Perceived Benefits and Concerns of Autonomous Vehicle Adoption

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Different Level of Autonomous Vehicles

- Also referred to as self-driving cars
- In levels 1 and 2, the driver governs the driving environment, assisted by an automated navigation system.
- From levels 3 through 5, the vehicle, instead of the driver, is in charge of most driving tasks.
  - Level 3 humans must still be available for some driving tasks
  - In level 4, the driving system controls the vehicle for a particular operation (e.g., high-speed freeway cruising, closed circuit shuttle or bus).
  - A level 5 AV performs all driving functions under all conditions and the driver has the option to control the vehicle.
- Currently, level 3 AVs are entering the market.

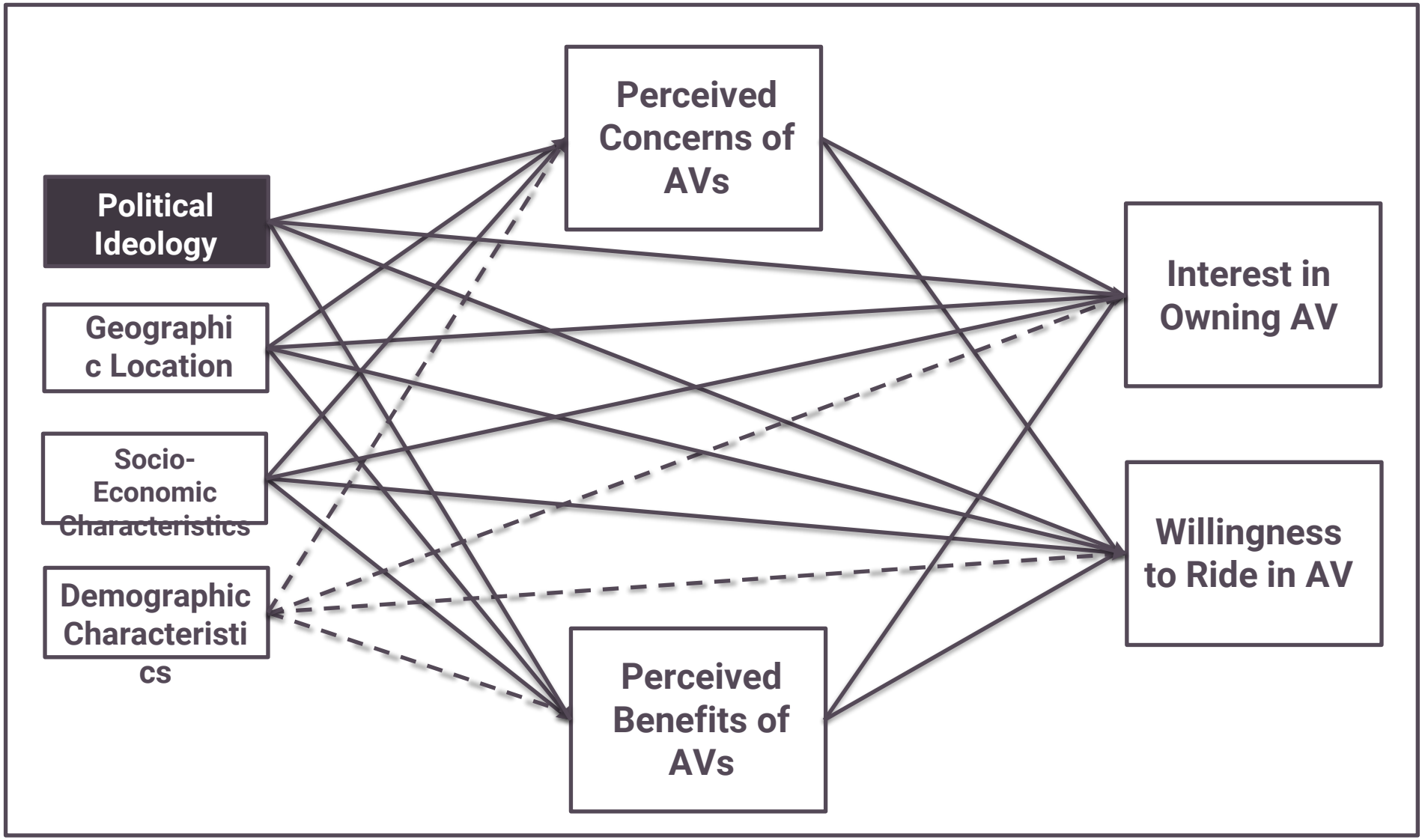
Survey Work on AV Perceptions

- Perceived benefits and risks associated with AVs (Woldeamanuel and Nguyen, 2018; Kim et al., 2019; Liu et al., 2019; Wang et al., 2020)
- Perceived benefits and risks affects support for self-driving car technology (Dixon et al., 2020)
- Work on AV perceptions has not determined whether there is a statistical association between political ideology and AV adoption

Political Ideology and Technology

- Factors including risk perceptions, trust in regulatory bodies, and individualism impact support for autonomous vehicles (Kaur and Rampersad, 2018; Dixon et al., 2020)
- Political ideology related to views on a variety of societal issues, such as the environment (Anderson, 2012), immigration (Neiman et al., 2006), abortion (Abramowitz, 1995), and the role of government in society (Faricy & Ellis, 2014).
- People with a conservative ideology have been shown to exhibit a greater preference for order and traditional values while liberals instead value progress and flexibility (Jost et al., 2008).

- Conservatives are more likely to express concerns about AVs and are also more likely to support restrictive regulations related to AVs (Peng, 2020)


Political Ideology
Geographic Location
Socio-Economic Characteristics
Demographic Characteristics
Perceived Concerns of AVs
Perceived Benefits of AVs
Interest in Owning AV
Willingness to Ride in AV

Data

- 2017 State of the State Survey (SOSS) administered by the Institute for Public Policy and Social Research at Michigan State University (Pierce, 2018)
  - In brief, the SOSS is a public opinion survey that employs a stratified random sample of Michigan adults
