Trust in Automation Among Volunteers Participating in a Virtual World Telehealth Mindfulness Meditation Training Program

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Abstract. Trust is important in group interactions; however, little is known about trust in wellness-related telehealth training. This study examined self-reported trust in U.S. military active duty and veterans (n = 45) who participated in an 8-week mindfulness course offered in the Virtual World (VW) of Second Life. Participants completed a VW Trust Questionnaire (VWT, measuring relational trust such as communication, confidentiality, and self-representation) and a Trust in Automation Questionnaire (TIA, measuring confidence in system and perceived system security, integrity, dependability, and reliability) post training. Participants reported moderately high levels of TIA and high relational trust (VWT). Higher class attendance was associated with being comfortable speaking in the VW and belief in confidentiality (relational trust). Higher attendance was also associated with higher TIA. These results demonstrate that individuals are more likely to participate in virtual world telehealth interventions, and complete more of their training, when their trust is high.

Keywords: Trust · Automation · Telehealth · Virtual world

1 Introduction

Human factors issues in group-based teaching over a Virtual World (VW) include considerations of input devices, methods of communication, keeping attendees engaged, developing group cohesion, response timing, virtual environmental design, and technology competence and use [1]. Trust in automation is another important aspect for consideration. Trust in automation includes factors that relate specifically to technology, but not necessarily to trust among humans. These factors include the reliability, validity, utility, and robustness of the technology, as well as false alarms incurred while using the technology [2].

Trust is a key determinant of automation reliance and usage [3]. That is, individuals need to trust automation before they elect to use it. This may be especially true when

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using automation for telehealth purposes, in which participants may express personal vulnerabilities. Trust in automation may impact their willingness to participate by virtually attending class or to communicate during training. In fact, health care staff acceptance of telehealth technologies for (and with) their patients are tied to their levels of trust in automation, including barriers such as difficulties with operating the system; apprehensions regarding information sharing, data security, technical and use issues; concerns about reliability and accuracy; and lack of confidence in technology [4].

This study focuses on trust in automation when participating in mindfulness meditation instruction in a VW. A VW is "A synchronous, persistent network of people, represented by avatars, facilitated by computers" [5]. In contrast to virtual reality, VW's allow users to interact with others and are persistent. Similarly, in a VW, users are represented by avatars, while in virtual reality users do not choose their representation or may not have a representation of themselves. VW's are highly social and interactive, and both users and developers create the environment, while virtual reality is not typically highly social and developers create the environment. Interactions are often more scripted in a virtual reality scenario, while they are free-flowing, person, and occur in real time in a VW. Second Life (SL) is a VW that is free to the public and provides a means for people to connect socially. It allows for extensive creativity, as users are able to script their own materials and have multiple avatars with various identities.

VW's are also used for communication and collaboration and trust has been found to be a key enabler of VW-based collaborations [6]. Some organizations initially moved forward in the use of VW such as IBM, Nissan, Toyota, Adidas, Reebok, Dell and Vodafone [7], possibly based on analysts' predictions that VWs will become the dominant method for accessing and sharing information over the internet [8]. Yet, some organizations have scaled back on the use of VWs, due to limited user response [7]. Chandra et al., 2011 postulated that perceived structural assurance and social presence were necessary for fostering initial trust in the VW, and that user trust is essential in influencing members of an organization to develop even the intention to use the VW for communications and collaborations. Gartner suggested that 90% of businesses fail in the VW, because the companies attend to the technology, instead of the needs, behaviors, and motivations of the users [9].

The purpose of this research was to examine research participants' self-reported relational trust (communication, confidentiality, and self-representation) and their trust in automation after attending a telehealth mindfulness meditation class via the VW of SL. It was expected that to freely and fully participate, participants would need to trust that the technology itself was safe and secure and their personal information was protected, as well as trusting in the functionality of the equipment and software.

2 Method

2.1 Participants

Forty-five (45) U.S. military active duty service members and veterans were recruited as part of a more extensive intervention-based study examining Mindfulness Meditation training offered in-person and via a VW.

2.2 Instruments

Demographic Survey. Demographic data included age, gender, education, ethnicity, military status, marital status, and deployment history. Participants also provided information on their hours of computer use per week (at home and at work) and self-ratings of their computer expertise.

