Original Research

DIGITAL HEALTH

DIGITAL HEALTH
Volume 9: 1–12
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DOI: 10.1177/20552076231218812
journals.sagepub.com/home/dhj
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Are nursing home employees ready for the technical evolution? German-wide survey on the status quo of affinity for technology and technology interaction

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Abstract

Background: Technological devices can support nursing home employees; however, their perspective is not sufficiently studied. Our aims were thus to (a) examine affinity for technology and technology interaction and related sociodemographic confounders, as well as (b) detect possible requirements and boundary conditions relevant for the development and implementation of assistive technologies among nursing home employees.

Methods: We conducted an online survey between May and July of 2022 among 200 nursing home employees in Germany. The survey included two questionnaires, that is, Affinity for Technology Interaction (ATI) and Affinity for Technology–Electronic Devices (TA-EG; subscales TA-EG-Enthusiasm, TA-EG-Competence, TA-EG-Positive Consequences, and TA-EG-Negative Consequences), as well as sociodemographic variables, that is, age, gender, professional groups, education/graduation level. We carried out factorial variance and multiple regression analyses.

Results: There were differences between age groups in ATI (lower score with increasing age) and between gender, age, and professional group in TA-EG (lower score for females, participants with higher ages, and nursing home managers). Predictors of ATI were age and professional group, predictors of TA-EG, TA-EG-Enthusiasm, and TA-EG-Competence were gender, age, and professional group. Predictors of TA-EG-Positive Consequences were education and professional group.

Conclusions: We observed rather high affinity for technology and technology interaction values overall, and particularly for nursing home employees compared to managers. Significant predictors for technology affinity and interaction may have important implications, for example the perspectives of nursing home employees and managers should be considered separately in the technological design, development, and implementation process. Furthermore, an open dialogue between all stakeholders should be encouraged to increase the probability of actual technology use.

Keywords

Technology acceptance, digital transformation, care professional, assistive technology, older people

Submission date: 16 May 2023; Acceptance date: 20 November 2023

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Introduction

Digitalization is becoming increasingly present in many areas of life and has a significant impact on how individuals communicate, consume, conduct daily tasks, organize their lives, and care for themselves or others.[1,2] Digitalization and technological development are regarded as a potential solution to the growing problems of an aging society, that is, the increased need for care for older individuals in light of a shortage of care providers.[3] In Germany in 2019, 796,489 persons worked in nursing homes and home care services, caring for 4.13 million individuals in need of long-term care.[4,5] In 2021, the number of individuals in need of long-term care had already increased by 20% to 4.96 million.[4] These numbers are alarming since the number of persons aged 65 and older worldwide is projected to more than double by 2050.[6] In recent years, visions of technologization in geriatric care have been well received by the public and academia, resulting in the initiation and mobilization of numerous research activities and research funds.[7]

Various assistive systems are currently available in the care sector.[8,9] Especially, networked systems that (supposedly) autonomously take over tasks (e.g. social robots that can interact with persons in need of care), have received attention in recent years. To this end, research funding programs such as "Demand-driven Care" of the German Federal Ministry of Education and Research have been established, which aim to fund major projects in the field of care technologies and medical engineering.[10] However, the actual use and acceptance of technical solutions and services in the care of older adults is often limited due to access gaps or limited knowledge.[1] Furthermore, it is known that the implementation of information and communication technology takes, in general, longer in health care compared to other settings, for example, due to safety concerns.[11]

A recent systematic review examined the adoption of health information and communication technology, and its impact on clinical outcomes, productivity, and the healthcare workforce.[11] The investigators reported modest impacts on improving clinical outcomes and reducing healthcare costs. However, there was no beneficial impact on healthcare productivity despite a strong increase in information technology adoption in recent years.[11] This indicates that the successful integration of technologies in the healthcare is subject to many influences and confounders. In nursing homes, for example, any successful technical solution should address the needs of older adults while also considering the specific circumstances and requirements of caregivers. Thus, barriers to the use of digital technologies in nursing homes are multifaceted, including but are not limited to, conditions and resources in a specific nursing home, attitudes and perspectives of individuals with decision-making authority, the actual caring staff, the individuals being cared for, and potential other determining factors.[12] It has also been reported that in nursing homes, potential gains in productivity and quality of care that may result from health information technology depend on the initial investment in implementation and training of their workforce.[12] Therefore, the use of any assistive technology—from mobile applications to assistive humanoid or social robots—requires a general readiness for their use among nursing home employees.[8]

