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Introducing shared automated vehicles (SAVs) should lead to several societal benefits, but both automated vehicles (AVs) and ridesharing must overcome barriers to acceptance. Previous research has investigated age differences in ridesharing usage and factors influencing acceptance of AVs. We investigate age differences in how two online introductory videos (educational or experiential) affect anticipated SAV acceptance. Participants in three different age groups were randomly assigned to watch 1.) an educational video about SAV technologies and potential benefits, 2.) an experiential video showing a SAV navigating traffic, 3.) both the experiential and educational videos, or 4.) a control video explaining how current ridesharing services work. Attitudes toward SAVs were measured pre- and post-video(s). Significant differences were found between video conditions relative to the control video, and between age groups. Findings suggest that educational and/or experiential videos delivered in an online format can modestly improve viewers' attitudes toward SAVs—particularly older adults'.

Keywords: shared automated vehicles; introductory information; online videos; age differences; technology acceptance

Introduction

For many, ridesharing can be a convenient and cost-effective transportation alternative to a personal car and can potentially help solve first-mile-last-mile problems (i.e., getting from home to a metro station and back) when using high throughput public transit systems (Gururmurthy, Kockelman, and Zuniga-Garcia, 2020). Previous studies have examined what factors influence a traveller's decision to use ridesharing services offered by transportation network companies (TNCs) such as UberPool or Lyft Shared Ride, where users are paired with other passengers requesting a ride along a similar route. Motivations for using ridesharing services include cost savings, travel time compared to public transportation, and comfort (Sarriera et al., 2017). Age has been found to be a significant factor in ridesharing use, with younger individuals being more likely to use these services than older individuals (Sarriera et al., 2017; Wang et al., 2020). Gender, however, has seen mixed results regarding ridesharing use. Some studies found that males were more likely to use ridesharing services than females (Wang et al., 2020), while others found no gender differences (Sarriera et al., 2017). For this reason, our hypotheses focus on age differences rather than gender differences.

Automated vehicles (AVs) should improve rider comfort and allow drivers to put the time and effort they would normally put into navigating through traffic into other tasks (Motamedi et al., 2019). Shared automated vehicles (SAVs) could lead to several additional benefits including reduced traffic, reduced pollution from vehicles, and improved parking availability (Motamedi et al., 2019, Mason et al., 2020). However, for these benefits to be realized, there needs to be high levels of public acceptance for SAVs (Paddeu et al., 2020).

Factors influencing the acceptance of AVs have also been widely studied (e.g., Kyriakidis et al., 2015; Charness et al., 2018; Wang et al., 2020). Perhaps unsurprisingly, individuals who identify as pro-technology – those who adopt new technologies early and use them often – tend to have positive attitudes toward AVs; as do younger individuals (Wang et al., 2020). Additionally, familiarity with and trust in automated technologies have been shown to positively correlate to positive attitudes toward AVs (Wang et al., 2020; Paddeu et al., 2020). Trust in AVs has been shown to increase with first-hand experience riding in one (Classen et al., 2020; Paddeu et al., 2020), and perceived safety influences both intention-to-use and perceived usefulness of AVs (Motamedi et al., 2019).

Computer-mediated communication has become an appealing approach for marketing and consumer research due to its low cost, speed, and breadth of reachable audiences (Kent & Lee, 1999). While the use of online videos as a persuasion tool is still a relatively new field compared to more traditional computer-mediated communications such as email campaigns, there has been some investigation into how effective different types of online videos are at appealing to their intended audience. For example, within the healthcare field, one study found that the instructional use of online videos on using a common psoriasis severity measure was able to improve the accuracy in assigning severity scores for both physicians and patients (Armstrong et al, 2013). In another recent study, the effectiveness of an educational, narrative-based online video was compared to that of traditional printed pamphlets in improving individuals' beliefs in their own ability to taper their opioid use as well as their behavioural intentions to do so, finding significant improvements in patients' attitudes towards the effectiveness of tapering their opioid use and additionally the tapering self-efficacy of patients who viewed the online video versus those who viewed a pamphlet (Feng et al., 2021). This shows the online video medium's unique ability and effectiveness over printed materials in changing attitudes that may be difficult to change. Video interventions have also been shown to be effective in modifying certain types of health behaviours, such as breast self-examination, prostate cancer screening, and sunscreen adherence (Tuong, Larsen and Armstrong, 2014). These are promising indicators for stakeholders that want to use online videos to inform consumers about novel technologies: that by developing online media showing the technology in action, they can educate consumers and/or address any misconceptions they may have.

While much of previous research has focused on age differences in ridesharing usage or factors influencing acceptance of AVs, our study aims to combine these factors by looking at age differences in the malleability of anticipated acceptance of SAVs and the factors influencing anticipated acceptance. For the purposes of this study, we define SAVs as Society of Automotive Engineers (SAE) Levels 4 and 5 which are considered fully autonomous vehicles capable of driving themselves in most (L4) or all situations a human driver could manage (L5; SAE, 2016) being shared by riders traveling similar routes to their various destinations. We also specify anticipated acceptance because

SAVs are not currently widely available for consumer use. Our hypotheses are as follows:

- H1: The educational video will have a positive effect on participants' attitudes towards SAVs.
- H2: The experiential video will have a positive effect on participants' attitudes toward SAVs.
- H3: When viewed together, the educational and experiential videos will have a more positive effect on participants' attitudes toward SAVs than either alone.
- H4: Younger participants will have a greater change in attitudes toward SAVs after watching the educational and/or experiential videos than middle aged or older adult participants.
- H5: Younger participants will have more positive attitudes toward SAVs than the middle aged or older participants.

Materials and Methods

Experimental Design

This study employed a 3x4 (age group x video condition) mixed experimental longitudinal study, with the between-subjects component coming from the different condition assignments (control, educational video only, experiential video only, and both educational and experiential videos), and the within-subjects component coming from changes to SAV attitudes before and after viewing their randomly assigned video(s).

Participants

In order to determine how many participants were necessary to detect an effect size of ~0.25 using *F*-test repeated measured within-between interaction, an a priori power analysis was performed using G*Power (Faul et al, 2009). A Cohen's *f* effect size of 0.25 was used during the analysis because this was the smallest significant effect size found by Classen and colleagues (2020) in their study that used a similar scale to make the pre-post measurements we used for our pre-post condition main effects. Using three groups of 20 measurements (10 measures each from the pre and post condition surveys) with an alpha level of 0.95, we calculated the minimum total sample size should be 335 participants.

Prior to participant recruitment, we sought and gained approval from Clemson University's institutional review board (approval # IRB2020-315). We recruited three different age groups of adults, with younger adults aged 18-25, middle-aged adults aged 30-64, and older adults aged 65 and over. We recruited the middle-aged and older adults through Prolific (www.prolific.co), an online data collection service, paying participants $9.50/hour. Younger adults were recruited through Clemson University's SONA system (www.sona-systems.com) for course credit. Students were given three course credits in return for their participation. All participants were US residents, and the survey took 35-45 minutes to complete.

