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Perceived benefit and willingness to use private autonomous cars for CBD commuting

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Abstract

Autonomous vehicles (AVs) are anticipated to significantly reshape travel behaviour, with self-parking functionality emerging as a major benefit. In Central Business Districts (CBDs), where parking fees are typically high, AVs could potentially alleviate this burden by independently navigating to free parking areas. However, it remains unclear how CBD car commuters would evaluate their value of travel time (VOT) and whether they would accept empty vehicle cruising as a strategy to avoid parking expenses in an AV-dominated future. This research investigates these issues using a stated-preference online survey conducted in Melbourne, Australia, featuring a discrete choice experiment. The results indicate that the VOT for AV travel is approximately 30% lower than for conventional car travel - $16.0/hr for AVs versus $22.8/hr for conventional cars. Furthermore, the reduction in AV VOT is more pronounced among self-paid parking (33%) commuters compared to those whose parking is employer-paid (14%). Additional analysis reveals that factors such as trip cost, residential location, level of AV awareness and the method used to demonstrate AV features significantly influence the willingness to commute using AVs. These insights offer valuable guidance for transport planners and policymakers, aiding in travel demand forecasting, transport modelling, and the development of effective parking and infrastructure policies to support the transition to a more sustainable, AV-integrated urban future.

1 Introduction

Autonomous vehicles (AVs), also known as self-driving or driverless vehicles, have garnered significant attention from both the research community and the automotive industry over the past few decades (Faisal et al., 2021). AVs are expected to alter the existing travel behaviour and urban landscapes (Singleton, 2019). Equipped with advanced sensing, computing and decision-making capabilities, these vehicles promise to enhance road safety (Victor et al., 2017), reduce insurance premiums (Xu & Fan, 2019), increase road capacity (Lazar et al., 2018), alleviate traffic congestion (Metz, 2018), lower energy consumption, mitigate pollution and emissions (Chen et al., 2019) and improve mobility for the elderly and disabled populations (Faisal et al., 2019; Harper et al., 2016).

Beyond these direct benefits, AVs are anticipated to lower the disutility of travel by enabling engagement in productive or leisure activities during their journey (Mokhtarian & Salomon, 2001). In conventional transport economics and appraisal literature, travel time is generally perceived as a ‘cost’ to the traveller (Jain & Lyons, 2008; Lyons & Urry, 2005), prompting efforts to minimize it. However, fully automated SAE (Society for Automotive Engineers) level-5 AVs are expected to handle all driving tasks autonomously (SAE, 2021), including parking, allowing users to utilize their in-vehicle journey time more effectively. This shift is likely to alter the perceptions of travel time utility, thereby reducing the value of travel time (VOT) associated with AVs compared to conventional car driving (Kolarova, 2020; Singleton, 2019).

Value of Time (VOT), also referred to as value of travel time or time valuation of travel, represents the monetary value an individual is willing to spend to reduce their travel time (Jara-Diaz, 2007). Literature suggests that if travel time can be used productively – whether for activities like work, relaxation or leisure – the disutility of travel time decreases, leading to a lower VOT (Lyons & Chatterjee, 2008). Given that fully automated AVs eliminate the need for active driving, riders can engage in other in-vehicle activities that enhance their travel experience (Wadud & Huda, 2018, 2023). Building on this concept, researchers have examined AV VOT estimates under various scenarios, including vehicle interior design (Lavoie et al., 2024), AV ownership concepts such as private, shared, pooled and transit (Steck et al., 2018; Sun et al., 2020), place of residence such as rural or urban (Zhong et al., 2019), trip purpose and distance (Ashkrof et al., 2019) and the type of activities performed inside an AV (Correia et al., 2019). However, the reported VOT estimates for AV travel exhibit significant variation for several factors as reported by Huda, Currie and Kamruzzaman (2025); Huda et al. (2023a, 2023b). While some studies suggest that AV VOT estimates would be lower than the conventional car VOT (Correia et al., 2019; Gao et al., 2019; Kolarova et al., 2019a), others argue that AV VOT could be higher (Krueger et al., 2019; Rashidi, Waller, et al., 2020). Meanwhile, a separate body of research contends that there may be no substantial difference between AV and CAR VOT (Rashidi, Najmi, et al., 2020).

One of the notable advantages of AVs is their self-parking capability. Unlike conventional cars, AVs can autonomously park themselves at a designated location after completing a trip. This feature has significant implications for Central Business District (CBD) car commuters, who currently experience expensive parking costs (daily parking cost in Melbourne CBD is $62.2 (Parkopedia, 2022)). Instead of paying for expensive CBD parking, private conventional car users might switch to private AVs to command their vehicles to park at home or in locations with lower or zero parking costs, fundamentally altering commuting patterns and parking demand in urban city centres. Although returning an AV home would incur empty cruising costs, such costs may be lower than the high parking fees typically associated with downtown or central business district (CBD) areas (Millard-Ball, 2019). While existing literature has demonstrated that parking costs significantly influence travellers' mode choice behaviour (Evangelinos et al., 2018; Rotaris & Danielis, 2014), limited research has examined the combined influence of parking costs and empty cruising costs on AV VOT estimates. Given that VOT is a critical parameter in understanding mode choice behaviour, accounting for these cost components in AV VOT estimation is essential for developing a more comprehensive and accurate assessment of travel decision-making in an autonomous mobility context.

