Measurement of Tech Anxiety in Older and Younger Adults

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Abstract. Tech anxiety is an established barrier to technology adoption, and recent work suggests it may also impair the development of higher-order digital competencies. Researching this issue requires a reliable measure of tech anxiety. The widely-used Computer Anxiety Rating Scale was developed more than 30 years ago, but computer devices and use have changed dramatically during that time. We developed and tested a new Tech Anxiety Rating Scale (TARS) encompassing a range of modern devices, tasks, and scenarios. One hundred eight older adults and 150 college students completed the TARS and six other surveys related to computer use, anxiety, self-efficacy, proficiency, and attitudes. We present an exploratory factor analysis of the TARS for the combined datasets and separately for the older and younger adults. Overall, the EFA revealed common underlying factors for older and younger adults, suggesting that the TARS is appropriate for use with both populations.

Keywords: Older adults · Senior citizens · Aging · Tech anxiety · Computer anxiety

1 Introduction

Computer anxiety is an established barrier to using or purchasing computers [14–16] and is associated with poor task performance [8] and difficulty learning computer skills [7,13]. Understanding the relationship between computer anxiety and these factors requires a validated scale of computer anxiety. The most commonly used scale, the Computer Anxiety Rating Scale (CARS [8]), was developed more than 30 years ago when personal desktop computers were becoming popular at school, work, and home. The CARS contains a range of statements focusing on a person's worried thoughts (e.g., It scares me to think that I could cause the computer to destroy a large amount of information by hitting the wrong key), self-confidence (e.g., I am confident that I can learn computer skills), attitudes (e.g., You have to be a genius to understand all the special keys contained on most computers), and performance (e.g., I have difficulty in understanding the technical aspects of computers). Since its original development, the nature of computers and computer use has changed dramatically. Although some researchers [3] have modified the scale to eliminate obsolete

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questions (e.g., I am sure that with time and practice I will be as comfortable working with computers as I am in working with a typewriter) or to slightly modify the terminology (e.g., change *computer terminals* to *computer*), the CARS has not had a major update to reflect the broad range of modern computing devices, tasks, and concepts (e.g., smartphones, online shopping, and Wi-Fi). Finally, as noted earlier, CARS includes statements pertaining to self-efficacy and performance. Many researchers, however, are interested in understanding the relationship between computer anxiety and these factors. The inclusion of statements related to self-efficacy and performance, therefore, may result in an inaccurate assessment of the relationship between these constructs.

We developed the Tech Anxiety Rating Scale (TARS) to address these issues. We use the term *tech* to be more inclusive of the range of modern computing devices. Scale instructions specify that respondents consider the use of desktop computers, laptop computers, tablets, and/or smartphones when rating each statement. Second, we focused each question on worry and negative self-talk, two aspects of the cognitive component of anxiety [2,9], and avoided statements that might be more related to self-efficacy or the behavioral outcomes of anxiety. Finally, we included statements that targeted modern anxiety-provoking issues like viruses and malware, privacy and security, and frequent software updates [13]. The 26-statement scale is included in Table 1.

In the current study, we administered TARS to both older adults and college students and conducted an exploratory factor analysis to reduce the set of statements, identify underlying factors, and determine whether the factors were consistent for both groups. Notably, past research on computer anxiety has focused primarily on these two populations. It is plausible that older and younger adults may differ not only in their tech anxiety levels, but also in the types of activities or scenarios that may provoke anxiety in the first place. Both older and younger adults are likely to have a range of proficiency levels with computer technology, but they are also likely to have had different types of experiences with technology simply by virtue of differences in their interests, use characteristics, and the age at which they first started using technology. To be useful, therefore, TARS must be validated with both older and younger adults to ensure its items are relevant to a wide range of users and that the scale scores allow for meaningful comparisons between the two groups.

2 Methods

2.1 Participants

One hundred eight older adults ($M_{age} = 66.81$, $SD_{age} = 7.72$; 72 women) and 150 Michigan Tech college students ($M_{age} = 19.41$, $SD_{age} = 1.27$; 46 women) participated in the study. Older adults were recruited through a combination of digital (email, listservs, Facebook) and non-digital (flyers and table tents posted at the public library, grocery stores, coffee shops, etc.) advertisements and snowball sampling [6]. Recruitment materials specified that we were seeking participants age 55 and older who were brand new to computers, mid-level users, or pros.

Older-adult participants received $20 upon completion of the study. Younger adults were recruited through the Michigan Tech undergraduate research pool which includes students from a range of majors. Participation was restricted to individuals ages 18–30. Younger-adult participants received course credit for participation.

2.2 Materials

Computer and Internet Use Questionnaire (CIUQ). The CIUQ collected basic demographic information, details about participants' history of ownership and use of computer technology (smartphones, tablets, laptops, and desktop computers), frequency and location of Internet use, and an inventory of common technology-based tasks.