In the care setting, the use of technology can only be discussed appropriately by also involving stakeholder and interest groups. These diverse stakeholder groups include care recipients and their relatives, professional caregivers, as well as political actors and players. Reviews have shown that the acceptance of technical systems among care recipients is determined by different factors such as age, cognitive abilities, educational level, or previous technology experience, as well as appearance, size, trustworthiness, or security of the systems itself.[13–15] Of particular interest, but not yet sufficiently considered, is the perspective of professional caregivers, particularly in nursing homes, who use or are expected to use a certain technology. Research showed that there is a mainly positive attitude toward robots used in health care settings,[16] that may be influenced by the scope of use, and reservations towards robots particularly concerning social and emotional affection.[10,16,17]

The intention to use a technology is closely linked to a person's affinity for technology.[18] Thus, the affinity for technology and technology interaction can be regarded as an intentional state or process that precedes the actual use of a technology.[19] In contrast to the consideration of technology acceptance, which usually requires the use of the technology, it is important to first determine a person's or professional group's affinity for technology, which depends on certain personality traits of the users.[19] The consideration of affinity for technology can thus allow the prediction of the potential future success of a technology implementation before its initial use. This perspective is particularly important during the design and development process of a new technology.

The affinity for technology was studied as part of the German Care Report 2020, and results showed that the sample of 127 professional caregivers had good knowledge of technical assistance systems and that their affinity for technology was high.[3,10] In general, it can be concluded, based on existing research, that the perspectives of different groups (i.e. carers, nursing home managers, care recipients, and their families) should be integrated and considered in the design and use of technical assistance systems in care settings.[20] A "technology-push" approach, as used in the past, has proven to be one-sided, and considering the technical readiness of nursing home employees is now seen as a key factor in the successful adoption of assistive technologies.[21] However, caregivers' interests have rarely been considered in the design and selection of technologies used in day-to-day care.[22]

Therefore, this study aimed to examine the affinity for technology and technology interaction as well as related sociodemographic confounders among nursing home employees in Germany by addressing the following research questions: (a) What is the average level of affinity for technology and technology interaction among nursing home employees, and are there differences by sociodemographic variables? (b) Can sociodemographic variables explain any variance in the affinity for technology and technology interaction of nursing home employees? In addition, we also aimed to gain information about possible requirements and boundary conditions relevant to the development and implementation of assistive technologies in nursing homes.

Methods

Recruitment of participants

We first conducted an internet search of portals that listed hospital facilities and nursing homes as well as websites of nursing home operators. Then, in April of 2022, we compiled a list of 8,144 nursing homes for older people across Germany that we contacted by email. Our sampling method was not random, and we did not reach the entire population of nursing home employees in Germany.[a]

Due to several areas of concern of large-scale online surveys (e.g. perception as junk mail), we assumed a low response rate.[23] We followed an exploratory approach, and required sample size was not calculated before the study. However, based on the results of the differences in affinity for technology and technology interaction as a function of sociodemographic variables, a post hoc power analysis was performed, resulting in test string values from 45% to 90%.

Study design and data collection

We carried out an online survey with an explorative character and a nonrandom sampling method. The study was conducted by the Institute of Sports and Sports Science of the Karlsruhe Institute of Technology (KIT), Germany. Data collection took place between May and July 2022.

A link to access the online survey was emailed to all identified nursing homes, followed by two reminders to participate. ScoSci Survey software (SoSci Survey GmbH, Munich, Germany) was used to create the online survey. Study information, and information on data protection were also included and participants had to provide written informed consent prior to enrollment in the study.

Measures

The survey included two questionnaires to assess affinity for technology and technology interaction as well as questions on sociodemographic information. The sociodemographic variables assessed via the survey were age, gender (i.e. male, female, diverse), professional groups (i.e. nursing home manager, employee with nursing operations, employees in therapy, and others), education/level of graduation, native language, occupation type, shift work, and federal state of residence.