This paper aims to measure the perceived benefit and willingness to use autonomous cars for CBD commuters. The paper is a synthesis of several research projects undertaken by the authors as part of a PhD Thesis on the topic. It represents a summary and brings together separate research projects on the topic. The research adopts stated-preference survey data collected from Melbourne CBD car commuters. The research aims to estimate the VOT value for AV travel and quantify the willingness towards using AVs for CBD commuting.

The rest of the paper is structured as follows: *Section 2* outlines the research methodology, *Section 3* presents the analytical models, *Section 4* presents and discusses the results, and *Section 5* concludes the paper by summarizing the key findings and their implications.

2 Methodology

This section outlines the methodology employed for data collection, including an overview of the stated preference survey design, a detailed explanation of the discrete choice experiment (DCE), and the procedures followed during the data collection phase.

2.1 Stated preference experiment

The study aims to estimate the value of time (VOT) among CBD car commuters and quantify their willingness to adopt AV travel. As fully automated Level 5 AVs are not yet commercially available, it is not feasible to gather revealed preference data based on actual AV travel

experiences. To overcome this limitation, a stated-preference approach was adopted, enabling the collection of empirical data through hypothetical but realistic AV travel scenarios.

A discrete choice experiment (DCE) was developed to elicit commuters' valuation of travel time (VOT) for both conventional private vehicles (CAR) and fully automated private AVs. The DCE methodology is well established for investigating behavioural preferences and is frequently used in the evaluation and forecasting of emerging transportation technologies (Ben-Akiva & Bierlaire, 1999; Hensher, 1994; Train, 2009). The experiment was tailored to respondents' self-reported commuting habits and was supported by scenario-based questions and clear instructions to facilitate an informed evaluation of AV travel options.

The stated-preference experiment was administered via an online survey using the Qualtrics platform. The target sample comprised individuals residing in Metropolitan Melbourne who are aged 18 years and over, employed full-time or part-time in Melbourne's CBD, and commute to work by car. The survey instrument was structured into five sections: (1) screening questions to confirm eligibility; (2) questions on daily commuting behaviour, including travel time and distance; (3) an assessment of AV awareness, followed by a brief introduction to fully automated AVs; (4) the choice experiment itself; and (5) the collection of socio-demographic and economic data.

2.2 Choice task attributes and levels

The stated-preference choice experiment featured two travel mode alternatives – private autonomous car (AV) and private conventional car (CAR). Each alternative was described using five key attributes: travel time, travel cost, parking cost, empty cruising cost and walk time.

Travel time refers to the in-vehicle duration required to complete a one-way journey from the commuter's home to their workplace. Travel cost includes expenditures related to fuel, insurance, and tolls, excluding vehicle depreciation, in line with the recommendations by Hang et al. (2016). This cost was estimated using each respondent's self-reported travel distance, applying a rate of $0.40 per km, consistent with Australian Taxation Office guidelines.

Parking cost was derived from revealed preference responses, reflecting the actual amounts respondents typically pay to park near their workplace. The empty cruising cost – a unique attribute introduced for AV trips - captures the financial impact of instructing an AV to travel without a passenger to a remote or free parking spot, or even return home. This cost represents the economic implications of unoccupied AV movement following passenger drop-off.

Conversely, for CAR users, walk time was included as an attribute to represent the duration required to walk from a parking spot to the workplace. AV trips were assumed to involve zero walk time, based on the expectation that fully automated vehicles will offer curbside drop-offs at the trip's final destination. Table 1 provides a summary of all attributes and their corresponding levels for both choice alternatives.

Table 1: Overview of the choice task attributes and associated levels.

Attributes	Conventional car (CAR)	Autonomous Vehicle (AV)
Travel time	0.7, 1, 1.3 of reference value	0.7, 1, 1.3 of reference value
Travel cost	0.7, 1, 1.3 of reference value	0.7, 1, 1.3 of reference value
Parking cost	0, 0.5, 1 of reference value	0, 0.5, 1 of reference value
Empty cruising cost	Not applicable	0, 0.25, 0.5, 0.75, 1 of travel cost
Walk time	5, 10, 15 minutes	Not applicable

