

# Privacy concerns of older adults using voice assistant systems

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## INTRODUCTION

Voice assistant systems (VAS) are software platforms that complete various tasks using voice commands (e.g., Amazon Alexa, Google Assistant). VAS present opportunities for older adults to increase interactions with their environment, improve home safety, participate in remote monitoring, and optimize medication adherence and may be underutilized.<sup>1</sup> In a recent study, VAS ownership and use in older adults (>60 years) was similar to that of younger adults (18–60 years).<sup>2</sup> Yet, less is known about older adults' VAS related privacy concerns or their understanding of VAS-specific privacy risks (e.g., VAS-initiated interactions) which are important factors that may limit VAS use for health monitoring.<sup>1,3</sup> It is necessary to understand the juxtaposition of younger and older adults' VAS privacy concerns as younger adults may have different concerns impacting VAS acceptance. Therefore, we examined the differences in VAS related privacy concerns across the lifespan.

## METHODS

We conducted a mixed-methods study using online surveys, semi-structured interviews, and qualitative and quantitative data analyses (February 2020–April 2021), to affirm consistency in results. This study was embedded within a VAS-related human subjects study aimed at identifying cognitive decline in older adults at the University of North Carolina-Chapel Hill and Dartmouth-Hitchcock.<sup>4</sup> The institutional review boards approved this study.

We recruited a younger cohort of individuals aged 18–64 years ( $n = 60$ ) and an older cohort aged  $\geq 65$  years ( $n = 55$ ) using [researchmatch.com](https://researchmatch.com) and geriatric specialty clinics at both sites. Participants aged  $\geq 18$  were English speaking and completed a privacy survey. All data were stored in REDCap.<sup>5</sup> An adapted version of the Internet Users' Information Privacy Concerns (IUIPC) assessed privacy concerns (Table S1) and was completed without assistance.<sup>6</sup> Participants who answered the four semi-structured interview questions (Table S2) to completion were included in the qualitative analysis ( $n = 11$ ).

	Younger adult	Older adult	p-value
	N = 60	N = 55	
Age	36.3 ± 12.6 years	73.3 ± 5.6 years	<0.001
Sex, Female	46 (77%)	23 (42%)	<0.001
Race		0.03	
White	44 (73.3%)	51 (92.7%)	
Black or African American	11 (18.3%)	2 (3.6%)	
Asian	3 (5.0%)	2 (3.6%)	
Other	2 (3.3%)	0	
Ethnicity		0.002	
Not Hispanic or Latino	50 (83.3%)	55 (100%)	
Hispanic or Latino	10 (16.7%)	0	
Education		0.913	
Less than college	3 (5.0%)	3 (5.5%)	
Some college and greater	57 (95.0%)	52 (94.5%)	
Income Range		0.780	
<\$50,000	12 (20%)	14 (25.5%)	
\$50,000–\$99,999	30 (50%)	26 (47.3%)	
\$100,000	18 (30%)	15 (27.3%)	
Cognition		<0.001	
Mild Cognitive Impairment	N/A	28 (51.0%)	
Dementia	N/A	1 (1.8%)	
Healthy	60 (100%)	26 (47.2%)	

TABLE 1 Participant characteristic data

Note: All continuous variables represented as mean ± standard deviation. Categorical as count (percent).

All quantitative data were aggregated into a single dataset and the mean and standard deviation were calculated for each question. A t-test of unequal variance compared continuous variables and a  $\chi^2$  for categorical. A p-value of <0.05 was considered statistically significant. *Listening-in*, *tracking*, and *unwanted sharing of information* were used as pre-determined, a priori, qualitative themes for the semi-structured interviews. Transcripts were manually reviewed and coded by two reviewers, with 100% agreement upon coding.