The primary outcomes were affinity for technology assessed by the questionnaire Affinity for Technology—Electronic Devices (TA-EG),[24] and affinity for technology interaction (ATI) assessed by the questionnaire ATI (please refer to supplementary material).[25] The 9-item ATI-scale has been developed as an economic, unidimensional instrument for assessing ATI. Its validity has been confirmed, and reliability is excellent ($\omega = 0.90$ [0.88–0.92]).[25–27] Participants were asked to complete the German version of the ATI by rating the nine items using a 6-point Likert scale (1 = completely disagree to 6 = completely agree). In the questionnaire, the term "technical systems" is consequently used which is defined in the introductory part of the questionnaire as "apps and other software applications as well as complete digital devices (e.g. cell phones, computers, televisions, car navigation)" following the example of Franke et al.[25] A mean score was calculated by considering all 9 items for statistical analysis.

The German 19-item TA-EG is often used as a standardized assessment.[24] The TA-EG questionnaire has four subscales (TA-EG-Enthusiasm = enthusiasm for technology, TA-EG-Competence = competence in dealing with technology, TA-EG-Positive Consequences = (perceived) positive consequences of technology, TA-EG-Negative Consequences = (perceived) negative consequences of technology). Participants respond on a 5-point Likert scale (1 = completely disagree to 5 = completely agree).[24] This questionnaire assesses affinity for technology in the sense of a personality trait that is expressed in a positive attitude towards technology. The questionnaire is widely used in research, and its validation is currently in progress, as described in the published study protocol.[28]

The ATI questionnaire assesses affinity concerning technology interaction, while the TA-EG generally assesses affinity for technology, including personality traits. The TA-EG technical enthusiasm subscale has similarities to the ATI that relate to active engagement and interaction with technology, which in turn involves affective components such as feelings and emotions.[25,28] The TA-EG also includes cognitive components, for example, assumptions and beliefs, which are reflected in its two subscales assessing positive and negative consequences of technology.[28]

Cronbach's alpha was calculated to determine the internal consistency of the measurements in our study sample. The internal consistency within the survey sample is $\alpha = 0.90$ for ATI and $\alpha = 0.87$ for TA-EG. The internal consistency for the subcategories of TA-EG range from $\alpha = 0.90$ for TA-EG-Competence to $\alpha = 0.87$ for TA-EG-Enthusiasm. The values for TA-EG-Positive

Consequences and TA-EG-Negative Consequences are $\alpha = 0.8$, respectively (please also refer to Table 2).

Statistical analysis

Results on the ATI and TA-EG with its subcategories are presented descriptively by means (M) and standard deviations (SD) for the whole group. According to the Shapiro–Wilk test, the variables were not normally distributed, but the histograms suggested an approximate normal distribution. Thus, we performed one-factorial variance analyses (ANOVA). In the next step, the prerequisites for the multiple regression analysis were checked, before a multiple regression analysis with stepwise inclusion of variables was carried out. The stepwise method was chosen to identify the best model fit, and the calculation was conducted including the best-identified combination of variables. All analyses were performed using SPSS version 27 (IBM Statistics), and a p-value of 0.05 was set to determine statistical significance.

Ethical considerations and approval

The study was carried out in accordance with the Declaration of Helsinki. The study was approved by the ethics committee of the KIT, Germany on May 5th, 2022 and registered at the German Clinical Trials Register (DRKS00029032). All participants were informed about the objectives and procedure of the study, as well as data protection. All participants provided informed consent.

Results

Sample characteristics

From 8,144 nursing homes that were contacted via email, 200 employees (i.e. participants) responded to the survey. Due to the anonymity of study participants and the fact that email recipients were asked to forward the survey invite to colleagues and other nursing homes in order to increase sample size, the response rate could only be estimated, as in comparable online surveys. The sample characteristics and demographics are presented in Table 1.

More females than males replied to the survey. Participants were distributed into five age categories as presented in Table 1. No participant was younger than 20 years. The native language was German for 95% of participants. Of all participants, 40.5% were nursing home managers, 33.5% were nursing operating employees, 7% were employees in the therapy field, as well as 26% were other employees (such as additional caregivers without vocational training, people from quality management or residential area managers). There is an even distribution of participants across

Table 1. Sample characteristics.

