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Perceptions of Emerging Urban Air Mobility Systems:
Differences Between Early to Laggard Adopters of Passenger Air Vehicles

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www.incose.org/symp2022 * presenter

Presentation Outline

- Background and Objectives
- Methodology
- Results and Discussion
- Conclusions

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Background

Urban Air Mobility Systems

- Safe, efficient aviation transportation system which utilizes highly autonomous aircraft at lower altitudes to transport passengers or cargo in and around urban and suburban metropolitan areas (ref: NASA)
- Developed to help address population growth trends, increased travel demand on capacity-strained transportation systems. Added benefit: CO2 emission reduction

Passenger Air Vehicles

- Electrically-powered, autonomously-piloted aircraft with vertical takeoff and land (VTOL) capability, no runway needed
- Transport 1 to 4 passengers at low altitudes (~1500ft), average speed of 150mph
- Also known as: On-demand Air Taxis, Flying Cars

Market Forecast

- Approximately 100 aircraft concepts in development
- Market valuation of US$115 billion with projected growth to ~US$160 billion by 2040 (ref: Goyal et al)
- Entry into Service as soon as 2025

Challenges

- Technological advancements, Regulations, Infrastructure, Community Acceptance & Integration

Objectives

Research Questions	
What are the initial perceptions of PAVs from the public?	What are the differences in perceptions, behavior, and intent to ride between early, moderate, late, and laggard adopters of PAV technology?

To capture insights of passenger air vehicles (PAVs), and general affinity to technological innovation and autonomous aerial transportation system concepts

Methodology

- Conducted U.S.-based survey, across broad representative socio-demographic sample (N=407)
- Leveraged sociological frameworks: *Technology Adoption Life Cycle and Technology Acceptance Model*
- Captured feedback on PAV systems (i.e., trust, safety, ease of use, usefulness and interior and interface design requirements) and general affinity to technological innovation and rate of technology adoption.
- Analyzed data using chi-square tests and ordered logistic regression models

