competence than male participants and significantly higher in organizational competence (see Tables 13 and 14). The self-assessment of the gender groups in this study affects the estimation of the depicted genders and therefore age groups. Presumably, female participants take their internalized negative gender images in relation to technological competence and merge

them with society's negative view of age in relation to technology. This resulted in female participants ranking the youngest age group significantly better in technical competence (see Table 5) and the missing significant positive effect on technical competence for the depicted females (see Table 9). Male participants rate themselves highly in technical competence, but, for presumably the same gender and age biased reasons as the female participants, rate younger persons as more technically competent and especially older women as more incompetent. The non-binary participants rated themselves highest in social competence, followed by technical competence and organizational skills. Due to the small group size of non-binary participants, no assumptions were made about how non-identification with binary genders would influence the assessment of binary genders.

When it comes to technical competence in this fictive scenario, the lower assessments for the older depicted adults does not differentiate significantly between age groups or gender groups of the participants but is shared by all. This is an indicator for a pan-generational, other-directed ageism. The results show no self-directed ageism as both age groups rated themselves similar in all competencies. It cannot be ruled out that for all calculations based on the participants age showed no significate results due to the fact that the sample as a whole is quite young with a median of 26 years.

The result of this study fits into the broader stereotype content model research with older adults. Fiske et al. (2002) concluded that older adults are perceived generally as incompetent but socially warm. This dichotomy is demonstrable in the results presented here. In addition to the negative effect on the technical competence, the oldest age group received the highest average rating for social competence (see Table 2).

The results on other-directed ageism agree with Petrie's study, however, this study shows a strong evidence of the double standard that Petrie found not. At one hand, this originates from an other-directed source, as the whole sample asset the older women as less technical capable. At the other hand, there is a self-directed source as the lower self-assessment of the participants who identify as female shows.

It can be stated that perceived age and gender is more negatively linked to the assessment of technical competence than to social or organizational competence. The technical competence results vary more between the depicted age and gender groups, which can be an indication that stereotypical negative ideas of age and gender are present especially there.

This study highlights that technology and older age create a negative, homogeneous image of older adults as technology user. Considering older adults as a homogeneous group can allow ageist beliefs to enter the research process and influence the development of technology for older adults (Oudshoorn et al., 2016). If stigmatized technology is rejected by older adults, it may not be considered valuable feedback for technology development (Knowles and Hanson, 2018). Instead, rejection may be attributed to negative stereotypes about older adults, such as incompetence or disinterest in technology use.

As ageism is invisible and internalized in society it will be necessary to deal with it more actively as a researcher. Based on the results of this research, user studies in information science or HCI examining variable age and technical competence should pay more attention to the possibilities of inherent ageistic influences on their research process.

Yet what exactly can be done in user studies to avoid ageistic influences remains to be figured out. A conscious planning of diversity in research design seems not to be enough (Oudshoorn et al., 2016). As ageism is strongly embedded in our society, the quick fix will not only be practical lessons for researchers, but also in a more profound discourse on intersectionality and its relevance for user studies. This can lead to raising awareness among researchers, who in turn can offer society heterogeneous views on age and technology.

6.1 Limitations

There was no planned age range for the survey. This resulted in the entire sample being very young on average (median = 26). For future replications, it would be an improvement to find more participants who fit the age groups depicted.

7 Conclusion

This study examined the effect of perceived age and one's own age on the assessment of technological competence. In an online survey, 262 people rated 12 depicted individuals and themselves in three competencies: social, technical, and organizational. The assessment of technical competence ge-

nerated stronger negative ratings for the older age groups than the social or organizational competencies. Older adults were rated as less technically competent than the sample, and if the person pictured was female, this had an additional effect on a lower rating. When the assessing person identified as female, their self-assessment for technical competence was significantly lower than when they identified as male. While older depicted females were not rated significantly higher in technical competence by female participants, this was the case for social and organizational competence.

This study highlights the strong complementarity of sexism and ageism. The gender-biased tendency is particularly interesting because the majority of participants identified as female. This indicates a self-directed sexism among female participants in relation to technical competence.

The results provide insight into the negative association between age and technology competence in society. User studies are a valuable way to design technology in a participatory way with user groups. However, for older user groups, the fruits of this collaboration seem to be constrained by the largely invisible challenge of ageism on different levels. As ageism is difficult to research, the implications for technological developments are just as difficult to grasp or quickly resolve. It remains a challenge to limit the effects of ageism and other forms of discrimination in the research design of user studies. Yet, as researchers investigating user behavior, it is important to identify and address them.

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