Outcome	*N*	%
Gender		
Female	152	76
Male	46	23
No answer	2	1
Age (years)		
20–30	19	9.5
31–40	42	21
41–50	51	25.5
51–60	73	36.5
>60	15	7.5
Native language		
German	190	95
Other	10	5
Education/graduation levels		
Hauptschule (graduation 5 years after elementary school)	15	8
Realschule (graduation 6 years after elementary school)	95	47.5
Abitur (graduation 8–9 years after elementary school, university entrance qualification)	89	44.5
Professional groups (multiple replies possible)		
Nursing home manager	81	40.5
Employee (nursing operations)	67	33.5
Employee (therapy)	14	7
Others	52	26
Occupation type		
Full time	159	79.5
Part-time	41	20.5

(continued)

Table 1. Continued.

Outcome	*N*	%
Shift work		
Yes	57	28.5
No	143	71.5
Federal state (in which the nursing home is located)		
Baden-Wuerttemberg	38	19.0
Bavaria	31	15.5
Berlin	6	3
Brandenburg	18	9
Bremen	3	1.5
Hamburg	0	
Hessen	10	5
Mecklenburg-Western Pomerania	2	1
Lower Saxony	19	9.5
North Rhine-Westphalia	39	19.5
Rhineland-Palatinate	6	3
Saarland	4	2
Saxony	10	5
Saxony-Anhalt	4	2
Schleswig Holstein	3	1.5
Thuringia	7	3.5

aThe education/graduation level refers to the duration of secondary school following the four-year primary school.

Germany, that is, the distribution across federal states roughly reflects the population size of the respective federal states.

Results on affinity for technology and technology interaction

The overall mean score for the questionnaire ATI is 4.08 (SD 1.00) and for TA-EG 3.17 (SD 0.56) as presented in Table 2. The means of the subcategories range from 2.27 (SD 0.94) for the TA-EG-Enthusiasm to 3.54 (SD 0.68) for the TA-EG-Positive Consequences.

Table 2. Results on affinity for technology and technology interaction.

Primary outcome	Mean	SD	Range	Cronbachs' Alpha
ATI	4.08	1.00	1.33–6.00	0.90
TA-EG	3.17	0.56	1.74–5.00	0.87
TA-EG-Enthusiasm	2.27	0.94	1.00–5.00	0.87
TA-EG-Competence	3.42	0.78	1.75–5.00	0.77
TA-EG-Positive Consequences	3.54	0.68	1.00–5.00	0.83
TA-EG-Negative Consequences	3.05	0.76	1.00–5.00	0.83

ATI, affinity for technology interaction; TA-EG, affinity for technology; SD, standard deviation.

Results on the differences in affinity for technology and technology interaction in relation to sociodemographic variables

The differences in affinity for technology and technology interaction in relation to sociodemographic variables are presented in Tables 3 and 4. Statistically significant differences were found between the age categories for total ATI ($p = 0.003$) and TA-EG ($p = 0.005$), with higher scores for younger participants; as well as for TA-EG between gender ($p = 0.027$; with males having higher scores than females) and the professional groups ($p = 0.036$; with employees having higher scores than managers). Within the subcategories of TA-EG, statistically significant differences in TA-EG-Enthusiasm and TA-EG-Competence were found between the age categories (TA-EG-Enthusiasm, $p = 0.001$; TA-EG-Competence, $p = 0.010$) as well as between gender (TA-EG-Enthusiasm, $p = 0.020$; TA-EG-Competence, $p = 0.004$). Between the professional groups in the subcategory TA-EG-Competence, the differences were also statistically significant ($p = 0.042$).

Results on the influences on affinity for technology and technology interaction

The results of the multiple linear regression analysis are presented in Tables 5 and 6. The multiple regression models are statistically significant for both dependent variables,

Table 3. Results of one-factorial ANOVA on the differences in affinity for technology and technology interaction (dependent variables) by sociodemographic variables (independent variables).