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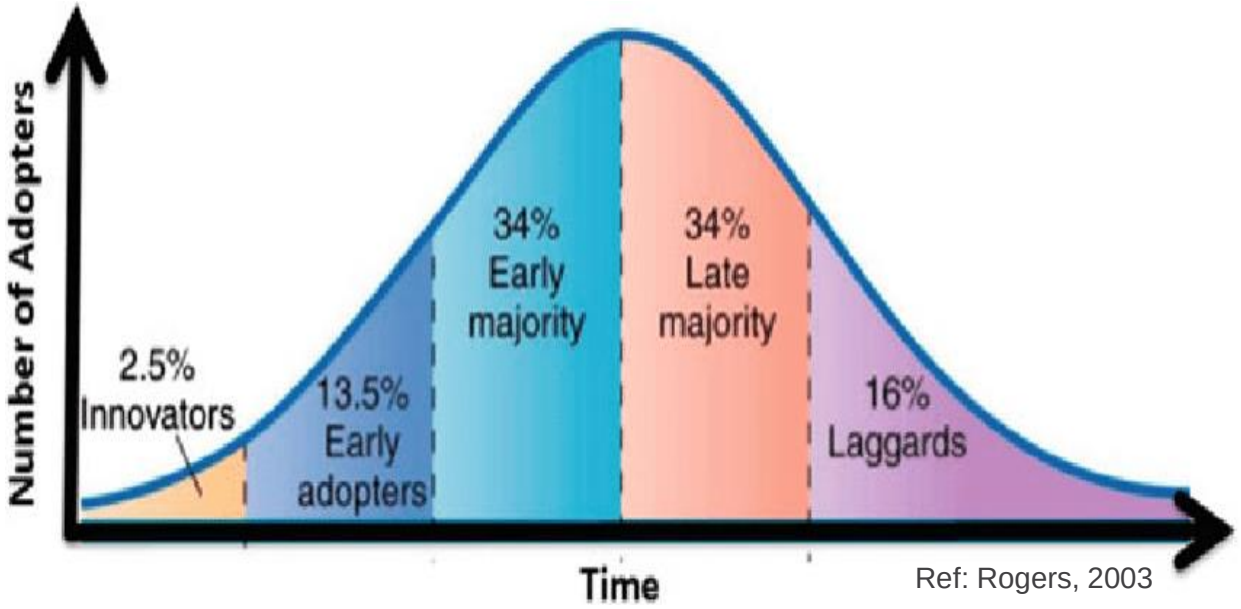
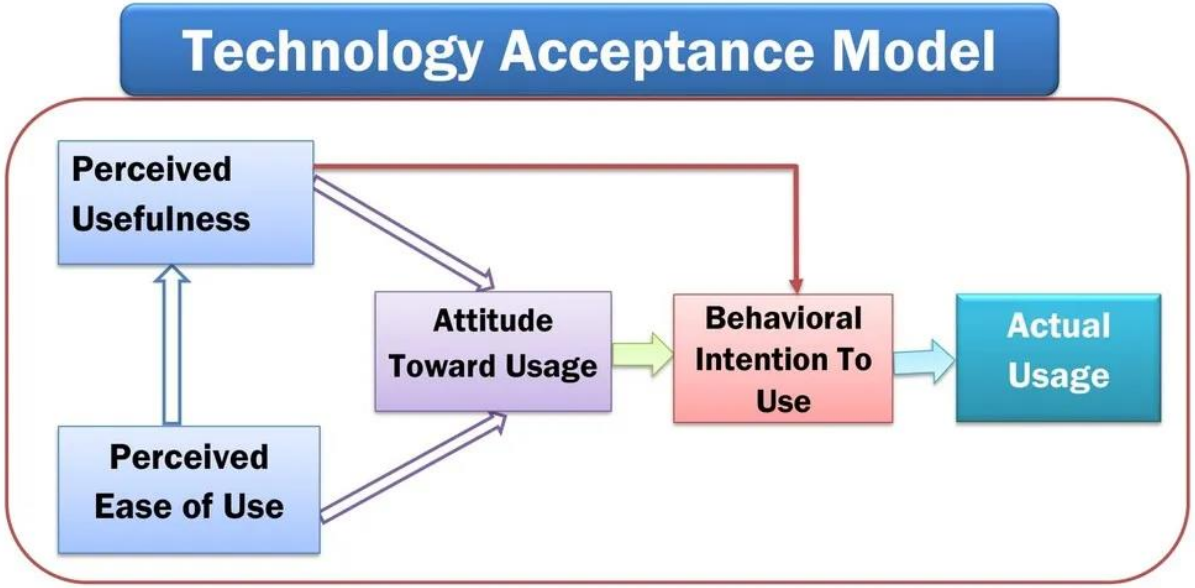
Methodology



Ref: Rogers, 2003

Technology Adoption Life Cycle



Ref: Davis, 1989

Methodology

Technology Adopter Profiles

Innovators | First to adopt new technology, knowingly accepting risk with perceived reward

Early Adopters | Adopt new technology fairly early albeit carefully in order to avoid risk

Early and Late Majority | Adopt new technology after others have tried it, with skepticism

Laggard | May adopt technology, if at all, only after the technology has been well-established

Results

PAV Adopter Profiles

How soon willing to ride a PAV once available to the public

Early	0 to 6 months	28%
Moderate	6 months to 1 year	29.6%
Late	1 to 5 years	34.9%
Laggard	5 or more years	7.2%