  - It is the only survey designed to provide a consistent systematic monitoring of the public mood in Michigan

- Final analytical sample of 776

Key Variables

- Two measures of AV adoption:
  1. How interested would you be in owning or leasing a completely self-driving vehicle in the future?
  2. Would you say very interested, moderately interested, slightly interested, or not at all interested?

- Measure of political ideology
  - Conservative, moderate, and liberal

- Measures of benefits and concerns

Benefits
Going places without having to drive myself
Staying independent as I get older
Fewer crashes
Improved emergency response
Reduced traffic
Better for the environment
Fewer driving related expenses
Concerns
Equipment or system failure
Security from hackers
Data privacy and location tracking
Being on the road with non-self-driving vehicles, peds. & cyclists
Learning to use self-driving vehicles
Not driving the way I want
Greater vehicle expenses

Benefits questions use the same 4 point Likert scale:
1=not at all important
2=slightly important
3=moderately important
4=very important

Concerns questions also use a 4 point Likert scale:
1=not at all concerned
2=slightly concerned
3=moderately concerned
4=very concerned

Control Variables

Variable	Description	Source
Age	Age in years	State of the State Survey 2017
Age-squared	Age squared	State of the State Survey 2017
Own income	Midpoint of income tiers from survey data	State of the State Survey 2017
Regional income	Median Family income at the ZIP code level	2014-2018 American Community Survey (ACS)
Average travel time	Mean travel time to work (minutes) at the ZIP code level	State of the State Survey 2017
Own travel time	Recoded variable (see Appendix question 19) characterizing number of hours driven in an average week: 0=no hours driven; 2.5=between 1 and 5 hours; 7.5=between 6 and 10 hours; 15=more than 10 hours	State of the State Survey 2017
Gender	Binary variable where 1 is female and 0 is male	State of the State Survey 2017
Large Metro	Binary variable where 1 is large metro and 0 is urban	USDA Rural-Urban Continuum Codes (RUCC) 2013
Small city/rural	Binary variable where 1 is small city/rural and 0 is urban	USDA Rural-Urban Continuum Codes (RUCC) 2013
Conservative ideology	Binary variable where 1 = conservative and 0=non-conservative	State of the State Survey 2017
Concerns	Average value across all concern questions in the survey	State of the State Survey 2017
Benefits	Average value across all benefit questions in the survey	State of the State Survey 2017