Class Attendance. Each of the eight classes for the VW group were held for 1.5 h, and a single, silent, extended class was held for 3 h. Class attendance consisted of the participant logging in to the Virtual World of Second Life at the designated class time, maintaining avatar presence during the class, and participating in class exercises and discussions. Researchers took role for each class and tracked participation.

Virtual World Trust Questionnaire (VWT). Four questions were designed to capture how comfortable the participants were with communicating in the Virtual World (via voice and text), how they felt they were perceived while using an avatar, and how much they trusted their information to be kept confidential. These comprise aspects of relational trust. A Likert Scale of 1–5 was used, 1 = "strongly disagree", 3 = "neutral", 5 = "strongly agree". Reliability for the VWT was good (α = .77).

Trust in Automation Questionnaire (TIA). The Trust in Automation Questionnaire consists of 12 items on a 7-point Likert scale with 1 being "not at all" and 7 being "extremely". Five questions address statements of distrust in the automation, six questions address statements of trust in the automation, and one question addresses familiarity with the automation. This scale was developed to examine trust in automated systems [10]. Reliability for the TIA was moderate (α = .62).

2.3 Procedure

Following an Institutional Review Board approved protocol, participants completed an informed consent form and a demographic survey, as part of the pre-intervention data collection. Participants were assigned to one of three intervention groups: In Person (IP), Virtual World (VW), or Waitlist Control. Participants in the IP and VW groups completed nine mindfulness classes over eight weeks. After training, participants completed post-intervention assessments.

This paper addresses a subset of post-intervention questions administered *only* to the VW group, specifically asking about their experience using Virtual World technology during training and their trust in the automation. The in-person training group and the control group did not use the Virtual World technology and thus were not included in this assessment.

2.4 Data Analysis

Means and Standard Deviations were assessed for the Virtual World Questions and Trust in Automation Questionnaire. Pearson Product Moment correlations were used to determine relationships between demographic variables, trust, and class attendance. An ANOVA and the Student's t-test were conducted to detect differences in trust and

class attendance based on demographics. IBM SPSS Statistics for Windows, version 22.0 (Armonk, NY) was used with all analyses having a .05 alpha level.

3 Results

Demographics. 45 individuals completed the study as part of the VW intervention group. Table 1 shows the demographic information. Participants ranged in age from 26 to 69 (M = 50.49, SD = 10.68).

Table 1. Participant demographics

	N (%)
Gender	
Male	25 (55.6)
Female	20 (44.4)
Military status	
Active duty	14 (31.1)
Reserve	1 (2.2)
Guard	1 (2.2)
Veteran	29 (64.4)
Education	
High school	3 (6.7)
Some college/associate's	10 (22.3)
Bachelors	13 (28.9
Masters/doctorate	16 (35.5)
Other professional	3 (6.7)
Ethnicity	
African American	9 (20.1)
Caucasian	29 (64.4)
Hispanic	4 (8.9)
Asian	1 (2.2)
Native American	1 (2.2)
Other	1 (2.2)
Marital status	
Married	28 (62.2)
Divorced/separated	9 (20.1)
Single	6 (13.3)
Widowed	1 (2.2)
Partnered	1 (2.2)
Computer experience	
Little to no	1 (2.2)
Basic	3 (6.7)
Intermediate	14 (31.1)
Expert	23 (51.1)
Advanced	4 (8.9)

Trust Measures. Tables 2 and 3 show the means, standard deviations, and number of responses for each item on the VWT and TIA. Although 45 participants completed the post-study questionnaire, not all participants answered all of the questions. Overall, participants felt comfortable communicating in SL, trusted their information would be kept confidential, and believed they were perceived as intended. For the TIA, mistrust in the system was low, while measures of trust in the system were relatively high.