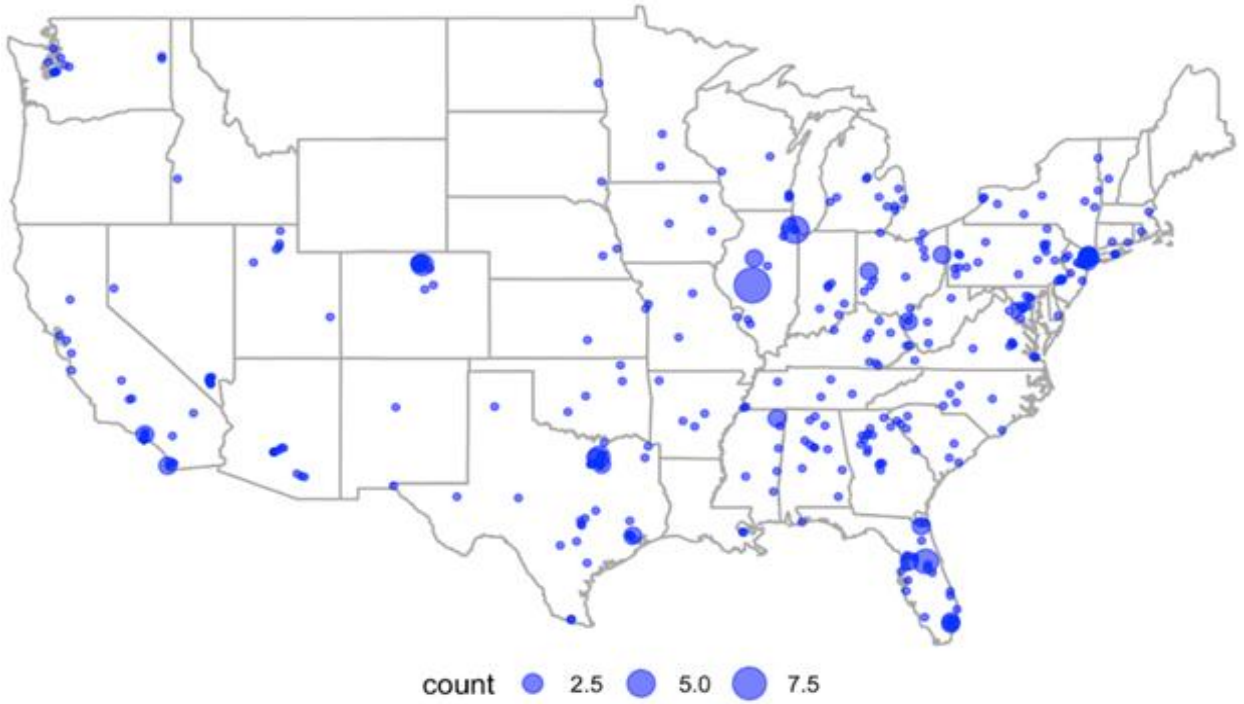
Results

PAV Adopter Group Demographics

Demographic Variable	PAV Adopter Group			
	Early *(0 – 6mo)*	**Moderate** *(6mo – 1yr)*	**Late** *(1 – 5yrs)*	**Laggard** *(5+ yrs)*
Total, *N (%)*	102 (28.0)	107 (29.6)	126 (34.9)	26 (7.2)
Age, *Average (SD)*	41.5 (13.7)	37.7 (11.5)	36.4 (11.5)	40.0 (10.7)
Male, *N (%)*	63 (61.8)	58 (54.2)	69 (54.8)	18 (69.2)
Live in Urban Area, *%*	40.2	52.3	46.8	30.8
At least Bachelor's degree, *%*	37.2	54.2	53.2	42.3