Three Types of Statistical Models

1. Ordinary least squares regressions for perceived benefits and concerns
2. Probit regression models for AV adoption variables

These regression models allow us to probe the unique effect of political ideology on AV-related variables while simultaneously controlling for demographic characteristics of the participants

3. Path model analysis to understand whether political ideology may be related to AV adoption through their associations with perceived benefits and concerns about AVs

Ordinary Least Squares Results

	Concerns			Benefits	
Predictor	**Coefficient**	**S.E.**		**Coefficient**	**S.E.**
Age	.003	.004		.002	.005
Age-squared	-.000	.000		-.000	.000
Own income	.000	.001		.001	.001
Regional income	-.000*	.000		-.000	.000
Average travel time	-.002	.006		.006	.007
Own travel time	.004	.005		-.002	.006
Gender	.177***	.052		.119	.062
Large Metro vs. Small Metro/Urban	-.104	.060		.051	.073
Large Metro vs. Rural	-.156	.060		-.200	.106
Moderate vs. Conservative ideology	**-.012**	**.020**		**.098*** **	**.024**
Liberal vs. Conservative ideology	**-.088*** **	**.023**		**.123*** **	**.027**
Constant	3.095	.200		2.850	.241
F	3.877			6.134	
p for F test	.000			.000	
df for F test	11, 722			11,722	
R-squared	.056			.085	

Note: N = 723; * p < .05; ** p < .01; *** p < .001; Gender was coded as 0 = male and 1 = female.

Large Metro vs. Small Metro/Urban was coded as 0 = large metro and rural and 1 = urban/small metro.

Large Metro vs. Rural was coded as 0 = large metro and urban/small metro and and 1 = small city/rural.

Conservative vs. moderate ideology was coded as -1 = conservative ideology, 2 = moderate, and -1 and liberal ideology.

Conservative vs. liberal ideology was coded as -1 = conservative ideology, -1 = moderate, and 2 = liberal ideology.

Probit Model Results

	Willingness to Ride in AVs					Willingness to Own AVs			
	Predictors only model		Full model			Predictors only model		Full model	
Predictor	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**		**Coefficient**	**S.E.**	**Coefficient**	**S.E.**
Age	-.015	.008	-.021*	.009		-.001	.008	-.001	.009
Age-squared	.000	.000	.000*	.000		-.000	.000	-.000	.000
Own income	.002	.001	.001	.001		.002*	.001	.001	.001
Regional income	.000	.000	.000	.000		.000	.000	.000	.000
Average travel time	-.013	.011	-.020	.012		.001	.011	-.003	.011
Own travel time	.005	.009	.011	.010		.007	.009	.013	.010
Gender	-.666***	.101	-.801***	.115		-.150	.098	-.198	.109
Large Metro vs. Small Metro/Urban	.011	.117	-.068	.128		-.005	.114	-.102	.124
Large Metro vs. Rural	.017	.172	.041	.191		-.054	.166	-.024	.183
Moderate vs. Conservative ideology	**.089**	**.066**	**.082**	**.073**		**.151***	**.065**	**.147***	**.071**
Liberal vs. Conservative ideology	**.262****	**.076**	**.085**	**.086**		**.285*****	**.075**	**.142**	**.084**
Concerns			**-.643*****	**.085**				**-.472*****	**.082**
Benefits			**.881*****	**.084**				**.891*****	**.078**
Constant	.389	.389	-.072	.526		-.048	380	-1.205	.512
Chi-square	90.635		265.426			64.777		243.721	
p for Chi-sqaure test	.000		.000			.000		.000	
df for Chi-square test	11		13			11		13	
-2 Log likelihood	899.260		724.468			952.758		773.814	
Cox & Snell R-squared	.116		.304			.085		.283	

Note: **N = 723; * $p < .05$; ** $p < .01$; *** $p < .001$; Gender was coded as 0 = male and 1 = female.**
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Mediation Analysis Results