Table 2. Means, standard deviations, and n's for the VWT

Item	*Mean*	*SD*	*n*
I felt comfortable speaking during my MBSR class over Second Life using my voice	4.00	.95	45
I felt comfortable speaking during my MBSR class over Second Life using my text	4.24	.83	45
I trust that my personal information will be kept confidential over Second Life	4.33	.67	45
I believe that my MBSR over Second Life classmates and instructors perceive me the way I intended using my avatar	3.95	.81	44

Table 3. Means, standard deviations, and n's for the TIA

Item	*Mean*	*SD*	*n*
The system is deceptive	1.86	1.34	42
The system behaves in an underhanded manner	1.67	1.22	42
I am suspicious of the system's intent, action or outputs	1.90	1.36	42
I am wary of the system	2.02	1.47	42
The system's action will have a harmful or injurious outcome	1.67	1.22	42
I am confident in the system	5.12	1.69	42
The system provides security	5.00	1.38	42
The system has integrity	5.00	1.33	42
The system is dependable	4.55	1.80	42
The system is reliable	4.48	1.85	40
I can trust the system	4.90	1.61	41
I am familiar with the system	4.59	1.50	39

Demographic and Trust Measures. No differences were found between trust measures for gender, military status (active duty and veterans) education level, ethnicity, marital status, or computer experience (intermediate, expert, advanced), p's > .05.

Hours of Computer Use per Week. Significant correlations were found between self-reported hours using a computer at work and responses on the VWT. Longer time spent using a computer at work was positively associated with feeling comfortable speaking, $r(45) = .38$, $p = .009$, and texting, $r(45) = .36$, $p = .017$, during class and trusting that personal information would be kept confidential, $r(45) = .43$, $p = .004$. Longer time spent using a computer at work was positively correlated with believing

that classmates and instructors perceived the individual participant as they intended, r (44) = .53, p = .0001. No significant correlations were found between computer use at work and class attendance or hours of home computer use and class attendance on VWT questions (p's > .05).

Class Attendance. Table 4 shows the frequency of class attendance. The majority of participants who completed a post study assessment attended 5 or more classes (82.2%). No differences were found for class attendances among demographic groups, p's > .05.

Table 4. Class attendance

Classes attended	N	%
2	4	(8.9)
4	4	(8.9)
5	4	(8.9)
6	9	(20.0)
7	9	(20.0)
8	12	(26.7)
9	3	(6.7)

Class Attendance and Trust. Table 5 displays the bivariate correlations between class attendance and responses on the VWT and TIA. For the VWT Questionnaire, class attendance was significantly correlated with the participant's comfort in using their voice to communicate in the VW and with participants' trust that personal information would be kept confidential, p < .05. For the TIA Questionnaire, all six measures of trust were significantly correlated with attendance, p < .05. Familiarity with the system was not significantly correlated with attendance, p > .05. Being wary of the system was significantly associated with lower class attendance, p < .01.

4 Discussion

The purpose of this study was to examine active duty and veteran U.S. military volunteers self-reported relational trust and trust in automation after attending an eight-week mindfulness meditation training class delivered online via a VW.

None of the demographic measures, except for hours of work-related computer use per day, were associated with trust. While America's seniors have been slower to adapt to technology, six of ten seniors now use technology [11]. The Pew report noted two groups of older Americans. The first group of younger, more highly educated, or more affluent seniors use technology and have a positive view of online systems. The second group of older and less affluent seniors often experience health challenges and are disconnected from digital technologies. Our results show that age did not influence responses to the trust questionnaires or class attendance, suggesting that this sample fell

into the former category of seniors, and among the 60% who use technology. Indeed, our participants reported high levels of education and relatively high use of computers at home and work.

Table 5. Significant correlations between class attendance and responses to the VWT and TIA.

Measure	Item	*r*	*p*	*n*
VWT	I felt comfortable speaking during my MBSR class over Second Life using my voice	.53**	.00	45
	I trust that my personal information will be kept confidential over Second Life	.30*	.04	45
TIA	I am wary of the system	−.30*	.05	44
	I am confident in the system	.41**	.01	44
	The system provides security	.39**	.01	44
	The system has integrity	.37*	.01	44
	The system is dependable	.40**	.01	44
	The system is reliable	.41**	.01	42
	I can trust the system	.31*	.05	43

**p < .01, *p < .05

Our research showed an association between longer hours of work-related computer use and trust. These findings support those of Blank and Dutton [12] who found that between 2003 and 2009, age became less of a factor in trusting technology, while experience became more important. More investigation would be needed to identify if certain types of tasks at work lead to greater comfort in using VW technology.