Materials

Respondents' attitudes towards SAVs might be influenced by several factors, including their current comfort with ridesharing services and their existing attitudes towards technology. To account for participants' comfort with ridesharing services, we used the measures implemented in Sarriera and colleagues' (2017) study on dynamic ridesharing usage (see Appendix A), with responses given using a 7-point Likert scale. To account for respondents' perceptions of technology, we used a combination of preconceptions measures from Lee and colleagues (2015) and experience measures from Mason and colleagues (2020) using a 100-point slider scale (see Appendix B), with greater values signalling more positive views of technology. Older participants additionally completed an online version of the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005) to capture any cognitive impairment.

Our dependent measure was the Shared Automated Vehicle User Perception Survey (SAVUPS; see Appendix B), which consisted of a modified version of the Automated Vehicle User Perception Survey (AVUPS; Mason et al., 2020) that was lightly changed to specifically assess attitudes toward SAV services. The AVUPS has established face and content validity (Mason et al., 2020) as well as construct validity and test-retest validity (Mason et al., 2021). We delivered the SAVUPS before and after participants watched the video(s) assigned to their condition. Responses from this survey can be broken down into the following dimensions that affect an individual's attitude towards AVs: intention to use, trust/reliability, perceived usefulness (PU), perceived ease of use (PEOU), safety, desire for control/driving-efficacy, cost, authority, media, and social influence. Finally, the post-video SAVUPS also concluded with four open-ended questions regarding respondents' attitudes towards AVs.

Our four experimental conditions included several videos (control, educational, experiential, and both educational and experiential) we found or produced and were differentiated based on the videos' content. We produced an educational video using information gathered from the Partners for Automated Vehicle Education (PAVE) website (www.pavecampaign.org) that introduced the different technologies that enable automated driving, what kinds of tasks automation performs better than or worse than human drivers, and the potential benefits of AV acceptance. Our experiential video used raw footage provided by an AV developer (Zoox, Inc.; www.zoox.com) of one of their AVs driving around San Francisco which included both a representation of what the automated driving system (ADS) ‘sees’ and footage from cameras mounted on the hood and both side mirrors (Figure 1). For the video employed in the control condition, we used a pre-made video describing how ridesharing services like Uber and Lyft work that we found on YouTube (Ridester, 2018).

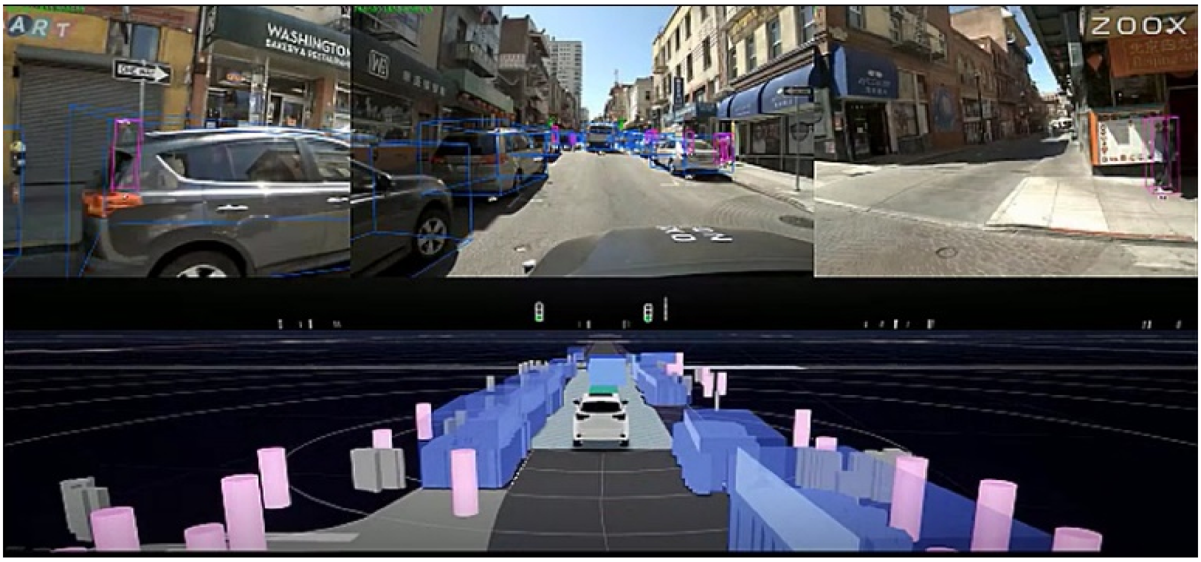

Figure 1: The top half of the screen shows the view from cameras mounted on an AV; the bottom half shows how the AV technology perceives the car’s surroundings.

Procedure

Once participants signed up for our study via SONA or Prolific, they were provided a link to a Qualtrics survey that randomly assigned them to either the educational video condition, the experiential condition, both educational and experiential videos, or a control condition that contained a video detailing how to use TNC services. Participants first filled out standard demographic information – gender, age, whether they lived in an urban/suburban/rural area, etc. – and filled out the comfort with ridesharing and perceptions of technology sections. Older adults completed the MoCA in-between the demographics and ridesharing comfort sections. Next, participants completed the SAV pre-video survey, watched their condition’s video(s), then completed the post-video

SAV survey and questions about comfort with human vs automated drivers. Figure 2 illustrates this survey flow.

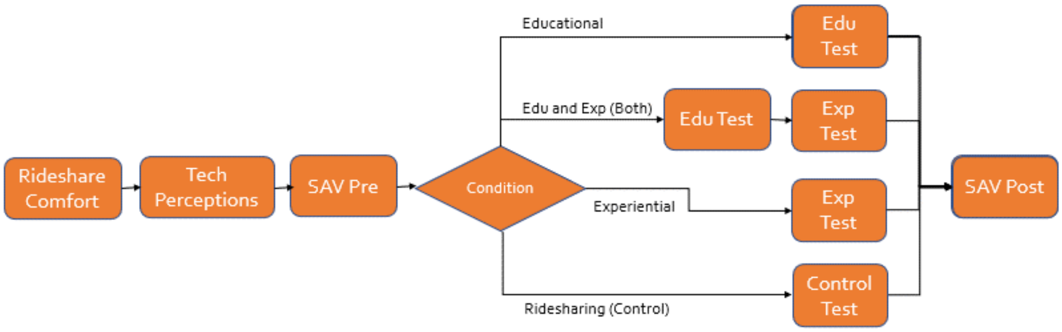

Figure 2. Survey Flow. Note: Edu Vid = Educational Video, Exp Vid = Experiential Video.

Because it was critical to our results that participants viewed the video(s) assigned to their conditions and retained their content, before conducting analysis we removed participants who did not spend enough time in the video block to watch their video(s). We also removed participants who failed either of the two attention check questions we inserted into the survey. Whether or not the videos were watched was determined by the length of time spent on the question with the video embedded. If the timing was less than 200 seconds or more than 1,000 seconds, the participant's data was removed from the pool of data for analysis. These numbers were based on the educational video and experiential video lengths being 442 and 420 seconds, respectively. The minimum of 200 seconds was chosen to account for the possibility that participants may choose to watch the videos at 2x speed. Spending longer than 1,000 seconds on the page with the video(s) we took as an indication that the participant clicked 'play' then walked away or turned their attention to another task.