Results

Survey Respondent Demographics



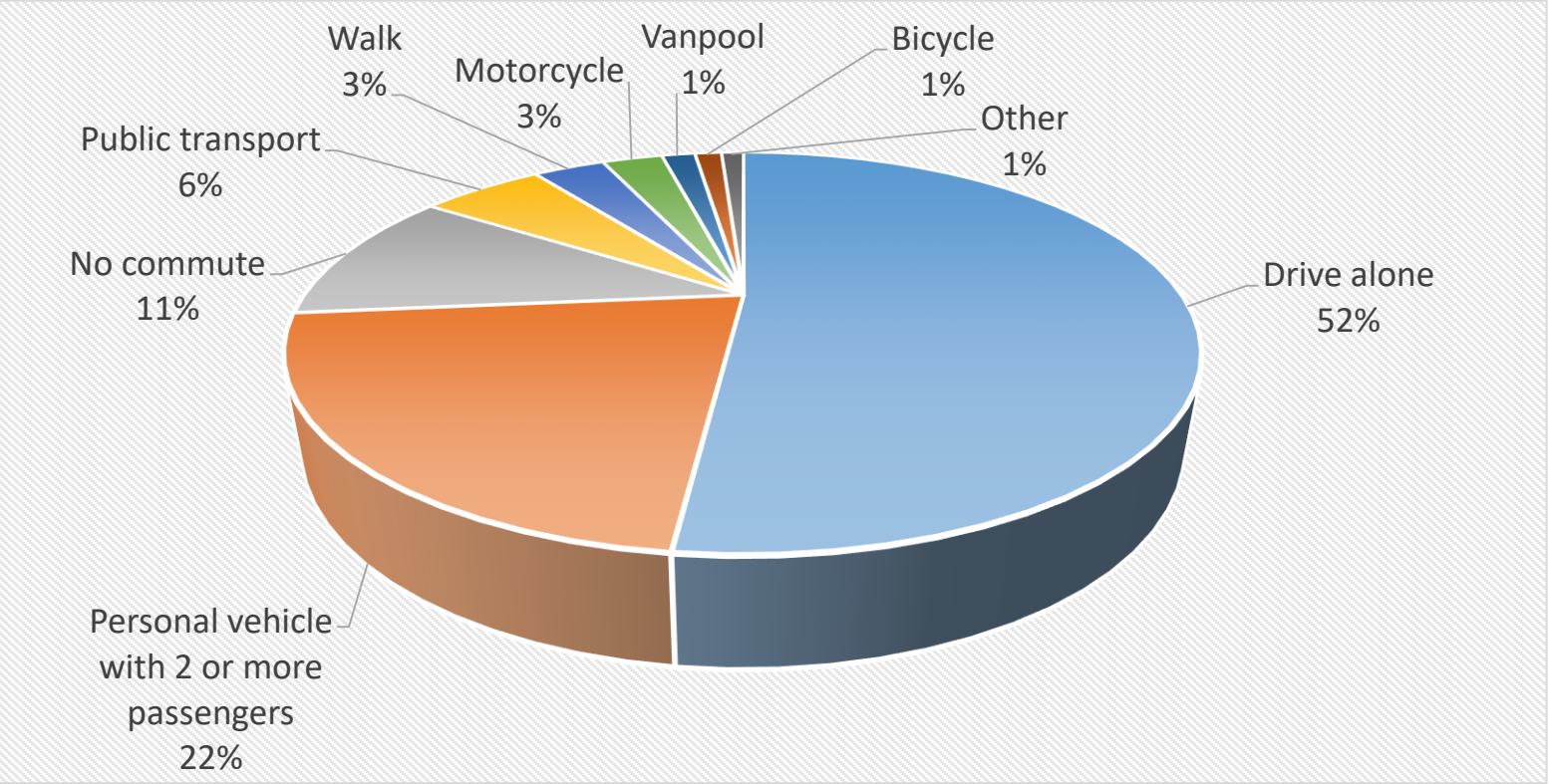
Participant residential locations across the U.S., per Zip Code

	Total	%
Rural	63	15.5
Unincorporated	2	0.5
Small Town	50	12.3
Suburban	110	27.0
Urban Core	118	29.0
Urban Non-Core	60	14.7
Unsure	4	1.0

Results

Survey Respondent Transport Modes

Primary mode of transport for commute to work (prior to COVID-19)



Results

PAV Adopter Group by **PAV Trip Type**

Variable: *Likely to use PAVs for…*	**Coefficient**	**Odds Ratio**	**SE**	**t-value**	**p-value**
Daily commute to/from work	-0.175	0.805	0.161	-1.09	ns
Occasional commute to/from work	-0.335	0.729	0.159	-2.10	.04
Personal, non-business travel	-0.430	0.751	0.159	-2.70	.01
Entertainment/sight-seeing	-0.028	0.916	0.161	-0.17	ns
Early | Moderate	1.090	-	0.129	8.26	< .01
Moderate | Late	0.206	-	0.106	1.94	.05
Late | Laggard	2.531	-	0.208	12.19	< .01