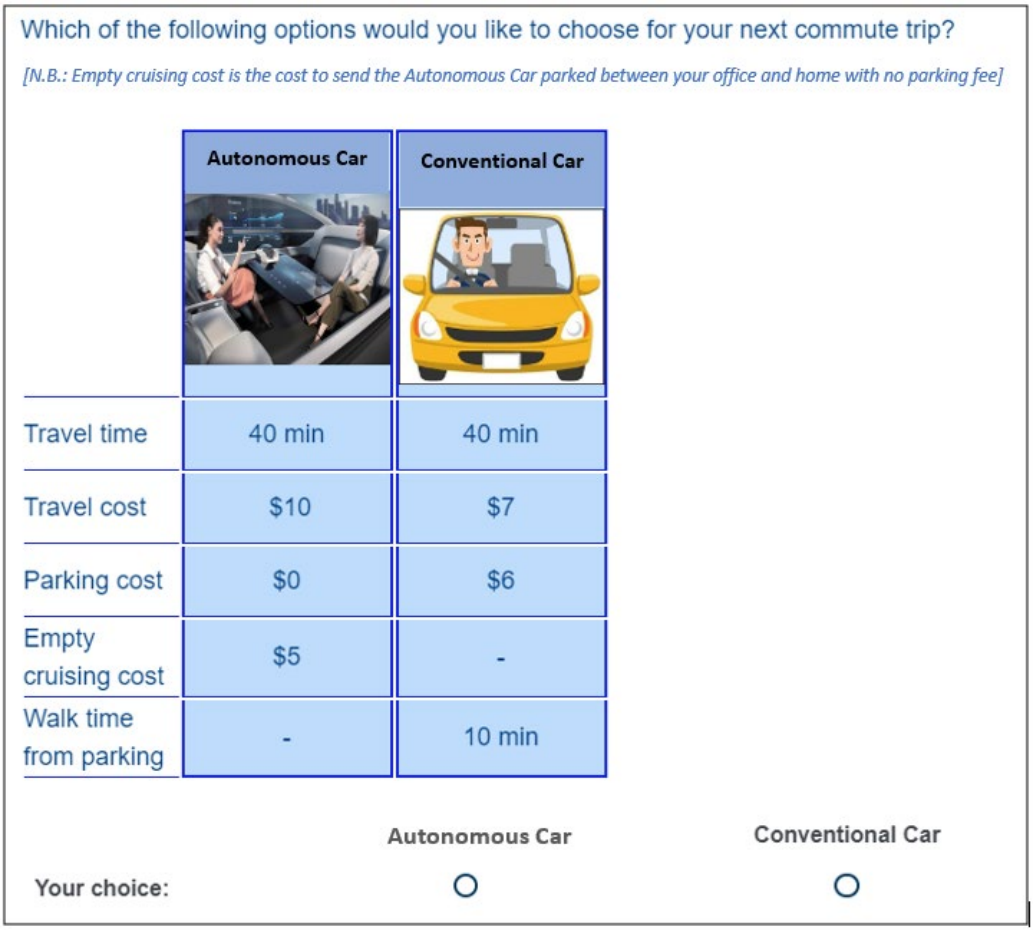
2.3 Experimental design

The experimental design adopted in this study aligns with the methodology established in Huda, Currie, Pimenta, et al. (2025). A Bayesian *D-optimal* experimental design was developed using the Ngene software (ChoiceMetrics), ensuring a statistically efficient and reliable stated-reference choice experiment. *D-optimal* or *D-efficient* designs are widely recognized for their capacity to minimize the standard errors of parameter estimates in discrete choice modelling, thereby enhancing the precision and validity of preference elicitation (Rose & Bliemer, 2007, 2009; Rose et al., 2008).

Following the finalization of the choice attributes, the design incorporated non-zero Bayesian priors, which were informed by estimated coefficients from comparable stated-preference studies (Correia et al., 2019; Washbrook et al., 2006). However, given the lack of empirical studies specifically quantifying the cost implications of empty cruising in AV contexts, the prior for this attribute was conservatively set to zero.

To construct the experimental design, respondents' revealed preference data were used as reference points for each attribute, enabling the generation of ten distinct choice tasks. The walk time attribute was restricted to three fixed levels: 5, 10 and 15 minutes. To reduce the risk of respondent fatigue and maintain data quality, each participant was randomly assigned five of the ten choice tasks to complete. An example of a typical choice task is shown in Figure 1.

Figure 1: Sample choice task provided to the survey respondents (source: author).



2.4 Data collection

The survey questionnaire and stated-preference choice experiment were conducted online using the Qualtrics platform between October 2023 and January 2024. A structured sampling framework, as shown in Table 2, was developed to capture a representative cross-sectional

data sample of CBD car commuters. The sample was stratified to reflect two key commuter groups: those who personally bear their parking costs (self-paid) and those whose parking expenses are covered by their employers (employer-paid). To enhance geographic representativeness, the sample was further stratified by respondents' residential location, categorized into three suburban zones - inner, middle and outer suburbs – along with local government area (LGA) distributions within metropolitan Melbourne. The proportions of self-paid and employer-paid parking commuters were aligned with empirical benchmarks from Hamer et al. (2012), which examined parking behaviours among Melbourne CBD car commuters.

A total of 1,035 respondents participated in the online survey. We collected these samples via two market research (MR) companies, distributing promotional placards in offices near Melbourne CBD, as well as by advertising through social media platforms. Respondents recruited via the MR companies received monetary incentives for completed answers, while the others were provided monetary incentives through a prize draw. However, following a series of data validation checks, the final sample was refined to 528 valid responses. The validation criteria – guided by insights from a pilot study – included checks for minimum completion time, plausible travel time and speed, reported parking fees, and income levels. These measures were implemented to ensure the internal consistency, reliability, and quality of the collected data.

Table 2: Sampling framework by place of residence and parking fee arrangement (adopted from: Huda et al. (2024); Huda, Currie, Pimenta, et al. (2025)).