Independent variables	*N*	ATI				TA-EG			
		Mean	SD	*F*(df), *p*	η^2	Mean	SD	*F*(df), *p*	η^2
Gender	198			3.522(1), 0.062	0.018			**4.984(1), 0.027**	0.025
Female	152	4.00	1.00			3.12	0.55		
Male	46	4.31	0.99			3.33	0.57		
Age (years)				**4.214(4), 0.003**	0.081			**3.789(4), 0.005**	0.072
20–30	19	4.38	1.03			3.46	0.67		
31–40	42	4.50	0.94			3.33	0.57		
41–50	51	3.99	1.00			3.18	0.48		
51–60	73	3.94	0.95			3.04	0.54		
>60	15	3.51	1.00			2.98	0.48		
Professional groups	200			1.873(3), 0.135	0.028			**2.908(3), 0.036**	0.043
Nursing home manager	81	3.89	1.02			3.07	0.49		
Employee (nursing operations)	64	4.17	1.03			3.16	0.58		
Employee (therapy)	13	4.17	0.96			3.21	0.66		
Others	42	4.29	0.92			3.38	0.58		
Education/graduation level	200			0.678(2), 0.509	0.007			1.023(2), 0.361	0.010
Hauptschule (after 5 years)	16	4.34	0.96			2.99	0.57		
Realschule (after 6 years)	95	4.03	1.00			3.17	0.56		
Abitur (diploma after 8–9 years, University entrance qualification)	89	4.09	1.02			3.20	0.55		

ATI, affinity for technology interaction; TA-EG, affinity for technology; SD, standard deviation; df, degrees of freedom; *p*, *p*-value; statistically significant results ($p < 0.05$) are shown in bold font.

ATI ($p = 0.000$) and TA-EG ($p = 0.000$). The corrected coefficient of determination (R^2) is 0.078 for ATI and 0.121 for TA-EG. Statistically significant predictors of ATI are age category ($B = -0.246$) and professional group ($B = 0.149$). For TA-EG, statistically significant predictors are age category ($B = -0.245$), gender ($B = 0.159$), and professional group ($B = 0.209$). Within the subcategories of TA-EG, statistically significant multiple linear regression models are found for TA-EG-Enthusiasm ($R^2 = 0.122$; $p = 0.000$) TA-EG-Competence ($R^2 = 0.110$; $p = 0.000$), and TA-EG-Positive Consequences ($R^2 = 0.045$; $p = 0.004$). Predictors of TA-EG-Enthusiasm and TA-EG-Competence are gender (TA-EG-Enthusiasm: $B = 0.163$; TA-EG-Competence: $B = 0.209$), age category (TA-EG-Enthusiasm: $B = -0.284$; TA-EG-Competence: $B = -0.202$), and professional group (TA-EG-Enthusiasm: $B = 0.150$; TA-EG-Competence:

Table 4. Results of one-factorial ANOVA on the differences in the subcategories of affinity for technology and technology interaction (dependent variables) by sociodemographic variables (independent variable).

	TA-EG-Enthusiasm			TA-EG-Competence			TA-EG-Positive Consequences			TA-EG-Negative Consequences		
	Mean	SD	*F*(df), *p*	Mean	SD	*F*(df), *p*	Mean	SD	*F*(df), *p*	Mean	SD	*F*(df), *p*
Gender			**5.536(1), 0.020**			**8.714(1), 0.004**			0.767(1), 0.382			0.017(1), 0.897
Female	3.34	0.78		2.63	0.91		3.51	0.66		3.05	0.76	
Male	3.65	0.73		3.08	0.95		3.61	0.73		3.04	0.76	
Age (years)			**4.944(4), 0.001**			**3.395(4), 0.010**			0.856(4), 0.491			1.062(4), 0.377
20–30	3.84	0.80		3.18	1.00		3.62	0.80		3.27	0.93	
31–40	3.70	0.77		3.02	0.98		3.62	0.81		3.05	0.84	
41–50	3.38	0.71		2.63	0.88		3.62	0.58		3.13	0.74	
51–60	3.25	0.76		2.52	0.89		3.44	0.63		3.00	0.69	
>60	3.03	0.68		2.65	0.84		3.43	0.72		2.80	0.63	
Professional groups			1.507(3), 0.214			**2.786(3), 0.042**			1.807(3), 0.147			1.542(3), 0.205
Nursing home manager	3.30	0.73		2.51	0.88		3.43	0.71		3.08	0.77	
Employee (nursing operations)	3.43	0.79		2.81	0.96		3.53	0.71		2.91	0.80	
Employee (therapy)	3.56	0.89		2.74	1.02		3.62	0.36		3.01	0.89	
Others	3.60	0.80		3.00	0.93		3.73	0.61		3.22	0.59	
Education/graduation level			0.376(2), 0.687			0.433(2), 0.649			2.173(2), 0.117			1.008(2), 0.367
Hauptschule (diploma after 5 years)	3.36	0.81		2.61	0.90		3.24	0.73		2.81	0.78	
Realschule (diploma after 6 years)	3.38	0.75		2.79	0.92		3.52	0.77		3.05	0.74	
Abitur (diploma after 8–9 years, University entrance qualification)	3.47	0.81		2.68	0.97		3.61	0.54		3.10	0.77	