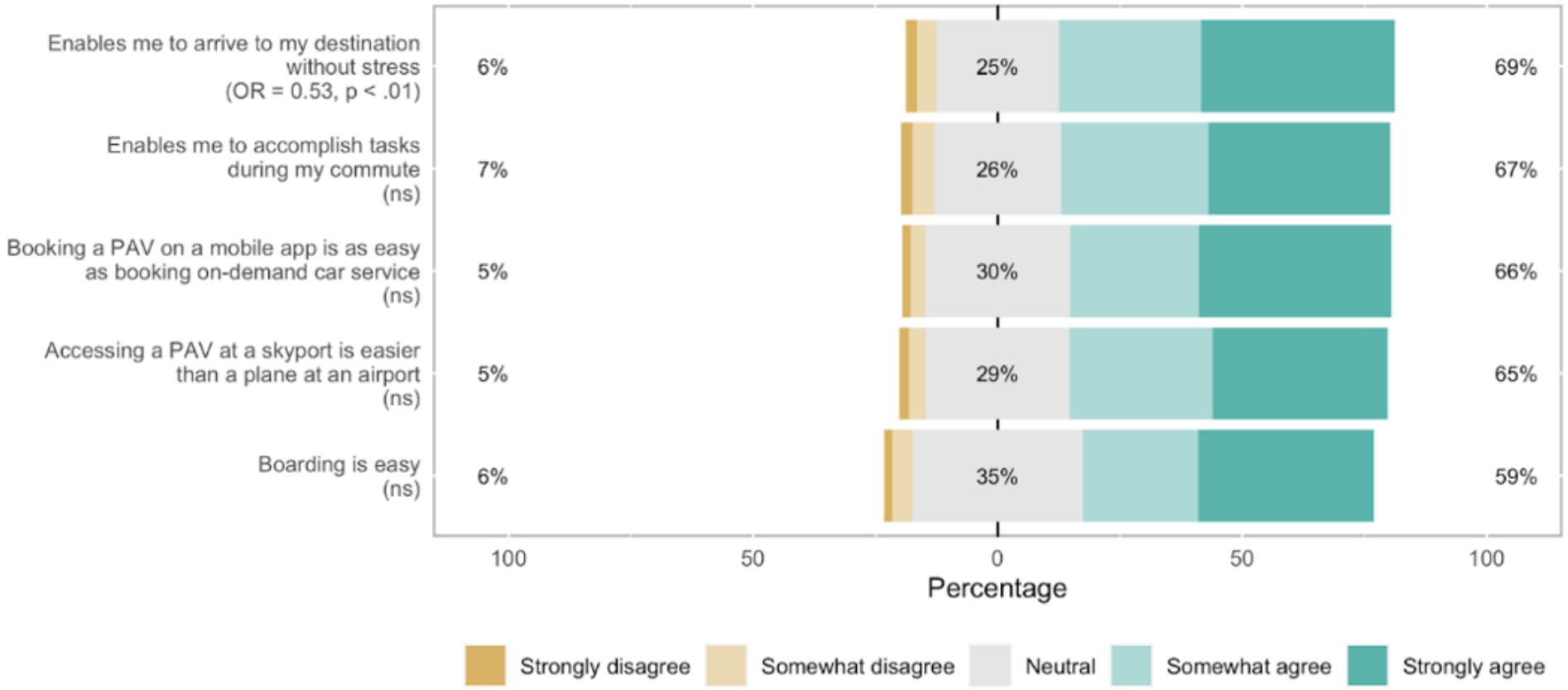
Results

PAV Adopter Group by **Trust in PAVs**

Variable	Coeff.	Odds Ratio	SE	t-value	p-value
Need visual indicators inside PAV to trust flight is operating safely *(agree)*	0.720	2.054	0.331	2.18	.03
Trust riding in a PAV operated by an established brand *(agree)*	-0.708	0.492	0.344	-2.06	.04
Trust riding in a PAV with a pilot on-board *(agree)*	-0.213	0.808	0.335	-0.64	ns
Trust riding a PAV that is autonomously piloted *(agree)*	-0.364	0.695	0.176	-2.07	.04
Early | Moderate	1.257	-	0.331	3.80	< .01
Moderate | Late	0.019	-	0.327	0.06	ns
Late | Laggard	2.380	-	0.361	6.39	< .01