	Spatial distribution of place of residence in Metropolitan Melbourne											
	Inner			Middle			Outer			Total		
Parking fee payment type	Target	Achieved	%	Target	Achieved	%	Target	Achieved	%	Target	Achieved	%
Self-paid	51	52	102	130	106	82	89	90	101	270	248	92
Employer-paid	44	78	177	110	110	100	76	92	121	230	280	122
Total	95	130	137	240	216	90	165	182	110	500	528	106

Table 3 compares the demographic characteristics of the final survey sample with those of the CBD car commuter population as reported in the 2016 Australian Census. Although data from the 2021 Census were available, they were excluded due to the significant impact of the COVID-19 pandemic, which substantially disrupted travel behaviour and commuting patterns, rendering the data unrepresentative for establishing a reliable pre-pandemic baseline. The age distribution of the final sample closely mirrors that of 2016 car commuter population. However, some demographic discrepancies are evident. Specifically, male respondents are underrepresented, while individuals with higher levels of education and income are overrepresented. Such biases are commonly observed in online surveys, where higher-income and more educated individuals tend to have higher participation rates in voluntary, web-based research (Couper, 2000). While the dataset provides valuable insights into commuter preferences and AV-related travel behaviours, these findings should be interpreted with caution, particularly in terms of their generalizability across socioeconomic groups.

3 Analytical model

The paper first investigates the willingness of CBD car commuters to switch to AV travel. As such, a binary logistic regression model was employed. This modelling approach was selected due to the binary nature of the dependent variable, which captured respondents' mode choice between continuing to drive a conventional car (CAR) or switching to AV travel. Compared to other regression techniques, binary logistic regression is more appropriate for analyzing

dichotomous outcomes. The analysis considered a range of explanatory variables to identify factors influencing the likelihood of switching to AVs based on the discrete choice experiment. Only variables found to be statistically significant were reported in the results section. Given that each respondent completed five choice tasks, the panel structure of the dataset was explicitly accounted for, allowing for adjustments to potential within-respondent correlations and improving the robustness of parameter estimates. Following the regression analysis, predictive margins with 95% confidence intervals were computed. These margins provide an estimate of the predicted probability of AV adoption for each independent variable, while holding the distribution of all other model variables constant. This approach offers a more interpretable understanding of the factors shaping commuter preferences in the context of AV travel.

Table 3: Demographic distribution of the survey sample, N = 528 (source: author).

Variable	Category	Survey sample	CBD car commuter population (2016 census)
Age	18 – 29 years	17%	18%
	30 – 39 years	36%	28%
	40 – 49 years	26%	27%
	50 – 59 years	13%	19%
	>= 60 years	7%	8%
Gender	Male	46%	60%
	Female	54%	40%
Education	Grade 12 or school certificate or lower	12%	22%
	Technical certificate or qualification	18%	26%
	Undergraduate university degree	37%	33%
	Postgraduate university degree	33%	18%
Annual Personal Income	$1 - $34,999	4%	9%
	$35,000 - $64,999	16%	28%
	$65,000 - $99,999	35%	30%
	$100,000 - $155,999	31%	16%
	$156,000 & more	15%	17%

To further investigate commuter preferences, we then employed a discrete choice modelling approach based on the framework proposed by Gao et al. (2019) to estimate the coefficients for travel time and cost. These estimated parameters were then used to calculate the value of time (VOT) for each mode alternative, namely, conventional car (CAR) and autonomous vehicle (AV). While a binary logit model provides a foundational approach for analyzing such data, it relies on the assumption that error terms are independent and identically distributed (IID). This assumption, however, can be restrictive, as it overlooks preference heterogeneity among individuals and ignores the correlation within repeated observations from the same respondent (Hensher & Greene, 2003). These limitations may lead to biased or oversimplified representations of commute behaviour. To address these shortcomings, we adopted the mixed logit (ML) model – also known as the random parameter logit model – which relaxes the IID assumption by allowing certain model parameters to vary randomly across individuals. This approach provides a more nuanced and flexible characterisation of individual preferences, capturing unobserved heterogeneity more effectively (McFadden & Train, 2000).

The utility function for individual *i* choosing alternative *j,* as specified in the mixed logit framework, is expressed as:

$$U_{(i,j)} = \alpha_{(i,j)} + \beta x_{(i,j)} + \varepsilon_{(i,j)} \quad (1)$$

Where α is a vector of intercepts or alternative-specific constants, β is the estimated coefficients associated with the predictors *x* and ε = random error term that captures the unobserved factors influencing the choice. Since the dataset includes repeated observations from each respondent which is considered as panel data, the ML model is well-suited to handle this structure. In the case of panel data, the model allows for correlations between choices made by the same individual. The probability of individual *i* choosing alternative *j* in observation *n* is given by:

$$P_{(i,n,j)} = \frac{e^{\alpha_{(i,j)}+\beta x_{(i,n,j)}}}{\sum_l e^{\alpha_{(i,l)}+\beta x_{(i,n,l)}}} \quad (2)$$

where, the denominator sums over all possible alternatives *l* for the individual *i* in observation *n*. The likelihood function for individual *i* choosing alternative *j* in observation *n* is then:

$$P_{(i,n)} = \prod_l P_{(i,n,l)}^{y_{(i,n,l)}} \quad (3)$$

where, $y_{(i,n,l)}$ is an indicator variable that equals 1 if alternative *l* is chosen, and 0 otherwise. Finally, the likelihood for all *N* observations from *I* individuals is:

$$P_{(i)} = \prod_n \prod_l P_{(i,n,l)}^{y_{(i,n,l)}} \quad (4)$$

4 Results and discussion

4.1 Willingness for AV commuting

Based on the regression analysis results presented in Table 4, we find that a one-dollar increase in travel cost is associated with a 1.04 times higher likelihood of CBD commuters opting for AV commuting. Since travel cost is inherently tied to travel distance, this result suggests that commute distance positively influences the preference for AV travel. In other words, the longer the commute, the more appealing AVs become for CBD workers, particularly for work-related trips.