In general, the participants in this study reported moderately high levels of trust and low levels of mistrust in the use of a VW technology system for attending a mindfulness meditation training class, and high positive levels of relational trust when attending a wellness intervention via a VW. This acceptance of using VW technology for attending a wellness-based training group was encouraging in terms of offering similar training to both military and civilian populations. Such training might include other forms of stress management, smoking cessation classes, assertiveness training, and perhaps support groups for those with serious illness, injury, or addiction.

Approximately 73% of the participants who returned for post-study assessments attended 6 or more classes during the study. While this does not account for the participants who left the study prior to the post-study assessment, it does indicate that the participants who completed the study were committed to the training. In a previous study looking at trust in telemedicine systems, researchers found the more interpersonal trust the participants had, the more trust they had in the system and vice versa [13]. Furthermore, the authors stated that increased experience fostered increased trust for both the interpersonal dynamic, as well as for the system, that is, greater technology (system) experience encouraged greater trust in both the instructor and other participants (and vice versa). It would also be expected that over the class duration (8 weeks), as more experience was gained, participant's trust would increase.

Greater trust was associated with higher attendance, while suspicion ("I am wary of the system" was associated with lower attendance. Correlations between class attendance and the questions about the use of the VW indicate that participants who felt comfortable speaking in the VW using their voice and who trusted their personal information would be kept confidential, attended more classes. This finding is consistent with reports that individuals are more likely to trust avatars when they are able to use voice communication [14]. Participants were encouraged to use their voice to communicate, but it was not required (texting was permitted). However, text was used by participants only when the technology failed and they could not be heard by other participants.

Interestingly, system familiarity was not significantly associated with class attendance. Twenty-two percent (22%) of participants had used a VW prior to participating in this study. However, none of the participants had ever used SL prior to the study. It was encouraging that familiarity was not required for participants to attend the classes, as this may indicate that those without familiarity can participate in, and gain from, participating in VW telehealth interventions.

As noted above, agreement with the statement "I am wary of the system" (indicating lower system trust) was associated with more absences from class. Since experience using the technology, and voice communication both increase trust in a technology system (VW), wariness may be mitigated by increasing practice time and using voice during training to use a VW prior to the start of an online group.

Another potential method for addressing lack of trust might include involving the users in the design considerations for the VW environment and for creating meaningful interactions within that environment. Most user involvement tends to stop at the technology interaction level [15]. Indeed, the value of co-creation could be considerable, especially in light of the type of services to be rendered and the experience levels of both healthcare professionals and the constituents they serve.

Trust in telehealth has also been shown to be connected to the perceived motives of the service providers [15]. That is, at a human systems integration level, all communications and interactions with patients should convey concern for the patient and his or her safety and privacy. Patients are likely to be concerned about the safety and reliability of the telehealth service and software, and their interest may be weighted around the perceived risks and benefits from the experience [15]. Finally, having a foundation of relational trust between the provider and the patient will likely impact patients' trust in the telehealth technologies used by their provider. Just as in in-person interactions, trust is progressive and molded by repeated interactions over time. Similarly, trust in the reliability, validity, usability, and integrity of the system build over time.

Limitations. The primary limitations of this study were the homogeneity of the sample population, which included U.S. military active duty and veteran volunteers, and the small sample size. Nevertheless, the findings provide valuable insight into the use of VW technology for providing health and wellness programs to U.S. military and veterans.

Conclusions. Overall, participants reported moderately high trust in automation and high relational trust. Relational trust that was high included feeling comfortable communicating, trusting in the confidentiality of the system and co-attendees, and

believing their avatars (as representations of themselves) were perceived as they intended. Greater work-related computer use was related to feeling comfortable communicating with others during class and believing that classmates and instructors perceived participants as they intended. Finally, our research supports Lee and Moray's [3] proposal that trust is key to the use of automation, as an increase in trust was related to an increase in VW class attendance. Our research also supports the idea that trust is vital in VW group work, as it reduces uncertainty and equivocality and thereby helps establish shared understanding and virtual relationships [16–18].

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