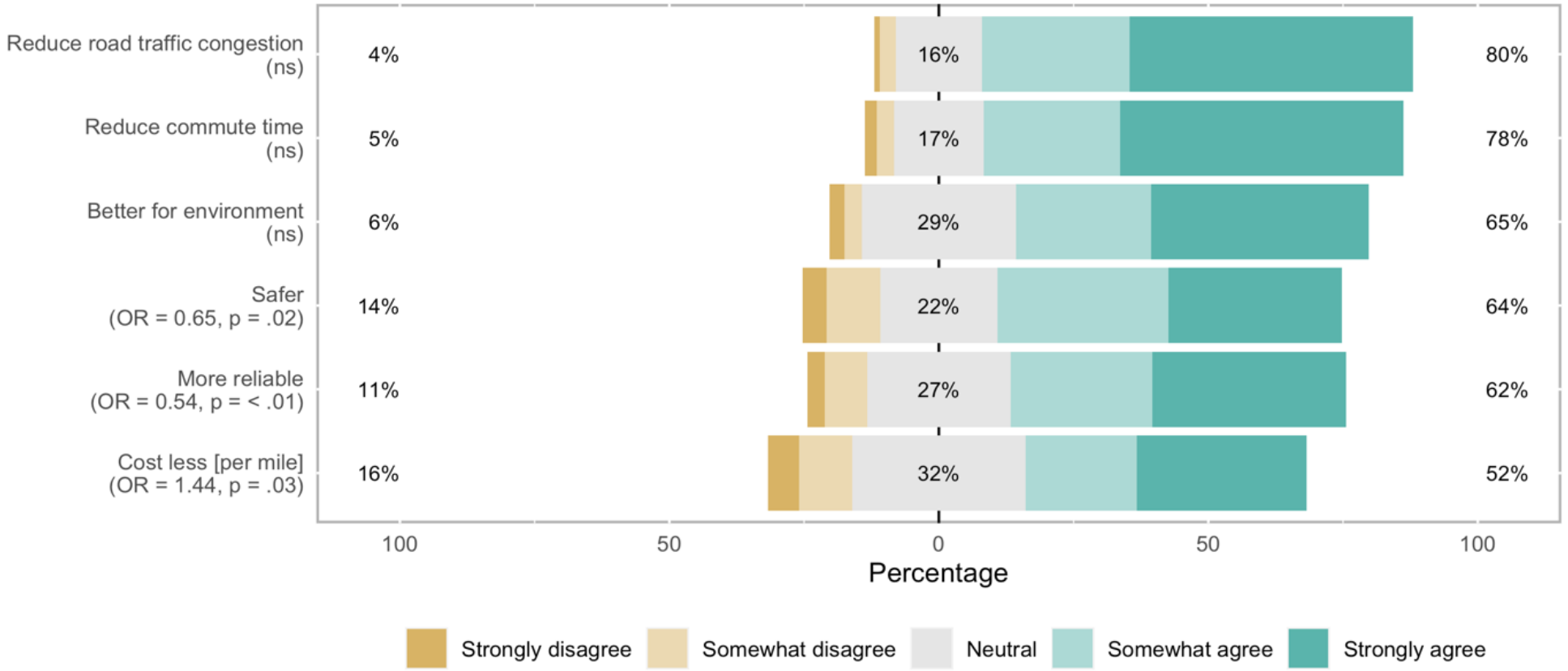
Results

Perceived PAV **Ease of Use**



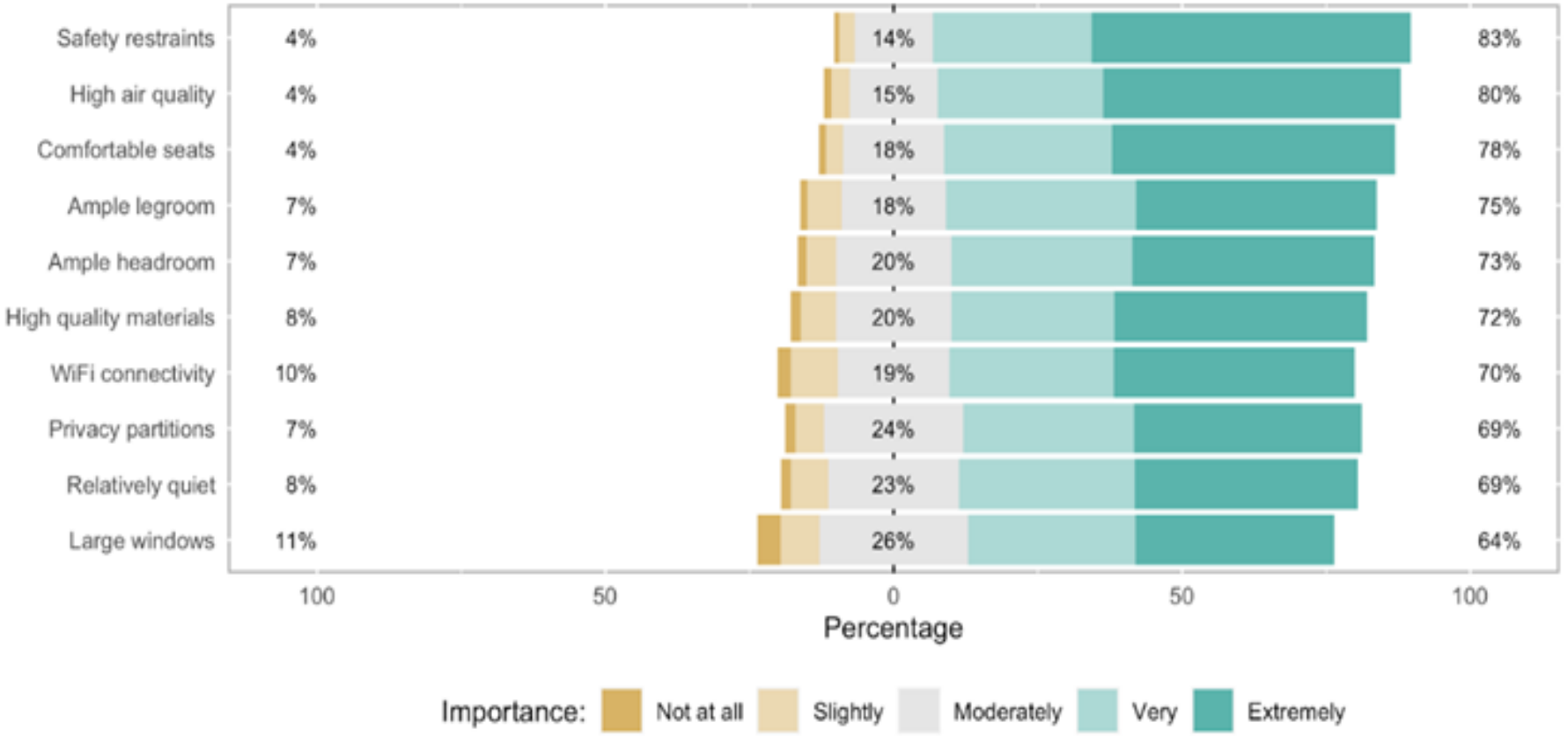
Results

Perceived PAV **Usefulness**



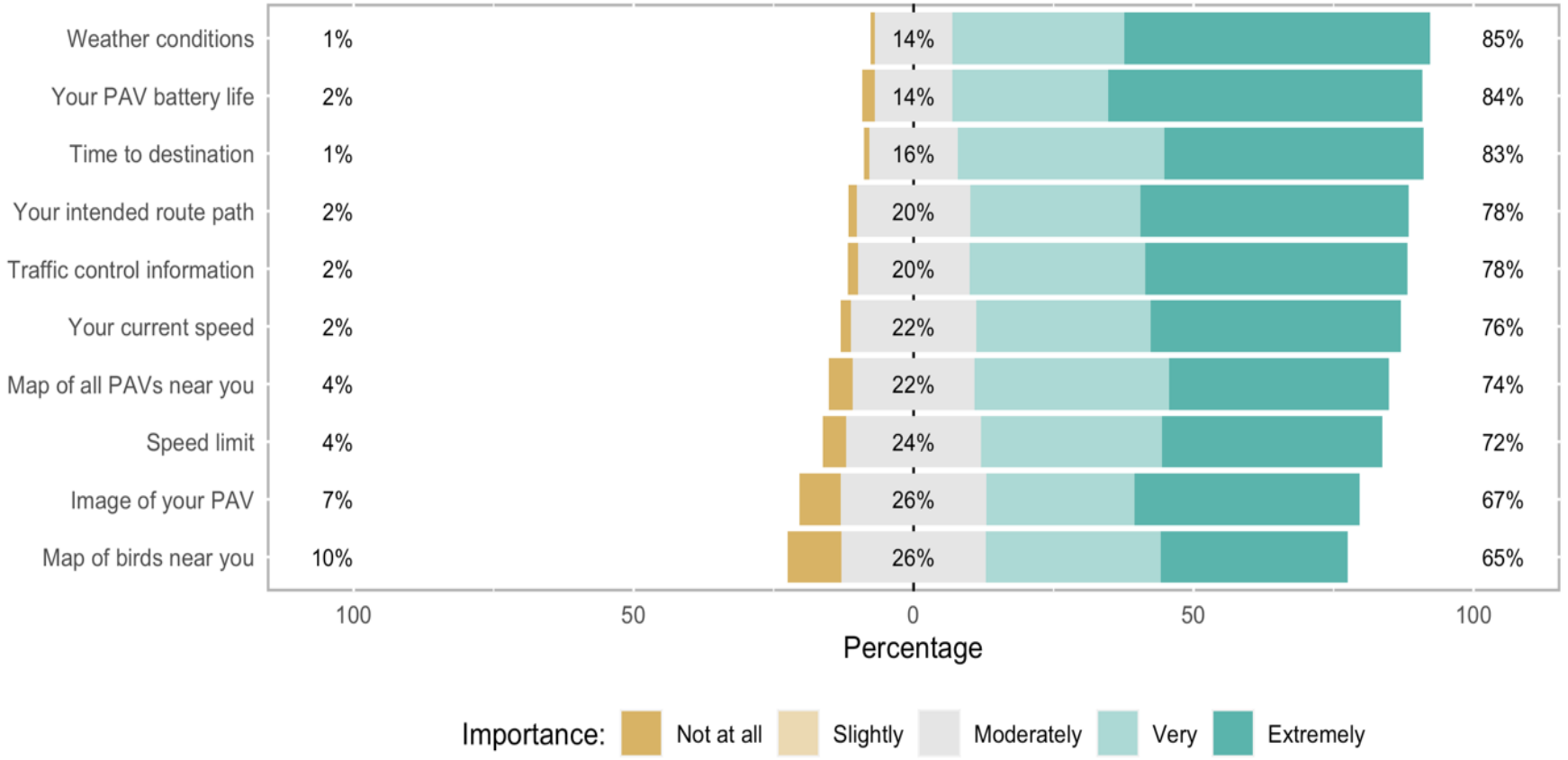
Results

Perceived **Importance of Cabin Features**



Results

Perceived **Importance of Display Panel Information**



Discussion

PAV Ease of Use and Usefulness Perceptions

- All PAV adopters concur of the **usefulness** of PAVs in reducing road congestion and commute time.
- Early adopters translate PAVs' **usefulness** into perceived value by indicating their willingness to pay a premium for using PAV technology (i.e. early adopters did not perceive the cost per mile of PAV to have less value than alternative transportation modes).
- Later adopters perceived PAVs lack of **usefulness**, by indicating less willingness to pay a premium to ride.
- Early adopters perceive PAVs **ease of use** as a stress-free, convenient mode of transport.