ATI, affinity for technology interaction; TA-EG, affinity for technology; SD, standard deviation; df, degrees of freedom; *p*, *p*-value; statistically significant results ($p < 0.05$) are shown in bold font.

Table 5. Results of multiple linear regression analysis on the predictors of affinity for technology and technology interaction.

	ATI					TA-EG				
Coefficients	*B*	SE	*T*, *p*	R^2	*F*(df), *p*	*B*	SE	*T*, *p*	R^2	*F*(df), *p*
				0.078	**9.296(2), 0.000**				0.121	**10.041(3), 0.000**
Gender						0.159	0.088	**2.375, 0.019**		
Age	−0.246	0.061	**−3.587, 0.000**			−0.245	0.033	**−3.660, 0.000**		
Education/ graduation level										
Professional groups	0.149	0.060	**2.178, 0.031**			0.209	0.032	**3.116, 0.002**		

ATI, affinity for technology interaction; TA-EG, affinity for technology; *B*, regression coefficient; SE, standard error of estimates; R^2, coefficient of determination; df, degrees of freedom; *p*, *p*-value; statistically significant results ($p < 0.05$) are shown in bold font.

Table 6. Results of multiple linear regression analysis on the predictors of the subcategories of the affinity for technology and technology interaction.

	TA-EG-Enthusiasm					TA-EG-Competence				
Coefficients	*B*	SE	*T*, *p*	R^2	*F*(df), *p*	*B*	SE	*T*, *p*	R^2	*F*(df), *p*
				0.122	**10.145(3), 0.000**				0.110	**9.134 (3), 0.000**
Gender	0.163	0.123	**2.427, 0.016**			0.209	0.149	**3.104, 0.002**		
Age	−0.284	0.046	**−4.246, 0.000**			−0.202	0.056	**−2.992, 0.003**		
Education/ graduation level										
Professional groups	0.150	0.045	**2.232, 0.027**			0.190	0.055	**2.814, 0.005**		
	TA-EG-Positive Consequences					TA-EG-Negative Consequences				
Coefficients	*B*	SE	*T*, *p*	R^2	*F*(df), *p*	*B*	SE	*T*, *p*	R^2	*F*(df), *p*
				0.045	**5.639(3), 0.004**	No significant inclusion possible.				
Gender										
Age										
Education/ graduation level	0.159	0.076	**2.262, 0.025**							
Professional groups	0.194	0.041	**2.764, 0.006**							

TA-EG, affinity for technology; *B*, regression coefficient; SE, standard error of estimates; R^2, coefficient of determination; df, degrees of freedom; *p*, *p*-value; statistically significant results ($p < 0.05$) are shown in bold font.

$B = 0.190$). For TA-EG-Positive Consequences, predictors are professional group ($B = 0.194$) and education/graduation level ($B = 0.159$). Sociodemographic variables did not statistically significantly predict TA-EG-Negative Consequences.

Discussion

Discussion on the results of affinity for technology and technology interaction

The affinity for technology and technology interaction among nursing home employees was rather high for both questionnaires used in this study, that is, ATI and TA-EG.

The mean ATI of our sample is high compared to the expected average score of about 3.5 previously reported.[25] The internal consistency of the questionnaire was also high and similar to previous reports.[25,26] This indicates a high affinity for technology and technology interaction, and thus, a positive prerequisite for active engagement and interactions with technology among nursing home employees.[29]

The TA-EG values are, on average, at a medium level, given that items are rated on a 5-Point Likert scale. Although this questionnaire is widely used in different settings, it is not yet validated and norm values are not available.[28] However, the TA-EG has been used, for example, in the areas of human–robot interaction,[30] brain–computer interface,[31] or online therapy.[32] As compared to scores reported in prior studies, the scores observed in our study can be classified as high, albeit keeping in mind the difference in study samples.