Analysis

To assess the effects of age and our videos on respondents' attitudes towards SAVs, we performed a 3x4 MANCOVA analysis on the SAVUPS dimension difference scores (intent to use SAVs, trust in SAVs, perceived usefulness of SAVs, perceived ease of use of SAVs, and perceived AV safety) using the independent variables age group (younger (18-25), middle (30-64), and older (65+)) and video condition (ridesharing control video, educational video only, experiential video only, both educational and experiential videos). We included the covariates gender, ridesharing comfort (i.e., how comfortable the respondent was sharing a ridesharing vehicle with another passenger), past and present ridesharing experience, perceptions of technology, as well as the pre-video SAVUPS dimensions cost (i.e., how much cost influences their intent to use SAVs) and desire for control/driving-efficacy (i.e., their preference to drive themselves despite having automation available).

Results

Participants

Table 1 provides a breakdown of several participant characteristics by both the four video conditions as well as the three age groups. We were able to recruit 239 younger adults, 173 middle-aged adults, and 173 older adults, giving us a total of 585 participants. Older adults MoCA scores were checked to ensure all participants showed no signs of cognitive impairment. No participants needed to be removed from the sample based on cognitive ability. Once participants were screened according to the criteria mentioned above, our final sample consisted of 151 younger adults, 143 middle-aged adults, and 144 older adults, giving us a total of 438 participants included in our analysis. See Figure 3 for the baseline SAVUPS dimension scores by age group and Figure 4 for the SAVUPS dimension difference scores (post-video scores minus pre-video scores).

Table 1. Video Condition & Age Group Participant Characteristics

				Area Type								
	N	# Female	Average Age	Rural	Suburban	Urban	Average Education	Average Income	Average Rideshare Experience	Average Rideshare Comfort	Average Technology Perceptions	Average MOCA Score
Video Condition												
Control	124	72	40.4(21.9)	17	90	19	3.57(1.33)	7.51(3.85)	3.95(2.34)	4.10(1.15)	73.7(12.03)	24.9(1.96)
Educational	104	59	45.5(21.1)	21	53	29	3.87(1.69)	6.79(3.92)	3.90(2.17)	4.07(1.02)	73.2(15.8)	25.2(2.02)
Experiential	111	72	43.3(21.7)	24	65	22	4.05(1.59)	6.82(3.72)	3.77(2.19)	4.03(.975)	74.1(13.95)	25.1(1.95)
Both	97	52	45.4(20.4)	19	55	23	4.05(1.54)	6.70(3.83)	3.64(1.86)	4.09(1.03)	73.2(13.3)	25.4(1.56)
Age Group												
Younger	147	99	19.9(1.28)	22	118	8	2.56(.598)	8.35(4.27)	4.59(2.39)	4.34(.911)	73.0(13.1)	
Middle	145	73	41(8.79)	25	73	47	4.37(1.45)	6.44(3.58)	3.94(2.19)	3.81(1.13)	73.8(14.6)	
Older	144	83	70.2(3.91)	34	72	38	4.71(1.42)	6.12(3.18)	2.91(1.42)	4.07(1.03)	73.8(13.6)	25.2(1.85)

Note. Values are Mean(*SD*). Education values: 1 = "Some high school", 2 = "High school graduate", 3 = "Some college", 4 = "Associate degree (2-year)", 5 = "Bachelor's degree", 6 = "Master's degree", 7 = "Doctoral degree", 8 = "Professional degree (JD, MD)"; Income values: 1 = "$0-$9,999", 2 = "$10K-$19,999", 3 = "$20K-$29,999", 4 = "$30K-$39,999", 5 = "$40K-$49,999", 6 = "$50K-$59,999", 7 = "$60K-$69,999", 8 = "$70K-$79,999", 9 = "$80K-$89,999", 10 = "$90K-$99,999", 11 = "$100K-$149,999", 12 = "$150K+"; Rideshare Experience Values: 1 = "Never", 2 = "3-4 Times a year", 3 = "Once a month", 4 = "2-3 times a month", 5 = "2-3 Times a week", 6 = "Daily"; Rideshare Comfort Values: 1 = "Strongly disagree" - 7 = "Strongly agree"

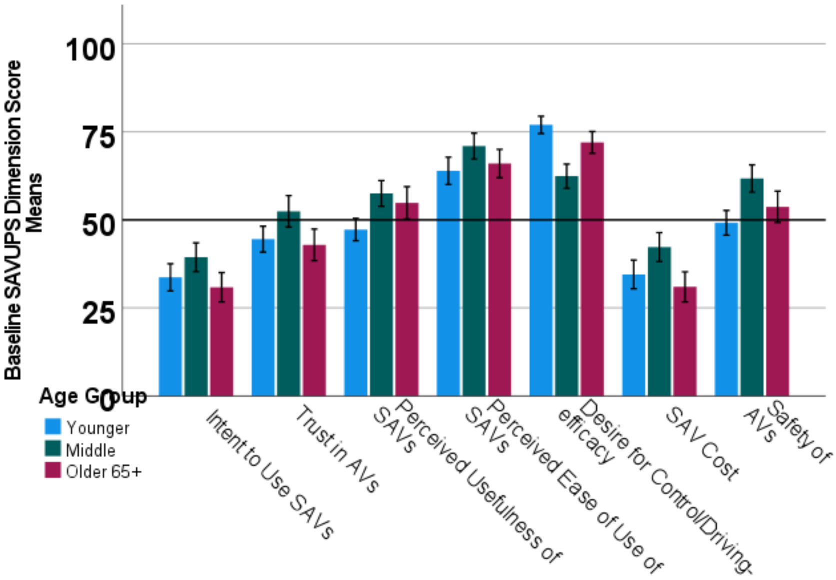

Figure 3. Baseline SAVUPS Dimension Scores by Age Group. Error bars are 95% confidence intervals (CIs).

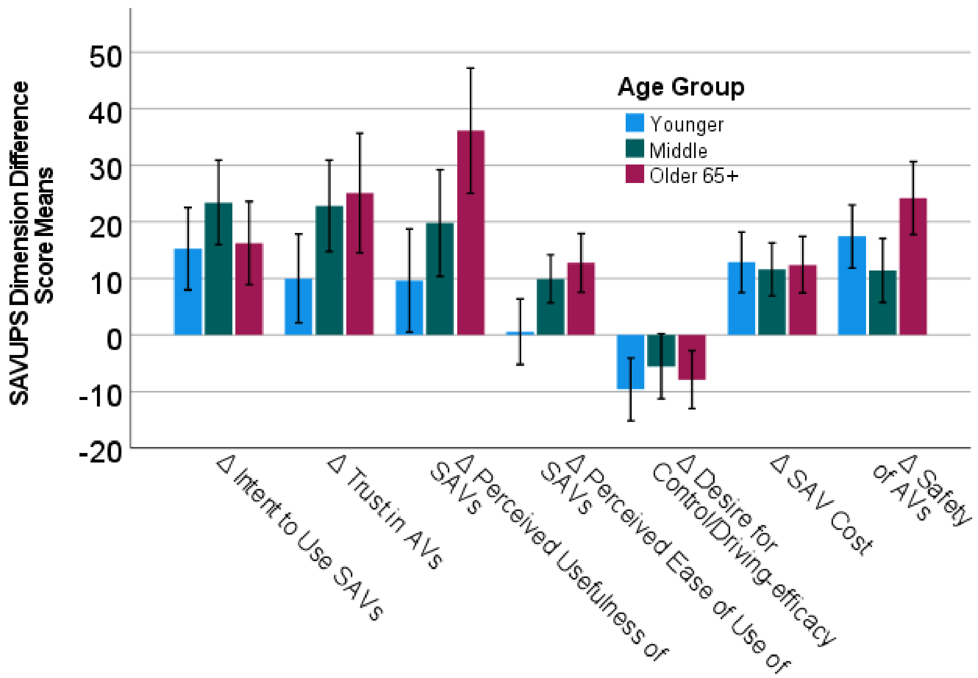

Figure 4. SAVUPS Dimension Difference Scores by Age Group. Error bars are 95% CIs.