Table 4: Regression analysis results regarding willingness to commute with AV (source: author's analysis extracted from Huda, Currie, Pimenta, et al. (2025)).

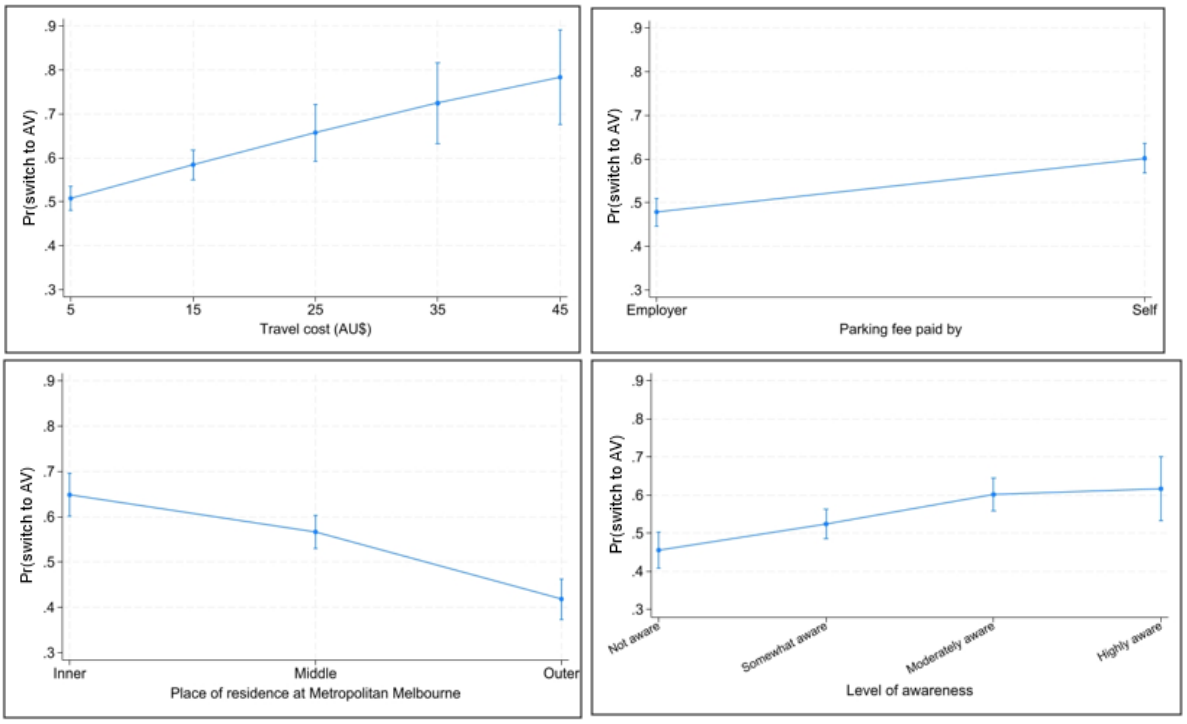
Explanatory variable [continue to CAR= 0, switch to AV= 1]	Odds ratio	Std. Error	z-value	P > |z|
Travel cost	1.041	0.011	3.50	<0.001
Parking fee payment [ref: employer-paid]				
Self-paid	1.885	0.234	5.08	<0.001
Place of residence [ref: inner Melbourne]				
Middle Melbourne	0.646	0.107	-2.63	0.009
Outer Melbourne	0.303	0.059	-6.08	<0.001
Level of AV awareness [ref: not aware]				
Somewhat aware	1.413	0.221	2.21	0.027
Moderately aware	2.106	0.356	4.41	<0.001
Highly aware	2.281	0.589	3.19	0.001
AV demonstration [ref: by picture]				
By animated video	1.262	0.155	1.89	0.059
Employment status [ref: part-time]				
Full-time	1.681	0.132	-1.97	0.049
Model performance No of observation = 2,640 LR chi^2 = 78.25, p < 0.001 pseudo r-squared = 0.15 AIC = 1328.5; BIC = 1463.6				

This relationship is further illustrated by the predictive margins presented in Figure 2. As travel cost increases from $5 to $15, the probability of switching to AVs increases from 50% to 60%, highlighting a significant shift in preference. Although the model does not directly capture

perceived benefits (such as comfort or productivity), the findings strongly indicate a greater willingness to adopt AVs for long-distance commutes, where the relative value of in-vehicle time becomes more pronounced.