A general readiness to use new technology was also reported based on a feasibility study with 51 nursing home employees on the use of a technology-supported activation and employment intervention for nursing home residents with dementia.[33] Slightly higher values for technology affinity were reported in nurses from all nursing areas within the German nursing report,[10] that is, the values of 127 professional nurses were higher in the subcategory of enthusiasm and competence while scores in the positive technical consequences subcategory were similar to ours, and in the negative technical consequences subcategory even slightly lower.[10] This was also shown in an online survey in 2018 that assessed the affinity for technology of 355 nurses, of whom 62% worked in hospitals, 13% in outpatient or home care, and 14% in nursing homes.[3] The slightly higher values could result from the composition of the samples, as the use of technology in hospitals is different, and less technical systems are used in the social and emotional context, which could lead to a generally higher acceptance of technology.[10,16,17] Furthermore, the reported data was collected prior to the COVID-19 pandemic, which caused an increase in technology use creating many challenges in the care sector.[11]

Discussion of the sociodemographic influences

In our study, we identified differences regarding professional groups in the TA-EG, and especially in its subscale competence. To this end, we observed that nursing home managers have lower values than employees. Similarly, for ATI, TA-EG, and the subcategories enthusiasm, competence, and positive technical consequences, we consistently observed the lowest scores for nursing home managers. These findings have not previously been reported. In a sample of employees from all nursing areas with 35% in a management position, the acceptance of technology was higher among managers than among nurses with operational functions.[3] In general, the perception of different areas, topics, and processes varies between employees with operational functions and employees in a management position.[34] Nursing staff are more concerned with direct contact with the person in need of care, while administrative aspects are more important in managerial positions. A direct comparison of the samples is not possible because the technical use in different application areas varies greatly.[8] However, this observation has important implications, for example, when it comes to the introduction of new technologies. It should be noted that the nursing home management has the decision-making authority, and if they decide against a technical system, it will most likely not be used. In light of our findings, nursing home managers may need to be addressed in a different way than employees when a new technology should be implemented. The rather lower values of the nursing home managers in our study are not directly related to the level of education/graduation; only for the subcategory positive technical consequences, the professional group and the education/graduation are statistically significant predictors of the affinity for technology.

We also observed that age is an important factor predictor of affinity for technology and technology interaction, that is, the higher the age of a participant in our study, the lower his/her affinity. This observation is in line with previous studies that focused on affinity for technology with regard to computers, and also reported a negative association between age and computer-related self-efficacy,[35] and between age and computer use.[36] However, other studies have shown that attitudes toward computers do not generally depend on individuals' ages.[37]

Furthermore, we observed an impact of gender, that is, for TA-EG and its subscales enthusiasm and competence. Our results show that the affinity for technology and technology interaction, and the associated self-assessed competence is lower among women than men. Other studies have reported similar findings, for example, women use computers less and have less computer-related self-efficacy than men.[38,39] Other studies examining gender differences in ATI scores in the fields of IT, sports, and natural sciences also reported statistically significant differences.[26] Whereas, in the fields of human and society, education, and business, these differences were not statistically significant.[26] In conclusion, gender may be an important influencing factor on affinity for technology, and should thus be considered depending on the respective setting.

The regression models were statistically significant except for the subcategory negative technical consequences. This indicates that the sociodemographic variables influence enthusiasm, competence, and positive consequences, but not negative consequences related to an affinity for technology and technology interaction. In general, the corrected coefficient of determination (R^2) was between 0.05 and 0.12 in our study, which means that between 5% and 12% of the variance can be explained. According to Cohen,[40] these values provide a low to medium variance explanation. This is not surprising when it comes to predicting human attitudes, which may be influenced by many internal and external factors, including but not limited to an affinity for technology and technology interaction, and especially the negative consequences seem to depend on individual factors. Furthermore, with regard to the constructs of technology acceptance and use, it is likely that these do not exclusively depend on age or the other variables we considered in our study, but are also determined by other factors such as intention of use, perceived usefulness, and ease of use, as well as self-efficacy and prior experience, affordability, conditions and contexts of use, and individual characteristics and abilities which were not examined and assessed in our study.[41,42]

Strengths and limitations

The strength of this study is the German-wide survey of the affinity for technology and technology interaction in a large sample of nursing home employees. To the best of our knowledge, this is the first study conducted after the COVID-19 pandemic that focused on nursing home employees rather than all care areas.