SAVUPS Difference Score MANCOVA

Levene's test was performed and was not found to be significant for any of the dependent variables, so the assumption of homogeneity of variance was not violated.

Box's M test was also not statistically significant, so the assumption of covariance homogeneity was also not violated. Multivariate tests showed rideshare experience to be the only significant covariate (Pillai’s Trace = .034, $F(5, 414) = 2.87$, $p < .016$, $\eta_p^2 = .034$), with more rideshare experience associated with significantly lower intent to use difference scores ($F(1, 418) = 4.52$, $p < .036$, $\eta_p^2 = .011$) and PEOU difference scores ($F(1, 418) = 7.18$, $p < .009$, $\eta_p^2 = .017$).

No significant interactions were found in the multivariate tests (Pillai’s Trace = 0.082, $F(30, 2090) = 1.16$, $p = .25$, $\eta_p^2 = .016$), but a significant between-subjects test interaction between video condition and age group was observed ($F(6, 418) = 2.65$, $p < .02$, $\eta_p^2 = .037$). Explored graphically (see Figure 5), it revealed that older participants in the control condition reported significantly higher PEOU difference scores after watching the control video on how to use ridesharing services than other age groups in their video condition. While such inconsistencies are to be questioned, we believe this has meaningful implications which we will elaborate on during discussion.

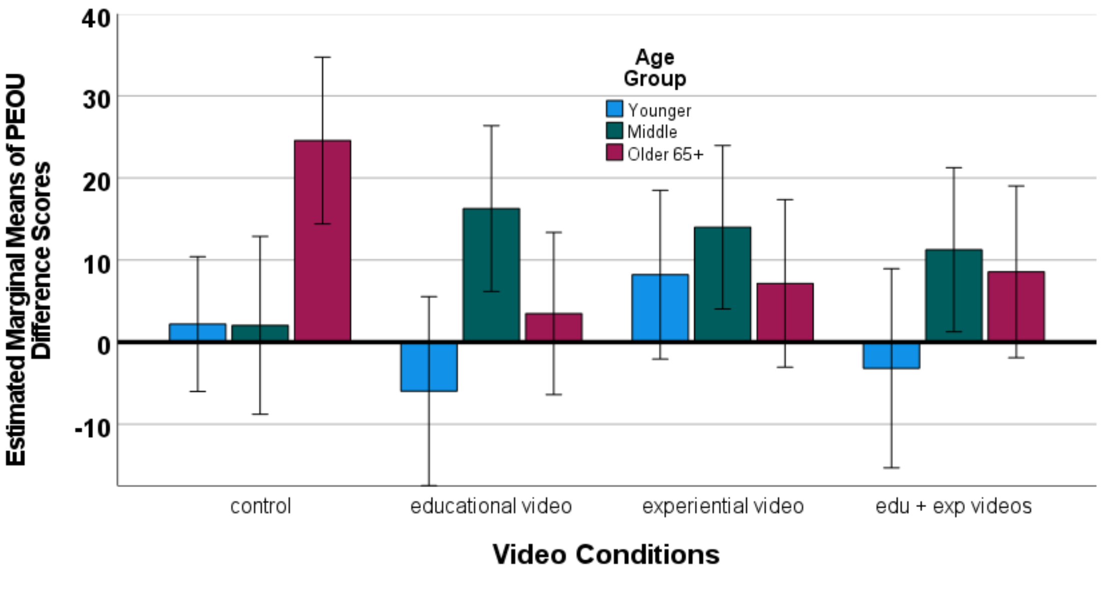

Figure 5. Observed Between-Subjects Tests Video Condition by Age Group Interaction on Perceived Ease of Use. Error bars are 95% CIs.

Main effects observed between the video conditions and age groups are detailed in the paragraphs that follow. See the descriptive statistics for the SAVUPS difference scores in Table 2 and full results of this analysis in Table 3. Covariates appearing in the model are evaluated at the following values: gender = 1.60, technology perceptions = 73.54, rideshare experience = 3.84, rideshare comfort = 4.07, SAVUPS driving = 211.47, SAVUPS cost = 71.77.

Table 2. Video Condition & Age Group SAVUPS Difference Scores

		N	Intent to Use SAVs	Trust in AVs	Perceived Usefulness of SAVs	Perceived Ease of Use of SAVs	Desire for Control/ Driving Efficacy	SAV Cost	Safety of AVs
Video Condition			mean(*SD*)	mean(*SD*)	mean(*SD*)	mean(*SD*)	mean(*SD*)	mean(*SD*)	mean(*SD*)
	Control	124	7.46(45.83)	11.86(50.82)	13.75(60.61)	8.27(31.1)	-6.5(30.17)	11.16(33.34)	6.47(30.54)
	Educational	104	19.68(42.23)	19.86(54.32)	34.34(72.13)	5.25(36.16)	-6.36(39)	10.46(26.14)	20.11(32.06)
	Experiential	111	23.41(43.79)	21.41(53.53)	16.23(49.16)	10.22(31.93)	-5.54(30.6)	12.8(28.14)	24.25(36.91)
	Edu+Exp	97	25.06(46.61	25.66(60.21)	24.89(60.64)	6.69(26.66)	-13.1(34.15)	15.18(33.86)	21.97(43.46)
Age Group									
	Younger	147	15.25(44.86)	9.99(48.28)	9.64(56.23)	0.57(35.58)	-9.6(34.1)	12.87(32.86)	17.43(34.32)
	Middle	145	23.42(45.58)	22.81(49.3)	19.79(57.6)	9.94(26.07)	-5.53(35.21)	11.6(28.65)	11.41(34.53)
	Older	144	16.24(44.66)	25.11(64.06)	36.14(67.15)	12.74(31.39)	-7.89(30.97)	12.42(30.18)	24.18(39.11)

Note: Edu+Exp = Educational and Experiential Videos

Table 3. Results of SAVUPS Difference Score MANCOVA (Tests of Between-Subjects Effects)