Regarding parking payment responsibility, the results show that self-paid CBD commuters are 1.89 times more likely to switch to AV commuting compared to those whose parking fees are employer-paid. This is also reflected in the predictive margins: 60% of self-paid commuters are likely to prefer AV travel, whereas this figure drops to 47% among employer-paid commuters. These findings suggest that self-paid commuters are more sensitive to parking costs and recognize the economic and logistical advantages of AVs, particularly the ability to redirect vehicles to cheaper or free parking locations, such as home or nearby suburbs.

Figure 2: Predictive margin plots of explanatory variables (source: author's analysis extracted from Huda, Currie, Pimenta, et al. (2025)).



With respect to residential location, the results indicate that individuals residing closer to the CBD are more likely to switch to AV commuting compared to those living in outer suburban areas. Specifically, the probability of switching to AVs decreases from 65% among inner suburb residents to 42% for those in the outer suburbs. A closer analysis of the sample reveals that respondents from inner suburbs tend to have higher levels of education, greater household income, and more awareness of AV benefits, which may explain their greater inclination toward AV adoption.

The analysis also reveals a strong association between AV awareness and mode choice. Respondents with a moderate level of awareness of AV benefits are 1.4 times more likely to switch to AVs, while those with a high level of awareness are 2.2 times more likely to do so. This trend is mirrored in the predictive margins, where the probability of switching increases from 45% to 63%, underscoring the critical role that information dissemination and public education can play in encouraging AV uptake.

Furthermore, the study examined the effect of scenario presentation format on participants' willingness to adopt AV commuting. Results show that respondents who were shown an animated video demonstration of AV travel were 1.3 times more likely to switch to AVs compared to those who received only still images and textual descriptions. While animated demonstrations are commonly used in stated preference surveys to convey futuristic scenarios, we recommend that such materials be carefully designed to reflect realistic

expectations, avoiding overly optimistic or hypothetical portrayals that may bias respondent perceptions.

4.2 Value of time (VOT) estimates for AV commuting

Table 5 presents the model estimation results for the value of time (VOT) analysis. A generic cost parameter, encompassing travel, parking, and empty cruising costs, was estimated and treated as an alternative-specific parameter. As expected, the cost coefficient is negative, indicating that higher travel-related costs decrease the likelihood of selecting a particular travel mode. Notably, the cost parameter remains consistent across both model specifications, reinforcing the robustness of cost sensitivity among respondents.

Travel time was also modelled as an alternative-specific parameter, with distinct coefficients estimated for conventional cars (CAR) and autonomous vehicles (AV). In line with theoretical expectations, travel time coefficients are negative across both alternatives, reflecting the disutility associated with increased travel duration. However, in Model 1, the absolute value of the travel time coefficient for CAR is greater than that for AV, indicating that respondents perceive travel time in conventional vehicles as more burdensome than in autonomous vehicles. This finding aligns with prior research (Gao et al., 2019; Kolarova et al., 2019b; Lavoie et al., 2024), which suggests that AV travel is perceived as more productive or comfortable, thus reducing the perceived cost of time spent travelling.

In Model 2, the results indicate that, regardless of travel mode, employer-paid (EP) commuters exhibit greater sensitivity to travel time compared to self-paid (SP) commuters. This heightened sensitivity among EP commuters suggests a higher perceived disutility of travel time, which may be influenced by greater workplace flexibility or opportunity costs associated with time spent commuting. Furthermore, consistent with the findings from Model 1, the travel time coefficient for conventional cars (CAR) remains higher than that for autonomous vehicles (AVs) across both commuter groups. This reinforces the notion that AV travel is perceived more favourably, particularly under time constraints.

Model 2 also incorporates two additional variables specific to the AV alternative: SPEC (empty cruising behaviour for self-paid commuters) and EPEC (empty cruising behaviour for employer-paid commuters). These variables capture commuter preferences for instructing AVs to park at intermediate locations between the workplace and home, a behaviour unique to AVs and not applicable to conventional vehicles.

The estimated positive coefficient for SPEC indicates that self-paid commuters are more likely to utilise empty cruising to park their AVs at intermediary locations. This finding is intuitive and can be attributed to cost-saving motivations, as CBD parking fees are typically high. By leveraging empty cruising, SP commuters can reduce direct parking expenses, thereby optimising their commuting costs. However, while such sharing practices may promote lower vehicle ownership, they could also lead to an increase in vehicle kilometres travelled (VKT) due to unoccupied vehicle movements. This raises important policy concerns, particularly around urban congestion, emissions, and sustainable transport planning in a future with widespread AV adoption.

In contrast, the coefficient for empty cruising among employer-paid (EP) commuters is negative, indicating a lower propensity to engage in empty cruising behaviour. This result is both statistically and conceptually intuitive. Since EP commuters are insulated from the direct financial burden of parking costs, they have limited incentive to seek alternative, cost-saving parking arrangements. As a result, directing their AVs to park at designated workplace parking facilities - mirroring their current practices with conventional cars - remains the most convenient and cost-neutral option.

Moreover, instructing an AV to park elsewhere would incur additional empty cruising costs, which EP commuters must personally bear, as these are not typically covered by employer-provided parking schemes. Consequently, for this commuter group, empty cruising is perceived not as a benefit but as an avoidable, out-of-pocket expense, deterring any shift from established parking habits.

Table 5: Estimated parameters for the mixed logit models.