## RESULTS

A total of 115 participants were recruited, 60 younger adults (mean age 36.3 ± 12.6 years, 77% female) and 55 older adults (mean age 73.3 ± 5.6 years, 42% female) (Table 1). Older adults had less VAS-related privacy concerns than younger adults regarding data being collected under user consent, data security, and data protection (Table 2). Both groups noted that data should be highly protected and were uncomfortable with daily monitoring. Both groups wanted stricter privacy regulations but

differences did not reach statistical significance. The frequency of privacy concerns for the semi-structured interviews were: listening-in ( $n = 4$ ), tracking ( $n = 2$ ), and unwanted sharing of information ( $n = 5$ ) (Table S2).

## DISCUSSION

Our findings suggest that older adults may have less privacy concerns about VAS use than younger adults. However, it is unclear if older adults understood the privacy risks associated with VAS use. While older adults have VAS privacy concerns, they have less desire for strict privacy regulations than younger adults.

Our study identifies VAS-specific privacy concerns and risk comprehension across the lifespan, which has important implications for VAS privacy education. The discordant VAS privacy concerns of older adults in our study are of particular concern as it increases their potential risk of identity and financial theft.<sup>3</sup> Contributing factors may include the digital divide (i.e., younger adults on average are more exposed to technology) and changes in cognition.<sup>3,7</sup> Similar to previous studies, both groups had

TABLE 2 Privacy perceptions with voice assistance system use

Question	Younger Adult Mean $\pm$ SD	Older Adult Mean $\pm$ SD	p-value
How confident are you that the VAS collects the data under your consent? <sup>a</sup>	6.1 $\pm$ 2.9	7.6 $\pm$ 2.8	0.005
How confident are you that VAS data are securely stored? <sup>a</sup>	5.3 $\pm$ 2.7	7.1 $\pm$ 2.9	0.001
How confident are you that the VAS data are properly used under your consent? <sup>a</sup>	5.1 $\pm$ 2.8	7.5 $\pm$ 2.8	<0.001
In general, do you think that the VAS securely protects your data? <sup>a</sup>	5.1 $\pm$ 2.8	6.8 $\pm$ 2.8	0.001
In general, do you think the VAS data need to be highly protected? <sup>a</sup>	8.6 $\pm$ 1.8	8.2 $\pm$ 2.5	0.35
In general, are you comfortable with the fact that companies, such as Google and Amazon, provide more personalized services such as voice assistance, while monitoring your daily activities? <sup>a</sup>	4.8 $\pm$ 2.6	4.8 $\pm$ 3.0	0.95
	Yes (%)	Yes (%)	
Do you think it is critical to have new privacy regulations on VAS data in place?	56 (93.3%)	39 (70.9%)	0.002
Do you want the VAS to provide more active services, such as initiating voice conversations?	17 (28.3%)	11 (20.0%)	0.30

Note: All continuous variables are represented as mean  $\pm$  standard deviation. Categorical as count (percent).

<sup>a</sup>Likert-style (1–10, with higher scores indicating less concern).

concerns about *listening-in*, suggesting this “privacy trade-off” may be a barrier to future healthcare-related VAS use.<sup>8,9</sup>

Strengths of this study include a robust methodology and younger cohort comparator group. Limitations included sample homogeneity and size, limited number of questions from the semi-structured interviews, pre-determined qualitative codes, a significant component of recruitment from geriatric clinics, unknown baseline technology use or literacy, and an internet-based format. Because the potential sample biases, future research should elaborate on these results. Additionally, the adapted IUIPC survey has not been widely validated in older adults with or without cognitive impairment.<sup>10</sup>

The aging demographic is growing and living longer making it is critically important for geriatric care providers to find novel ways to promote aging in place. Our findings suggest that older adults are open to using a VAS but may lack a full understanding of their privacy implications. Future efforts by geriatricians and researchers are needed to determine older adult baseline technology use and their specific VAS-related educational needs in order to promote the safest VAS healthcare experiences.

## AUTHOR CONTRIBUTIONS

All authors participated in the study's conceptual design, data analysis and accuracy and creation of the brief report.

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## CONFLICT OF INTEREST

No authors have any financial, personal, or potential conflicts of interest to disclose.

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## REFERENCES

## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

**Table S1** Thematic analysis of older adult VAS-related privacy concerns.

**Table S2.** Semi-structured interview questions about Voice Assistant System Use.

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