Source of Variation	Dependent Variable	Type III Sum of Squares	*DF*	Mean Square	*F*	Sig.	η_p^2
Corrected Model	Intent to Use SAVs	50050.898[a]	17	2944.17	1.47	0.102	0.056
	Trust in AVs	66060.116[b]	17	3885.889	1.316	0.178	0.051
	PU of SAVs	123566.599[c]	17	7268.623	2.001	0.001	0.075
	PEOU of SAVs	45034.118[d]	17	2649.066	2.822	< 0.001	0.103
	Safety of AVs	72625.436[e]	17	4272.084	3.549	< 0.001	0.126
Intercept	Intent to Use SAVs	425.459	1	425.459	0.212	0.645	0.001
	Trust in AVs	342.826	1	342.826	0.116	0.733	0
	PU of SAVs	2486.48	1	2486.48	0.685	0.408	0.002
	PEOU of SAVs	1391.67	1	1391.67	1.483	0.224	0.004
	Safety of AVs	362.176	1	362.176	0.301	0.584	0.001
Covariate-Gender	Intent to Use SAVs	45.832	1	45.832	0.023	0.88	0
	Trust in AVs	0.92	1	0.920	0	0.996	0
	PU of SAVs	2526.362	1	2526.362	0.696	0.405	0.002
	PEOU of SAVs	999.072	1	999.072	1.064	0.303	0.003
	Safety of AVs	284.342	1	284.342	0.236	0.627	0.001
Covariate- Tech Perceptions	Intent to Use SAVs	241.002	1	241.002	0.12	0.729	0
	Trust in AVs	6659.394	1	6659.394	2.256	0.134	0.005
	PU of SAVs	1323.189	1	1323.189	0.364	0.546	0.001
	PEOU of SAVs	2759.137	1	2759.137	2.94	0.087	0.007
	Safety of AVs	6971.914	1	6971.914	5.792	0.017	0.014
Covariate-Rideshare Experience	Intent to Use SAVs	9059.517	1	9059.517	4.522	0.361	0.011
	Trust in AVs	426.273	1	426.273	0.144	0.384	0
	PU of SAVs	1335.098	1	1335.098	0.368	0.744	0.001
	PEOU of SAVs	6737.374	1	6737.374	7.178	0.935	0.017
	Safety of AVs	701.648	1	701.648	0.583	0.007	0.001
Covariate-Rideshare Comfort	Intent to Use SAVs	1671.851	1	1671.851	0.835	0.361	0.002
	Trust in AVs	2246.491	1	2246.491	0.761	0.384	0.002
	PU of SAVs	386.729	1	386.729	0.106	0.744	0
	PEOU of SAVs	6.207	1	6.207	0.007	0.935	0
	Safety of AVs	8719.729	1	8719.729	7.244	0.007	0.017
Covariate-SAVUPS Driving	Intent to Use SAVs	4823.116	1	4823.116	2.408	0.122	0.006
	Trust in AVs	9333.667	1	9333.667	3.161	0.076	0.008
	PU of SAVs	1931.391	1	1931.391	0.532	0.466	0.001
	PEOU of SAVs	1163.07	1	1163.07	1.239	0.266	0.003
	Safety of AVs	5212.927	1	5212.927	4.331	0.038	0.01
Covariate-SAVUPS Cost	Intent to Use SAVs	38.854	1	38.854	0.019	0.889	0
	Trust in AVs	2053.673	1	2053.673	0.696	0.405	0.002

	PU of SAVs	7378.965	1	7378.965	2.032	0.155	0.005
	PEOU of SAVs	8.543	1	8.543	0.009	0.924	0
	Safety of AVs	4074.293	1	4074.293	3.385	0.067	0.008
Video Condition	Intent to Use SAVs	20844.216	3	6948.072	3.468	0.016	0.024
	Trust in AVs	8348.188	3	2782.729	0.943	0.420	0.007
	PU of SAVs	24772.703	3	8257.568	2.274	0.079	0.016
	PEOU of SAVs	2296.361	3	765.454	0.815	0.486	0.006
	Safety of AVs	24843.867	3	8281.289	6.88	0	0.047
Age Group	Intent to Use SAVs	9226.077	2	4613.039	2.303	0.101	0.011
	Trust in AVs	24162.239	2	12081.119	4.092	0.017	0.019
	PU of SAVs	43131.142	2	21565.571	5.938	0.003	0.028
	PEOU of SAVs	8700.895	2	4350.448	4.635	0.010	0.022
	Safety of AVs	6396.637	2	3198.319	2.658	0.071	0.013
Video Condition* Age Group	Intent to Use SAVs	5172.305	6	862.051	0.43	0.859	0.006
	Trust in AVs	15712.062	6	2618.677	0.887	0.504	0.013
	PU of SAVs	23272.265	6	3878.711	1.068	0.381	0.015
	PEOU of SAVs	14942.119	6	2490.353	2.653	0.015	0.037
	Safety of AVs	1521.47	6	253.578	0.211	0.973	0.003
Error	Intent to Use SAVs	837383.239	418	2003.309			
	Trust in AVs	1234128.588	418	2952.461			
	PU of SAVs	1518138.162	418	3631.909			
	PEOU of SAVs	39350.855	418	938.638			
	Safety of AVs	503145.598	418	1203.698			
Total	Intent to Use SAVs	1032394	436				
	Trust in AVs	1463375	436				
	PU of SAVs	1849660	436				
	PEOU of SAVs	463402	436				
	Safety of AVs	711087	436				
Corrected Total	Intent to Use SAVs	887434.138	435				
	Trust in AVs	13000188.7	435				
	PU of SAVs	1641704.761	435				
	PEOU of SAVs	437384.972	435				
	Safety of AVs	575771.034	435				

Note. a. R Squared = 0.056 (Adjusted R Squared = 0.018); b. R Squared = 0.051 (Adjusted R Squared = 0.012); c. R Squared = 0.075 (Adjusted R Squared = 0.038); d. R Squared = 0.103 (Adjusted R Squared = 0.066); e. R Squared = 0.126 (Adjusted R Squared = 0.091)

Video Condition Findings

Multivariate testing showed that watching the educational and/or the experiential video had a significant effect on participants' SAV attitude difference scores, with a Pillai's Trace of 0.090 $F(15, 1248) = 2.56$, $p < 0.002$, $\eta_p^2 = 0.030$. Tests of between-subjects effects revealed that intent to use increased significantly more after watching the video(s) in the Both and Experiential conditions $F(3, 418) = 3.47$, $p < 0.017$, $\eta_p^2 = 0.024$ (see Figure 6). Perceived safety difference scores also increased significantly more after viewing any of the intervention videos compared to the control condition $F(3, 418) = 6.88$, $p < 0.0001$, $\eta_p^2 = 0.47$ (see Figure 7).