Variable name	Variable description	Model 1 Coefficient	Sig.	Model 2 Coefficient	Sig.
ASC	Alternative specific constant	-0.5389	***	-0.5707	***
TC	Total travel cost ($)	-0.1266	***	-0.1272	***
carTT	Travel time (min) in CAR	-0.0482	***	n/a	
avTT	Travel time (min) in AV	-0.0338	***	n/a	
SPcarTT	Travel time (min) in CAR by self-paid individual	n/a		-0.0471	***
SPavTT	Travel time (min) in AV by self-paid individual	n/a		-0.0316	***
EPcarTT	Travel time (min) in CAR by employer-paid individual	n/a		-0.0598	***
EPavTT	Travel time (min) in AV by employer-paid individual	n/a		-0.0516	***
WT	Walk time (min)	-0.1049	***	-0.0776	***
SPEC	Empty cruising by self-paid individual	n/a		0.1618	*
EPEC	Empty cruising by employer-paid individual	n/a		-0.1992	*
SDIST_Out	Live in outer suburb	-0.4900	***	-0.4554	***
AVDemo_Anim	AV demonstration via animation	0.2289	**	0.1449	*
Aware_High	Highly aware of AV benefits	0.7972	**	0.8461	***
API_High	Annual personal income is $156,000 and above	0.2894	*	0.4644	**
EDU_High	Holds a postgraduate degree	0.3377	**	0.2670	*
Observations		5,280		5,280	
Final log-likelihood		-1371.02		-1365.55	
Rho-squared		0.378		0.383	

*Significant at *90%; **95%; ***99%*

This behavioural distinction aligns with the predictions made by Huda et al. (2024), who argued that employer-paid commuters are more likely to retain conventional parking behaviours despite the introduction of AV technology. These findings carry important policy implications, particularly in relation to demand management and the environmental consequences of AV deployment. The evidence points to a divergence in parking behaviours based on employer-provided benefits, underscoring the need for targeted interventions such as differentiated parking pricing strategies. These could play a pivotal role in mitigating the externalities of empty cruising, such as increased vehicle kilometres travelled (VKT), traffic congestion, and emissions, while ensuring equity in access to AV benefits across different commuter groups.

Beyond trip-specific attributes, socio-demographic factors emerge as critical determinants of mode choice, particularly in the context of autonomous vehicle (AV) adoption. Our analysis reveals that variables such as place of residence, AV demonstration methods, awareness of AV benefits, income, and education level significantly influence respondents' preferences for AV travel. In both models, commuters residing in the outer suburbs of Metropolitan Melbourne exhibit a lower propensity to choose AVs for commuting. One plausible explanation for this trend is that, despite the potential benefits of AV travel, such as the ability to engage in secondary activities, commuters may still hesitate to accept longer commutes. While our study does not delve into these specific factors, potential explanations may include concerns about

motion sickness, a desire to return home earlier, or a preference for spending more time with family.

Our findings reveal that demonstrating AV travel through animated video significantly increases commuters' likelihood of adopting AVs. This result aligns with the meta-regression analysis by Huda et al. (2023a), which identified a positive correlation between AV demonstration techniques and AV mode preference. Moreover, recent evidence from Huda, Currie and Kamruzzaman (2025) indicates that the use of animated video in AV travel studies is associated with a reduction in the estimated VOT by approximately AUD 3.8 per hour, reinforcing the influence of visualization techniques in shaping respondents' perceptions and preferences. Our results further reveal that individuals with higher income and education levels exhibit a significantly stronger preference for AV travel, a trend consistent with findings from earlier studies (Best & Nazifi, 2023; Krueger et al., 2016). High-income individuals tend to assign greater value to their time, making the ability to reduce unproductive travel particularly appealing. Likewise, highly educated individuals may be more familiar with technological advancements and more open to adopting emerging mobility solutions.

Based on the estimated coefficients for travel time and travel cost, Table 6 presents the value of time (VOT) estimates across different commuter groups. Considering all respondents collectively (Model 1), the VOT for conventional cars (CAR) is estimated at $22.8 per hour, whereas the VOT for autonomous vehicles (AVs) is $16 per hour. This 30% reduction in VOT for AV commuters suggests that AV technology mitigates the perceived burden of travel time, likely due to the ability to engage in alternative activities during travel. The findings are also in line with Jara-Díaz (2007) and Jara-Díaz and Videla (1989), in finding the relation of greater utility of travel time during travelling and also for constrained resources, i.e., income, education. Our VOT estimates are also consistent with previous studies in Australia. For example, Hensher et al. (2011) reported a mean CAR VOT of 17.6 $/hr for Brisbane commuters. In Sydney, Ho et al. (2016) reported a mean CAR VOT of 13.7 $/hr for work-related travel. In a more recent study, Krueger et al. (2019) estimated a mean VOT of 25.6 $/hr for conventional CARs.

Notably, substantial differences in VOT emerge between self-paid (SP) and employer-paid (EP) commuters, particularly for conventional car (CAR) travel. EP commuters exhibit a VOT of $6.0 per hour higher than their SP counterparts. This discrepancy can be largely attributed to parking fee payment arrangements. SP commuters, who bear the direct financial cost of parking, may exhibit greater sensitivity to travel costs and thus be less inclined to invest in time savings. Conversely, EP commuters, insulated from parking expenses, appear more willing to prioritize time efficiency, as reflected in their higher VOT estimates. These findings highlight the influence of employer-subsidized benefits on travel behaviour and have important implications for designing equitable pricing and mobility policies in an era of increasing AV integration.