Tech Anxiety Rating Scale (TARS). TARS included 26 questions that encompass a range of modern technology-based tasks, devices, and scenarios. Responses were provided on a five-point, Likert-like scale ranging from strongly disagree to strongly agree. Scores could range from 26–130, with high scores indicating higher levels of tech anxiety.

Computer Anxiety Rating Scale (CARS [8]**).** We used the 19-statement version of CARS, with questions edited as suggested by Cooper-Gaiter [3]. Responses were provided on a five-point, Likert-like scale, ranging from strongly disagree to strongly agree. Scores could range from 19 to 95, with higher scores indicating higher levels of computer anxiety.

Computer Self-Efficacy Scale (CSES [4]**).** The CSES included 28 statements about the user's confidence with computer-related tasks. CSES scores could range from 28 to 140, with higher values indicating a greater confidence in one's ability to use computers.

Generalized Anxiety Disorder-7 Assessment (GAD-7 [12]**).** The GAD-7 asks participants to rate how often they have been bothered by seven different issues on a four-point scale: not at all, several days, more than half the days, and nearly every day. GAD-7 scores could range from 0 to 21.

Computer Proficiency Questionnaire (CPQ [1]**).** The original CPQ includes 33 items rated on a five-point, Likert-like scale: never tried, not at all, not very easily, somewhat easily, very easily. Items are divided into six subscales. CPQ scores are calculated by summing the average of each subscale. We modified the CPQ to add a seventh subscale about security and updated the Internet and General Skills sections to include modern technologies and tasks (e.g., touchscreens, trackpads, connecting to Wi-Fi, saving to the cloud, using cloud-based software like Google Docs). Modified CPQ scores could range from 7 to 35, with higher scores indicating a higher level of proficiency on technology-based tasks.

Attitudes Toward the Internet Scale (ATIS [10]**).** ATIS includes 16 statements, each rated on a 7-point Likert-like scale. High scores indicate more positive attitudes toward the Internet.

2.3 Procedure

After participants signed an informed consent, surveys were administered in group settings to older-adult participants at several community locations (e.g., libraries and community centers) and to younger-adult participants in classrooms at Michigan Tech. All surveys were administered on paper. Participants completed the CIUQ first followed by the other six surveys, with the order determined by a Balanced Latin Square design.

3 Exploratory Factor Analysis

Exploratory factor analysis (EFA) of the 26-question TARS was conducted separately for the older and younger adults and for the combined datasets. Principal Axis Factoring was selected as the factor extraction method [5] with PROMAX rotation [11]. For all three analyses, Kaiser-Meyer-Olkin measures were greater than 0.878, indicating sufficient data for EFA; Bartlett's test of sphericity indicated a patterned relationship between items (all $ps < .001$). Variables were dropped if cross-loading of greater than 0.3 occurred on two or more factors, if the variable did not have a factor loading of at least 0.4, or if the communality of the variable was below 0.3. For each dataset, the number of factors was determined by the scree test.

Factors and loadings are presented in Table 2. For the combined dataset, variables loaded onto four factors, explaining 72.8% of the variance. Three of the factors were labeled as *safety and security* (10.3%), *consequences of actions* (6.9%), and *judgment from others* (6.2%). The factor that explained the largest portion of the variance (49.3%) included three statements about negative self-talk and four questions regarding managing new tasks.

EFA of the older adult dataset produced the same four factors, which accounted for a total of 75.5% of the variance. The first factor (56.7%) contained eight statements, distributed between *negative self-talk* and *managing new tasks*. Five of the statements overlapped with those from the EFA of the combined dataset. The *safety and security* factor (5.0%) and *judgment from others* factor (4.9%) included the same set of statements as in the combined analysis. The *consequence of actions* factor (8.9%) included one additional statement.

For the younger adult dataset, the variables loaded onto five factors, with 72.6% cumulative variance. Three of the factors were consistent with the previous two analyses: *consequences of taking action* (7.1%), *safety and security* (12.5%), and *judgment from others* (9.0%). In contrast to the other two analyses, *negative self-talk* (37.2%) and *managing new tasks* (6.8%) were split into separate factors. The *negative self-talk* factor, however, contained two statements that were more related to the consequences of worry (feeling overwhelmed; difficulty concentrating) than self-talk.

Table 1. Tech Anxiety Rating Scale: Indicate how often you worry about or tell yourself each of the following items when using a computer device (desktop computer, laptop computer, tablet computer, and/or smartphone). Please circle one number to respond to each statement: (1) never, (2) rarely, (3) sometimes, (4) often or (5) always.