- Late and Laggard adopters perceive PAVs **ease of use** as a stressful, less-convenient mode of transport.

Discussion

PAV Technology Trust Perceptions

- **Early PAV adopters** are more trusting of PAV technology, willing to pay more to ride, and exhibit higher risk tolerance in their overall general behaviors. Earlier adopters have shorter daily commutes.
- **Later PAV adopters** are less trusting of PAV technology and present as risk-adverse. These later adopters need more in-flight feedback and an on-board pilot to consider riding, as compared to earlier adopters.
- Both **Late and Laggard PAV** adopters indicate that to trust PAV flight is operating safely, they need visual indicators inside the PAV

Discussion

PAV Transportation Alternative Perceptions

Chi-square test indicated that respondents with shorter work commute times are more likely to be **Early and Moderate PAV** adopters

All PAV adopters do not perceive PAVs as an immediate replacement for daily trips.

Conclusions

PAV Safety Perceptions

Safety was identified as a crucial element of PAVs amongst all potential users

All PAV adopters regardless of adopter group, expect additional in-flight safety feedback (i.e., displays relating to current and projected flight operations) beyond the level of safety systems found in conventional aircraft (i.e., seatbelts, air quality).

Conclusions

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PAV manufacturers, operators, and policymakers should prioritize needs and expectations of Early PAV adopters to achieve successful PAV technology integration into the transportation network.

Once established, shift focus to satisfy requirements of Moderate and Late PAV adopters, to enable further scale-up and broader community acceptance.

To satisfy expectations of all potential PAV users, PAV safety is paramount.

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Thank You

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