Table 6: Value of time (VOT) estimates.

Model	Characteristics	VOT in $/hr		% change in AV VOT
		Conventional Car	Autonomous Vehicle	
1	All drivers	22.8	16.0	-29.8%
2	Self-paid	22.2	14.9	-32.8%
	Employer-paid	28.2	24.3	-13.8%

Despite differences in parking payment arrangements, both self-paid (SP) and employer-paid (EP) commuters report lower value of time (VOT) estimates for AV travel compared to CAR travel, reinforcing the notion that AV technology can ease the perceived disutility of travel time. For SP commuters, the estimated VOT is $22.2 per hour for CAR travel and $14.9 per hour for AV travel, representing a 33% reduction in VOT with AV adoption. Similarly, EP commuters

value their time at $28.2 per hour for CAR travel and $24.3 per hour for AV travel, amounting to a 14% reduction.

Interestingly, EP commuters exhibit a significantly higher VOT for AV travel than SP commuters ($24.3/hr vs. $14.9/hr), a difference of $9.4/hr. However, this does not necessarily indicate a stronger preference for AVs among EP commuters. On the contrary, the larger VOT reduction among SP commuters suggests that they perceive greater utility gains from AV travel. This finding is consistent with expectations: SP commuters, who are directly impacted by CBD parking costs, are more likely to leverage AV functionalities such as empty cruising or remote parking to reduce these expenses. Consequently, while EP commuters place a higher overall value on their time, SP commuters may derive more practical benefits from AV use, particularly in terms of cost savings and flexibility.

5 Conclusion

The impending introduction of fully automated vehicles (AVs) is poised to bring transformative changes to urban mobility and individual travel behaviour. Understanding the conditions under which commuters are willing to adopt AVs, as well as the perceived value they assign to this mode of travel, is essential for informed transport planning, demand forecasting, and the formulation of responsive public policy. To contribute to this understanding, the present study conducted a comprehensive stated-preference survey targeting car commuters to Melbourne's Central Business District (CBD). The data were analyzed using both binary logit and mixed logit models to capture variations in mode choice behaviour and to estimate the value of travel time (VOT) under conventional and autonomous travel conditions.

Results from the binary logit model highlight several key determinants that significantly influence commuters' willingness to switch from driving conventional cars to AVs. These include:

- Parking payment responsibility (self-funded vs. employer-funded); commuters with self-funded parking tend to have a greater likelihood for AV adoption.
- Residential location (inner, middle, or outer suburbs); commuters residing closer to CBD demonstrated a higher propensity towards AVs.
- Level of awareness regarding AV benefits; higher awareness increases the likelihood of AV adoption.
- The method used to demonstrate AV scenarios (e.g., animated video); animated videos depict easy understanding of probable AV benefits.
- High-income and highly educated individuals would be the early adopters of AVs.

The mixed logit model provided further insights by accounting for preference heterogeneity across individuals and repeated observations. A consistent finding across all segments was the lower disutility associated with AV travel time compared to conventional car travel. On average, commuters assigned a VOT of $16.0/hr to AV travel, a substantial 30% reduction from the $22.8/hr estimated for CAR travel. When disaggregated by parking payment type, self-paid commuters showed a 33% decrease in VOT for AV travel ($14.9/hr vs. $22.2/hr), whereas employer-paid commuters exhibited a smaller, but still significant, 14% reduction ($24.3/hr vs. $28.2/hr). These figures reflect a clear behavioural distinction: individuals who personally incur parking costs are more responsive to the economic advantages of AV travel, including opportunities to avoid CBD parking fees through remote or empty vehicle cruising.

The implications of these findings are multifaceted. First, they underscore the influence of parking payment structures on AV mode preference and travel time valuation. Second, they point to the likelihood of increased empty vehicle kilometres travelled (VKT) among self-paid AV users, as these commuters may choose to send their AVs away from the CBD for parking or reuse by other household members or even use their AVs as a shared taxi service during their free time to earn some extra money. While this could offer household-level convenience or an additional income source, it also raises concerns regarding urban traffic congestion,

energy consumption, and environmental sustainability. Future research can look into the possibility of using private AVs as taxi services by their owners for an additional income source during the idle time.

From a policy standpoint, these behavioural insights call for proactive regulation and strategic urban planning. Measures such as differentiated parking charges, VKT-based pricing, and controlled AV access zones may be necessary to counterbalance the unintended consequences of AV adoption, particularly those stemming from empty cruising. For car manufacturers and AV service providers, the results offer valuable guidance in identifying high-potential market segments—namely, commuters with self-paid parking and those in higher-income or more technology-savvy demographic groups—as likely early adopters of AV technology.

Overall, this study contributes to a growing body of literature that highlights the complex interplay between economic incentives, individual preferences, and emerging mobility technologies. It emphasizes the need for targeted interventions to ensure that the benefits of AVs are maximized while mitigating their negative externalities on urban transport systems.

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