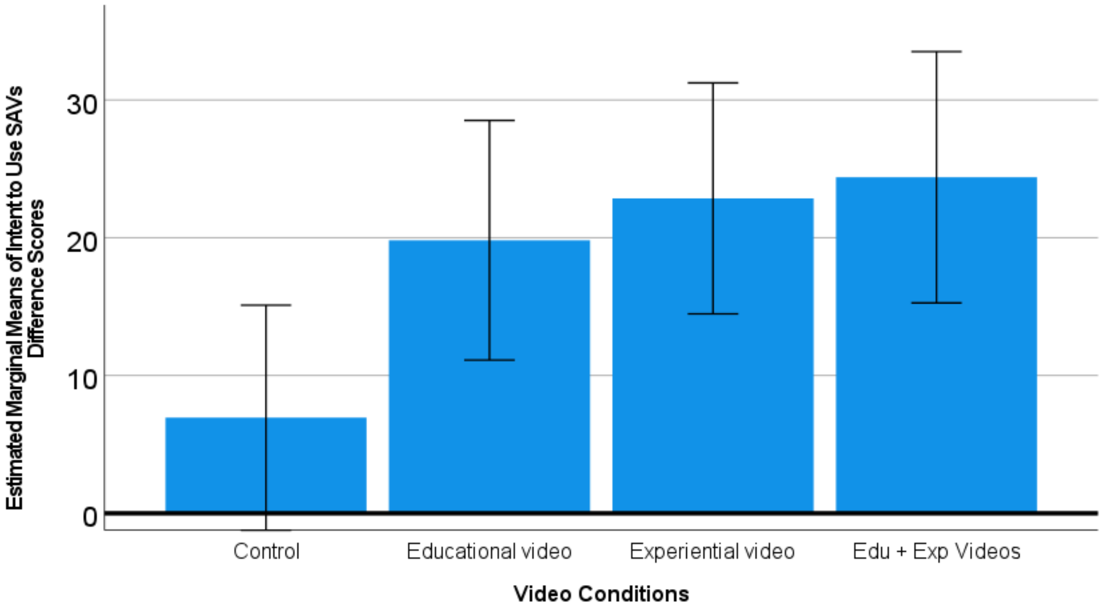

Figure 6. SAVUPS Intent to Use Difference Scores by Video Condition. Error bars are 95% CIs.

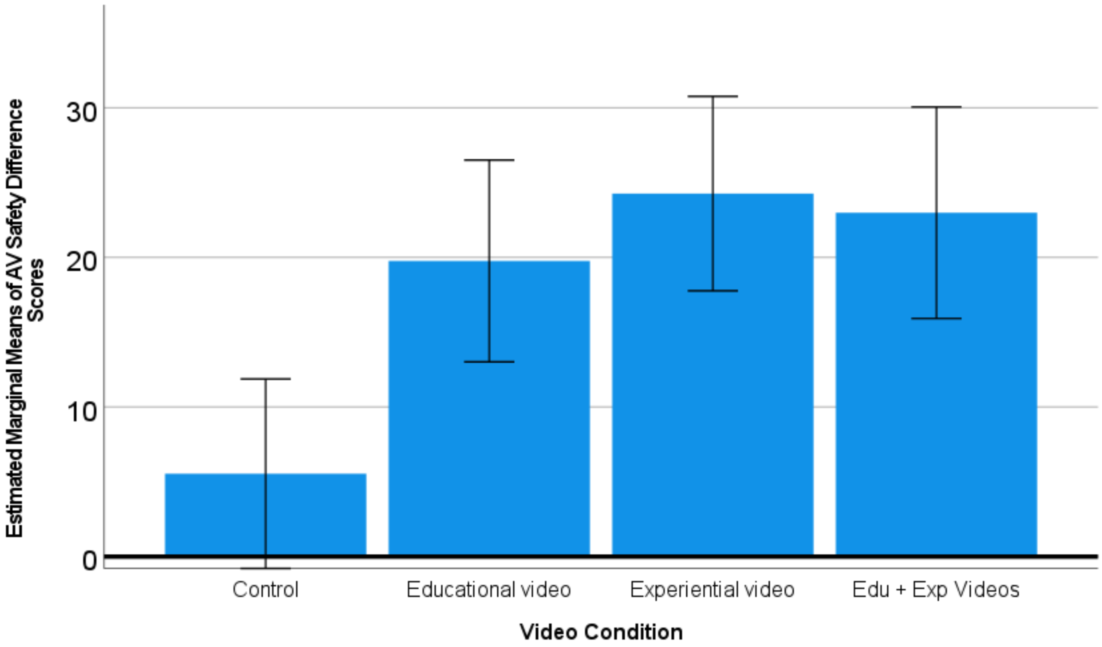

Figure 7. SAVUPS AV Safety Difference Scores by Video Condition. Error bars are 95% CIs.

Age Group Findings

For differences between age groups, multivariate testing showed that older adults had greater improvements in their attitudes towards SAVs than younger respondents, with Pillai's Trace of 0.078, $F(10, 830) = 3.39$, $p < 0.0001$, $\eta_p^2 = 0.039$. Tests of between-subjects effects showed that older adults' trust toward AVs increased significantly more than younger adults ($F(2, 418) = 4.09$, $p < 0.018$, $\eta_p^2 = 0.019$; see Figure 8). Older adults also increased significantly more in PU of SAVs than younger adults ($F(2, 418) = 5.94$, $p < 0.004$, $\eta_p^2 = 0.28$; see Figure 9), as well as PEOU increasing more for older adults than either middle-aged or younger adults ($F(2, 418) = 4.64$, $p < 0.02$, $\eta_p^2 = 0.022$; see Figure 10) after watching their randomly assigned video(s).

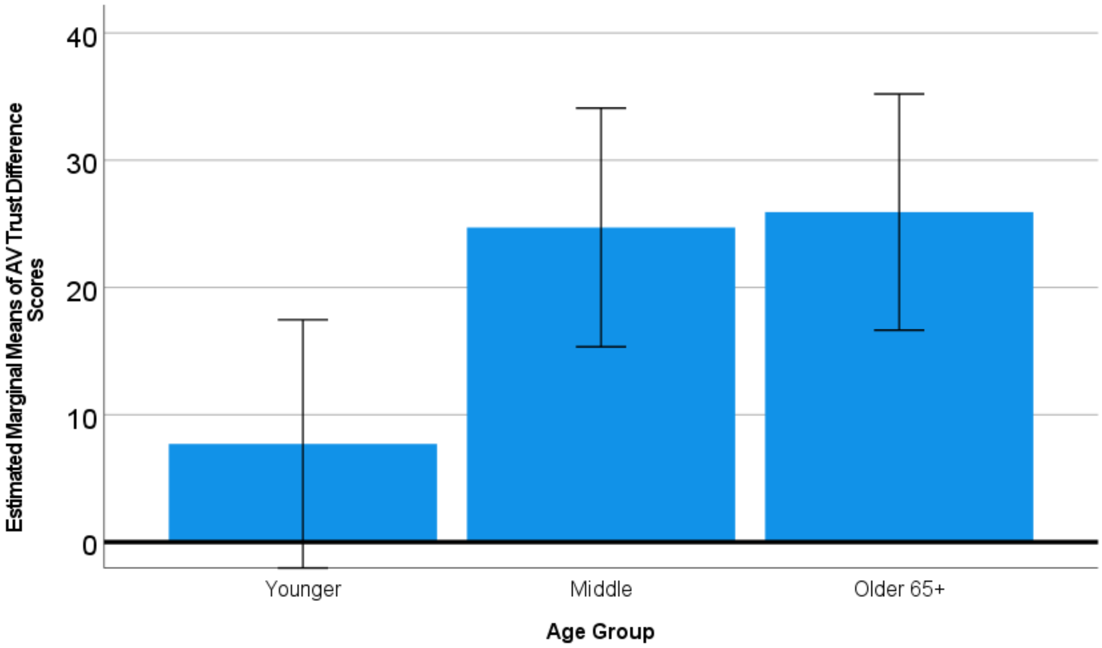

Figure 8. SAVUPS Trust in AVs Difference Scores by Age Group. Error bars are 95% CIs.