No.	Question
1	I worry that something I do will break my device
2	I worry that bad things will happen if I press the wrong button or click the wrong thing
3	I worry that something I do will accidentally delete important information or files
4	I worry about what might happen after I press a button or click something
5	I worry about whether it is safe to connect to the Internet (Wi-Fi) in public places
6	I worry that other people will see information that I don't want them to see
7	I worry that people I don't know (hackers) will steal my information or identity
8	I worry that my device will get infected with a computer virus or malware
9	I worry that people will think I'm stupid if I ask for help
10	I worry that I will look silly or foolish
11	I worry that people will watch and judge me
12	I worry that I will forget how to do something that I've already learned how to do
13	I worry that I won't be able to figure something out on my own
14	I worry that I won't be able to use my programs (or apps) if a new version comes out
15	I worry if I have to do something new
16	I worry when a window or message appears (pops up) on my screen
17	I worry about what will happen if I choose to install or accept an update to my device, program, or app
18	I worry that I won't be able to find something that I've saved on my device
19	I worry that I won't be able to get back to where I started after I click a link or open a new page or program
20	My worries overwhelm me
21	My worries make it difficult to concentrate on my task
22	I tell myself that I am too old to do this
23	I tell myself I'm not good with computers
24	I tell myself that I will never figure out a new task
25	I tell myself that I need to do things more quickly
26	I rehearse the steps that I need to take in my head

Table 2. Factor loadings for EFAs conducted on the combined dataset and separately for the older and younger adult samples. Column 3 contains the statement numbers from Table 1.

Label	Factor	No.	Combined	Older	Younger
Negative self talk	1a	24	0.992	0.919	0.601
	1a	23	0.846	0.637	0.592
	1a	22	0.759		
	1a	25		0.684	
	1a	26		0.932	
	1a	21			0.974
	1a	20			0.714
Managing new tasks	1b	14	0.733	0.690	0.534
	1b	15	0.729	0.672	
	1b	19	0.620		0.732
	1b	13	0.495	0.604	
	1b	16		0.511	
	1b	18			0.791
Safety and security	2	7	1.079	0.999	0.995
	2	6	0.751	0.729	0.811
	2	5	0.658	0.699	0.633
	2	8	0.572	0.695	0.460
Consequences of actions	3	2	0.942	0.942	0.911
	3	1	0.749	0.565	0.730
	3	3	0.626	0.960	
	3	4	0.606	0.825	0.578
	3	18		0.598	
Judgment from others	4	10	0.892	0.934	0.886
	4	9	0.869	0.946	0.852
	4	11	0.708	0.569	0.824

4 Discussion

As shown in Table 3, both TARS and CARS scores were significantly negatively correlated with attitudes toward the Internet (ATIS), computer self-efficacy (CSES), and self ratings of proficiency (CPQ). These relationships held when calculated for all participants and separately for older and younger adults. TARS scores were significantly positively correlated with generalized anxiety scores. CARS, in contrast, was not correlated with GAD-7 scores for younger adults or when calculated across all participants. Overall, CARS scores were more strongly correlated with measures of self-efficacy, attitudes toward the Internet, and

self-ratings of computer proficiency than were TARS scores. This finding is not surprising given that many of the CARS statements are related to these factors.

Scores on the TARS were calculated using the reduced set of 18 statements from the combined EFA. As illustrated in Fig. 1, older adults generally reported higher levels of tech anxiety and had a wider range of tech anxiety scores than the college students. TARS and CARS scores were significantly correlated across all participants ($r = .50$, $p < .001$) and when calculated separately for the older adults ($r = .42$, $p < .001$) and younger adults ($r = .50$, $p < .001$).

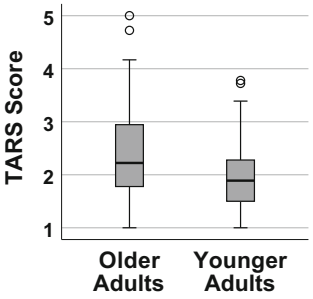

Fig. 1. Boxplots of TARS scores.

Table 3. Correlations between TARS and CARS and other measures. $^{**}p < .01$ $^{*}p < .05$

	TARS			CARS		
Scale	All	Older	Younger	All	Older	Younger
ATIS	−.34**	−.26**	−.25**	−.57**	−.60**	−.37**
GAD7	.17**	.34**	.35**	0.04	.23*	0.15
CSES	−.51**	−.39**	−.52**	−.76**	−.76**	−.73**
CPQ	−.37**	−.24*	−.38**	−.56**	−.58**	−.48**

5 Conclusion

In summary, the exploratory factor analyses revealed common underlying factors for both the older- and younger-adult samples and motivated the reduction of the TARS from 26 questions to 18. Follow-up analyses with the reduced scale indicate that the TARS is negatively correlated with measures of computer self-efficacy, attitudes toward the Internet, and self-ratings of computer proficiency.

Current work is focused on refining TARS based on the results of the current study. Specifically, we are adding questions related to negative self-talk and managing new tasks, the two categories of statements that loaded onto a single factor in the EFAs for the combined dataset and for the older adults, but into two separate factors for younger adults. The next step will be to administer the survey and to conduct a confirmatory factor analysis to validate the scale.

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