As with any study, some limitations should be considered, namely the lack of a sample calculation before the study. However, a post hoc power analysis was carried out and showed test string values from 45% to 90%. Another limitation, based on the chosen large-scale online survey approach with a non-random sampling method, is the lack of representativeness of the sample, which may limit the generalizability of our findings. Our sample may also be biased, as the email including the invite to participate in our online survey may not have been forwarded to all eligible employees in the nursing homes. This is also reflected by the results, as 40.5% of participants reported to be nursing home managers, and 95% indicated German as their mother tongue which may not reflect the true population of nursing home employees in Germany, for example, with many employees coming from Eastern European countries. Furthermore, it is possible that only employees with a higher affinity for technology responded, and we only included main sociodemographic variables in our analyses, whereas other explanatory variables that may also predict affinity for technology and technology interaction were not assessed. In light of these limitations, findings from our study should be interpreted with caution.

Conclusion and recommendations

The findings of this study on the current state of affinity for technology and technology interaction and related sociodemographic influences in nursing home employees in Germany are of high relevance. This is especially true for persons and stakeholders who deal with assistive technologies for nursing homes and should be taken into account in the development phase, but especially in the implementation phase. Based on our results, it can be concluded that the affinity for technology and technology interaction is generally high in nursing home employees in Germany and that there is likely no need to persuade nursing home employees to use new technologies. Rather, it must be ensured that the environment and circumstances, such as the technical requirements but also the actual benefit of the assistive technology is given and provided in order to make an implementation successful.

Our observation that nursing home managers seem to have a lower affinity for technology and technology interaction requires special consideration of this professional group. To this end, it may be important to implement an information culture that informs nursing home employees about new technologies in an appropriate way, for example by using layman's terms, while facilitating an open dialogue between all stakeholders in nursing home settings. To this end, cost-benefit considerations and feasibility within the respective nursing homes must be discussed and considered, especially through dialogue with nursing home managers.

The degree as to how much individuals would like to interact with technology varies significantly among participants in our study. Therefore, attitudes, ideas, and perspectives of nursing home employees and managers should be considered separately and early in the design, development, and implementation process to enhance the likelihood of later actual use of technology. More research is needed to gain further insights into the affinity for technology and technology interaction in nursing homes. Through conducting interviews and focus groups, possible reasons for the differences in affinity for technology as observed in our but also other previous studies can be identified, and ideas and practical implications for technical solutions in nursing home settings can be generated.

Acknowledgments: The authors acknowledge support by the KIT-Publication Fund of the Karlsruhe Institute of Technology.

Contributorship: BBF, JB, TM, KW, JKR, and AW conceived the idea and the study design. SR, JB, JD, and KW collected the

data. BBF performed statistical analysis of data and wrote the manuscript. NR, MM, WN, LJ, and AT performed literature review and supported manuscript writing. JKR helped to revise English writing. All authors revised the manuscript and approved the final manuscript.

Declaration of conflicting interests: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval: The study was approved by the ethics committee of the KIT, Germany on May 5th, 2022.

Funding: The authors received the following financial support for the research, authorship, and/or publication of this article: This research is part of the BestAge project which was founded by the AOK Baden-Württemberg. This research was also supported by the JuBot project, which is funded by the Carl-Zeiss-Foundation.

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Supplemental material: Supplemental material for this article is available online.

Note

a. Facts about employees of nursing homes in Germany: from the 16,115 inpatient nursing homes, about 7,000 are from private sponsors. In 2021, a total of 1,25 million people were employed in care facilities, including geriatric nurses, (pediatric) nurses, additional caregivers, domestic support workers, administrative staff and members of other social professions. In geriatric care, about 184,000 state-approved geriatric nurses were employed in nursing homes, and about 65 % were part-time employees. ("https://www.bundesgesundheitsministerium.de/themen/pflege/pflegekraefte/beschaeftigte.html") (accessed August, 2023).

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