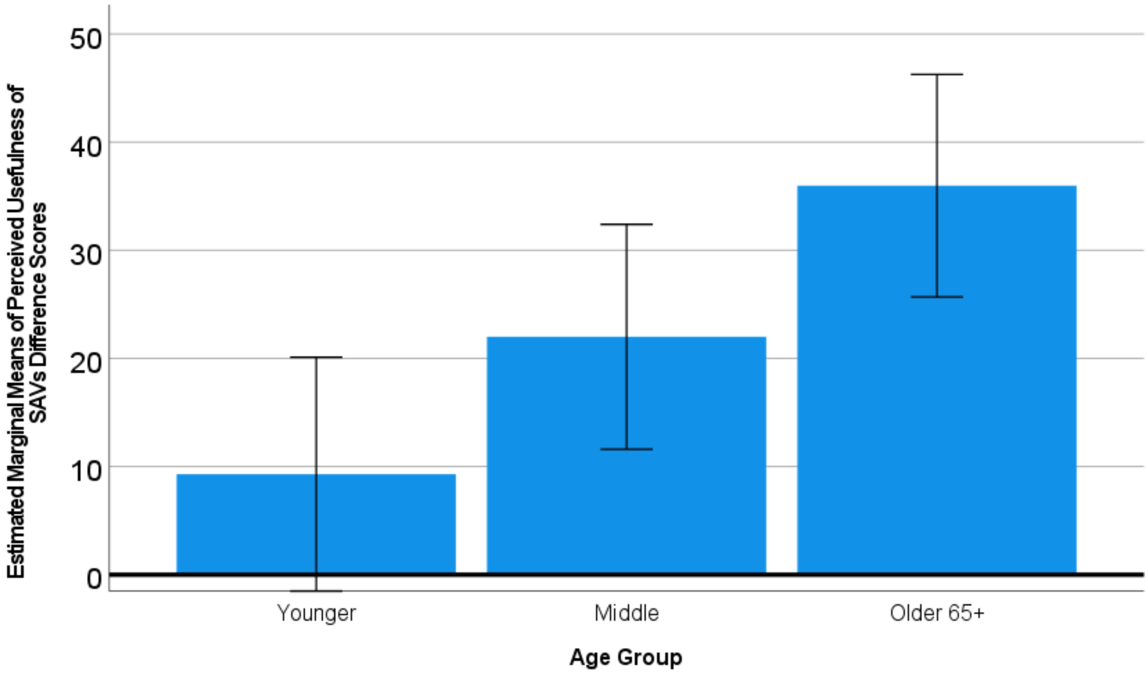

Figure 9. SAVUPS Perceived Usefulness of SAVs Difference Scores by Age Group. Error bars are 95% CIs.

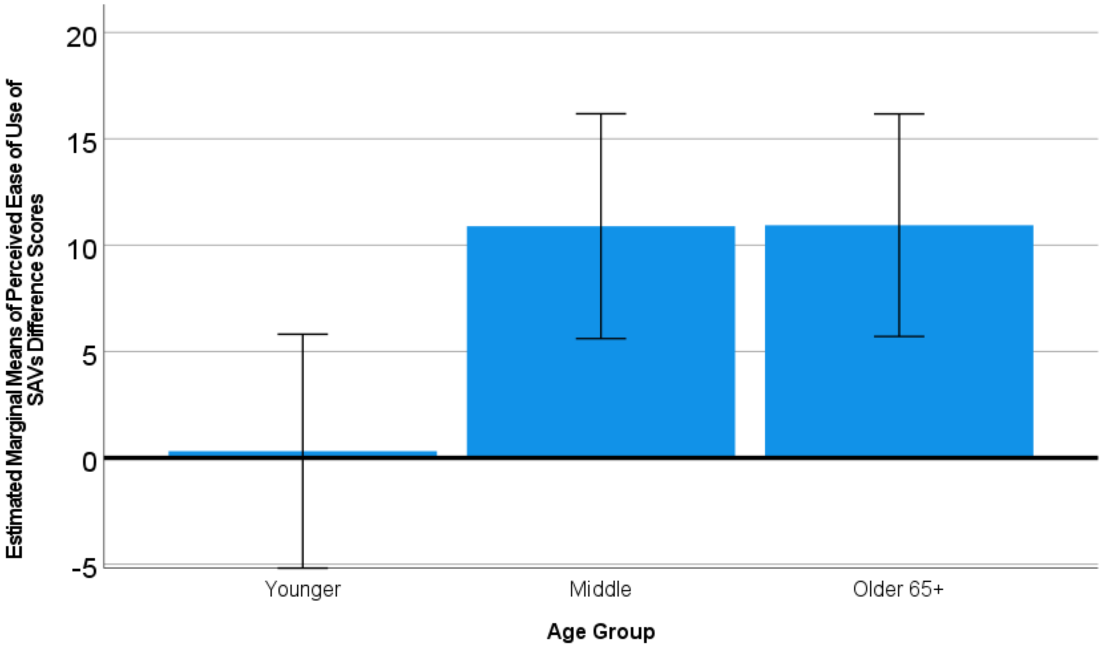

Figure 10. SAVUPS Perceived Ease of Use of SAVs Difference Scores by Age Group. Error bars are 95% CIs.

Discussion

As can be seen in Figure 3, the baseline attitudes toward SAVs were low to middling for all age groups. Interestingly, there was not a large difference between younger and the older participants' baseline attitudes toward SAVs as we expected based on previous literature. After viewing one of our intervention videos, attitudes shifted in a positive direction, but the observed effect sizes were only in the small to medium range. For example, average intent to use SAVs scores suggested a slight reluctance at baseline. After intervention, the average intent to use scores suggested a neutral intent to use SAVs. While this shift in behavioural intentions to use SAVs is in a positive direction, it does not suggest that online intervention videos can turn someone who was strongly opposed to the use of SAVs into someone who is now intending to use them, but it may make them slightly more open to the idea. Similar trends of participants being slightly more positive about their attitudes toward SAVs can be seen across the other SAVUPS dimensions as well.

We found that short, online videos were useful in improving attitudes toward SAVs. This is promising for future promotional campaigns that companies intending to offer SAV services may want to initiate to increase their profile among potential riders. While the subjective results observed in this study may not directly impact use behaviour, they can serve as indicators for future behaviour. Both video conditions that contained the experiential video showed the potential to increase participants' intent to use SAVs, which provides evidence that short online videos showing AVs safely navigating different, somewhat difficult driving conditions improve the likelihood of SAV services intending to be used by individuals of all ages that view them. Both educational and experiential videos also positively impacted perceptions of safety across the age groups in this study, suggesting that either knowing more about how SAVs work or seeing them in action may improve perceived safety. Findings from this study suggest that both experiential and educational video approaches can have a positive effect on potential users' perception of SAVs and could be integrated into strategies for preparing the public for a future where SAVs play an important part in everyday transportation.