	Concerns		Benefits		Willingness to Ride in AVs		Willingness to Own AVs	
	Coefficient	**S.E.**	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**
Predictors								
Age	.005	.004	.003	.006	-.012	.007	-.001	.007
Age-squared	-.000	.000	.000	.000	.000	.000	-.000	.000
Own income	.000	.001	.001	.001	.001	.001	.001	.001
Reginal income	-.000*	.000	-.000	.000	.000	.000	.000	.000
Average travel time	-.006	.005	.002	.007	-.016	.010	-.004	.010
Own travel time	.005	.005	-.001	.005	.004	.008	.009	.008
Gender	.195***	.053	.111	.061	-.675***	.090	-.200*	.086
Large Metro vs. Small Metro/Urban	-.119	.062	.020	.072	-.054	.105	-.036	.102
Large Metro vs. Rural	-.114	.093	-.207*	.097	.056	.153	.118	.145
Moderate vs. Conservative ideology	-.013	.020	.098***	.024	.082*	.036	.129***	.034
Liberal vs. Conservative ideology	-.091***	.024	.120***	.027	.096*	.041	.141***	.040
Mediators								
Concerns					-.352***	.059	-.202**	.062
Benefits					.616***	.048	.668***	.040
R-squared	.055		.086		.436		.405	

Note: **N = 776; * $p < .05$; ** $p < .01$; *** $p < .001$; Gender was coded as 0 = male and 1 = female.**
Large Metro vs. Small Metro/Urban was coded as 0 = large metro and rural and 1 = urban/small metro.
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	Effect	S.E.	t	p	95% CI boundaries
Moderate political ideology (versus conservative ideology) → Willingness to ride in an AV					
Total effect	.146***	.039	3.730	.000	.073, .226
Direct effect	.082*	.036	2.253	.024	.015, .155
Indirect effect					
Mediator 1: Perceived concerns	.005	.007	0.633	.526	-.010, .019
Mediator 2: Percevied benefits	.060***	.015	3.920	.000	.031, .091
Liberal political ideology (versus conservative ideology) → Willingness to ride in an AV					
Total effect	.202***	.045	4.477	.000	.118, .296
Direct effect	.096*	.041	2.348	.019	.018, .182
Indirect effect					
Mediator 1: Perceived concerns	.032**	.010	3.119	.002	.014, .055
Mediator 2: Percevied benefits	.074***	.018	4.111	.000	.041, .111
Moderate political ideology (versus conservative ideology) → Willingness to own an AV					
Total effect	.197***	.039	5.121	.000	.128, .278
Direct effect	.129***	.035	3.688	.000	.065, .202
Indirect effect					
Mediator 1: Perceived concerns	.003	.004	0.602	.547	-.006, .012
Mediator 2: Percevied benefits	.065***	.016	3.991	.000	.035, .098
Liberal political ideology (versus conservative ideology) → Willingness to own an AV					
Total effect	.240***	.045	5.381	.000	.159, .332
Direct effect	.141***	.040	3.500	.000	.069, .225
Indirect effect					
Mediator 1: Perceived concerns	.018*	.008	2.356	.018	.005, .036
Mediator 2: Percevied benefits	.080***	.019	4.183	.000	.044, .120

Discussion

- Political ideology was an important predictor for individuals' intent to adopt AVs, as characterized by both willingness to ride in and to own AVs.
- Compared to conservative participants, moderates and liberals reported higher AV adoption intentions.
- Compared to conservative participants, politically moderate participants reported AV adoption intention via higher perceived benefits about AVs.
- Compared to conservatives, liberals reported higher AV adoption intention through both higher perceived benefits and lower perceived concerns about AV.
- Build upon prior research showing that perceived benefits and concerns are associated with support or openness to AVs (Howard and Dai, 2014; Schoettle and Sivak, 2014; Kyriakidis et al., 2014; Gkartonikas and Gkrita, 2019).

Policy Implications

- Messaging around AVs could influence people's intention to adopt.
- Elected leaders may support legislation that paves or inhibits widespread adoption of AVs
- Targeted marketing necessary to convince people about the benefits of AVs and assuage or overcome their concerns about AVs
  - For conservatives this targeted messaging may be more effective if it emphasizes the potential benefits of AVs to help foster their positive reactions towards AVs
  - To overcome the concerns expressed about AVs it may be more influential to provide conservatives with more information to change their existing, negative evaluations of AVs

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