Knowing which methods different age groups respond to most positively when it comes to learning about and accepting SAVs can help stakeholders planning to launch these kinds of services target their messaging. For example, older adults displayed significantly greater increases in PU, trust, and PEOU than their younger counterparts after watching 7-15 minutes of online videos, which shows that the usefulness, trustworthiness, and ease of use of SAVs can be effectively demonstrated using such a brief, easily distributable medium. SAV stakeholders could host promotional events aimed at older populations, giving potential users experience with these technologies. In fact, evidence of the potential utility of providing general training on how to use currently available TNC services was observed in an unanticipated between-subjects tests interaction (Figure 5). Older participants' PEOU ratings of SAV services benefitted from viewing the control condition's instructional TNC ridesharing video. This implies that older participants, relative to younger and middle-aged participants, had a lack of understanding of how currently available TNC services might be hailed from their smartphone. Only roughly four-in-ten older adults are smartphone users (Anderson & Perrin, 2017), and this number seems to be increasing. This lack of familiarity and/or comfort with using such technology may be an inhibiting factor limiting older adults' use of current and future ridesharing services. It is possible that these older participants might be conflating the TNC services described in the control video with SAV services, but recent divestures and/or partnerships made by TNCs regarding their self-driving ventures (Conger, 2021; Somerville, 2020) suggests that future SAV services might be hailed quite similarly to today's TNC rides.

While it is promising that promotional campaigns delivered via online video can be modestly effective in improving attitudes, it is still likely that in-person experience would be more effective. Classen and colleagues (2020) observed moderate to large effect sizes in their in-person study, whereas ours are smaller effect sizes. However, due to the costs of such in-person demonstrations, and the wider range of people an online campaign could reach compared to smaller, targeted, in-person interventions, we believe that online videos like the ones used in this study have the potential to have a more widespread impact on the general public's SAV attitudes than in-person demonstrations. It is also worth noting that interventions like these could be safely deployed now, during a global pandemic, rather than waiting for it to be safe to return to in-person interactions.

This online survey study was not without limitations. One was our limited control over participants' attentiveness to our video interventions. We attempted to mitigate the issue of video attentiveness by removing any participants who spent less than half the video length on the video page and who miss more than one video attention check question, but even with those measures in place it is difficult to ascertain to what extent the video content was absorbed by participants. Another limitation was that our younger adult sample was more homogenous than typical online samples due to local convenience sampling. Younger participants were all students at Clemson University, and their lack of changes in attitudes may have been due to their location in a rural area where there is low availability of any kind of TNC services, and SAV deployment in such areas is unlikely to happen any time soon. Additionally, another limitation is the complex and intertwined nature of SAV attitudes. It is difficult to tell from a single online study what criteria any given participant's reasoning for their responses we collected was based upon. Is the threat of COVID infection leading to a muted effect on participants' willingness to participate in ridesharing? Is the potential physical threat from other unknown riders a consideration? Or is the primary driver of attitudes more the novel, relatively untested, safety-critical technology that AVs rely upon? All of these are questions that will need to be answered before we can say with certainty what kinds of interventions will work best for which age groups when it comes to SAV attitudes.

Conclusion

Participants of varying ages participated in an online survey study to gauge the impact of educational and experiential videos on their SAV attitudes, which were measured before and after watching the intervention videos. Participants viewed videos that either allowed them to see an AV navigating challenging traffic situations from the drivers' as well as the ADS' perspective (experiential), instructed them on how AVs' enabling technologies work and what benefits they might confer (educational), took both educational and experiential perspectives, or explained how current TNC services work (control). Significant changes between the pre- and post-video scores both for between video types and across age groups. While observed effect sizes were small to middling in this study, it is promising for SAV stakeholders that educational and/or experiential videos delivered online can have a modest, positive effect on viewers' attitudes toward SAVs, particularly older adults' attitudes.

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Author Contributions

The authors confirm contribution to the paper as follows: study conception and design: DJS, KB, JL; data collection: DJS, KB, JL; analysis and interpretation of results: DJS, KB; draft manuscript preparation: KB, DJS, JL. All authors reviewed the results and approved the final version of the manuscript.

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Appendix A: Comfort with Ridesharing

Measured on a 7-point Likert scale.

If I were to choose ridesharing over traditional services:

- I would feed safer because there would be another passenger in the car.
- I would feel less safe because there would be more strangers in the car, in addition to the driver.
- I would look forward to having positive interactions with other passengers.
- I would be worried about having negative interactions with other passengers.
- I feel it would be necessary to have a driver who can act as a mediator between passengers if needed.
- I would be excited about the potential to meet someone who is different from me.
- I would be uncomfortable if I were paired with someone who were different from me.

Appendix B: Perceptions of Technology

Measured on a 100-point slider

- What is your level of experience with technology?
    - "Very inexperienced" to "Very experienced"
- Do you self-identify as being an avoider or and early adopter of new technology?
    - "Avoid as long as possible" to "Try as soon as possible"
- Please rate your ability to learn how to operate a new technology
    - "Very poor" to "Very good"
- What is your overall trust in technology?
    - "Very distrustful" to "Very trustful"
- Please rate your level of trust in established car technologies (e.g., cruise control)
    - "Very distrustful" to "Very trustful"
- Please rate your level of trust in new technologies that are being introduced into cars (e.g., automatic emergency braking, lane-keeping assist)
    - "Very distrustful" to "Very trustful"
- I have had bad experiences when I try to use new technology instead of doing things "the old-fashioned way"
    - "Never" to "Always"

Appendix C: Shared Automated Vehicle User Perception Survey

100-pt slider from “Disagree” to “Agree”

<u>Definition:</u> An automated vehicle (i.e., self-driving vehicle, driverless car, self-driving shuttle) is a vehicle that is capable of sensing its environment and navigating without human input. Full-time automation of all driving tasks on any road, under any conditions, and does not require a driver nor a steering wheel.

<u>Directions:</u> Please place a vertical dash (|) on the scale (by moving the slider) to display the degree to which you agree or disagree with the statement.

- I am open to the idea of using shared automated vehicles.
- I am suspicious of automated vehicles.
- I believe I can trust automated vehicles.
- I would engage in other tasks while riding in an automated vehicle.
- I believe automated ridesharing services would reduce traffic congestion.
- I believe automated ridesharing services will alleviate parking headaches.
- I believe automated ridesharing services will allow me to stay active.
- Automated ridesharing services will allow me to stay involved in my community.
- Automated ridesharing services will enhance my quality of life/well-being.
- I expect that automated ridesharing services will be easy to use.
- I expect that it would require a lot of effort to figure out how to use automated ridesharing services.
- I would us an automated ridesharing service on a daily basis.
- I would rarely use an automated ridesharing service.

- Even if I had access to an automated ridesharing service, I would still want to drive myself occasionally.
- It will be important for there to be the option for a human to drive when using an automated ridesharing service.
- My driving abilities would decline due to relying on an automated ridesharing service.
- I would be willing to pay more for an automated ridesharing service compared to what I would pay for a traditional ridesharing service.
- If cost was not an issue, I would us an automated ridesharing service.
- I would use an automated vehicle if the National Highway Traffic Safety Administration (NHTSA) deem them as being safe.
- Media portrays automated vehicles in a positive way.
- My family and friends would encourage/support me when I use an automated ridesharing service.
- When I’m riding in an automated vehicle, other rode users will be safe.
- I believe that automated vehicles will increase the number of crashes.
- I would feel safe riding in an automated vehicle.
- I feel hesitant about using an automated vehicle.