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What Makes Parents Consider Shared Autonomous Vehicles as a School Travel Mode?

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Abstract: The integration of shared mobility and autonomous vehicles (AVs) could potentially change the way parents decide to transport their children to and from school. A better understanding of the factors influencing parents' intentions to use shared autonomous vehicles (SAVs) for school transportation is necessary to enhance their children's mobility. Unlike prior research, this paper significantly contributes to the literature by exploring the impacts of socioeconomic, travel-related, and psychological factors and their interactions. Using Google Forms for an online survey, the authors collected 1435 valid responses from parents in Kerman city schools in Iran. The estimation results of the generalized ordered logit model indicate the significant impact of parents' socioeconomic status (occupation, education, income), travel behavior (accident experience, crash severity, travel cost), and attitude (innovativeness, perceived usefulness, environmental concern, pro-driving, safety), and their children-related factors (gender, the most frequently used travel mode, the possibility of tracking the child). The findings show that an increase in parents' education, perceived usefulness, and environmental concern increase the likelihood of their intentions to use SAVs. Finally, based on the findings, several implications are suggested to increase parents' intentions to use SAVs for transporting their children and to make SAVs a safe, affordable, and sustainable transport solution.

Keywords: shared autonomous vehicle; rideshare services; school travel mode; generalized ordered logit; intention to use

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1. Introduction

There has been a growing concern about the safety of school children, especially primary and secondary school students, whose ages usually range from 5 to 14 years as a subgroup of vulnerable individuals (e.g., those without a driving license, children, elderlies, and people with disabilities) [1]. Worldwide, it is estimated that approximately 186,300 children lose their lives in road traffic incidents each year, making it the leading cause of death among children aged 5–14 [2]. Many children are dependent on their parents or other adults to accompany them to the school [3–5], but some parents often feel inconvenienced when transporting their children to and from school because parents' working hours often overlap with their children's school hours, leading to time conflicts [6,7]. But to ensure their children's safety, many parents drive them to and from school [8,9]. On the other hand, commuters and young couples are more interested in autonomous vehicles (AVs) than couples with children. This is likely because couples with children are more concerned about the safety of their children and the lack of clear policies and regulations governing AVs [10,11]. Therefore, a reliable and safe school travel mode that provides affordable, accessible, independent, and sustainable mobility could be an appealing solution for parents.

AVs provide parents with greater convenience and freedom when it comes to transporting their children to and from school due to the development of autonomous driving technology. Many studies have shown that AVs could actually enhance passenger safety by eliminating human error, which is the cause of 90% of crashes [12–16]. However, the price of AVs will be higher than conventional vehicles, and they would increase travel distance and trips made by single-occupancy vehicles, which is in conflict with sustainable transportation development [17,18]. Therefore, policymakers may not generally support this type of motorized alternative, and shared use of this technology, called shared autonomous vehicles (SAVs), are likely to become more popular in the future. Dynamic ride-sharing (DRS) services, a service form of SAVs, enable children to share their trips to and from school with other students, which leads to a reduction in travel costs [19].

Even though SAVs offer many benefits [20,21], many concerns still remain regarding their safe operation, security, privacy, and design [22–25]. For example, as a result of an international adult sample, only 11% were inclined to use AVs for transporting their children, far less than the 22% who would not use AVs at all [26]. Therefore, the identification of factors motivating individuals to embrace new technologies and lessen their resistance to change is a crucial step in guaranteeing the successful implementation of any new policy [27–30]. In light of this, the authors of this paper sought to gain a better understanding of the factors influencing the intentions of parents to transport their children to and from school using SAVs. Moreover, based on the results, several implications for policy and practice are suggested to develop a suitable SAV service as a school travel mode. In this study, the authors aimed to answer questions such as "What factors significantly influence parents' usage intention to permit their children to travel unaccompanied to school?", "Among these significant factors, which ones have the greatest impact on parents' intentions?", and "Which factors show the heterogeneity among the intention levels of respondents?". One of the main novelties of our research is that, unlike previous studies, we have examined the effects of socioeconomic, travel-related, and attitudinal factors, and their interactions as a form of systematic heterogeneity. Furthermore, to the best of our knowledge, the integration of SAVs and DRS as a school travel mode has received less attention in previous studies, as most of them have focused on AVs. In addition, we used an intricate method (i.e., generalized ordered logit model) to consider the ordinal nature of the dependent variable (i.e., intention to use) and the heterogeneity among the levels of usage intention. Finally, most of the previous studies have been conducted in developed countries, and less attention has been paid to this topic in developing countries.

The remainder of paper is organized as follows: prior studies in the context of using SAVs/AVs as a school travel mode are presented in Section 2. Section 3 introduces the methodology, including the research method, survey process, and preliminary data analysis. Section 4 presents the estimation results, a critical discussion of the findings, and recommendations for policy and practice. In Section 5, the authors provide a conclusion, as well as some suggestions for future research.

2. Literature Review

There have been many studies investigating the determinants behind school travel modes. In this section, we focus on the factors affecting parents' usage intentions of AVs to send their children to school, which are very limited in the literature (Table 1). Prior studies can be classified based on the considered methodology and factors affecting parents' willingness/intentions to use automation technology for their children's school travel mode. For instance, in the following paragraphs, we review the studies that considered any combination of socioeconomic, travel-related, or psychological factors. Then, the gaps in each study are mentioned, followed by our formulated research hypotheses. Finally, our research contribution to the existing body of literature regarding the role of SAVs in school travel modes is presented.

In terms of the effects of socioeconomic characteristics, contradictory findings have been observed. For instance, in several studies, it has been found that the age of parents is positively associated with their intention to allow their children to travel with SAVs [7,31]. While Lee et al. [32] concluded that the parents' age has a negative effect on their intention, no significant effect has been observed in the studies conducted by Ayala et al. [33] or Lee and Mirman [34]. In addition to parents' age, the impact of the children's age has also been investigated in previous studies, such as that by Lee and Mirman [34], and a positive association between the children's age and the parents' intentions to allow their children to use SAVs has been observed. Parents' gender is also another factor that has been considered in previous studies. In most prior studies, it has been concluded that fathers are more likely to allow their children to use autonomous mobility as a school travel mode [7,31,32,35]; however, no significant relation was found by Ayala et al. [33] or Anania [36]. Parents' education level is another demographic factor that positively influenced their intentions to use AVs in most studies [9,31,32,34]; however, Mao et al. [7] found no significant relationship between these two factors. Different and contradictory findings have also been reported for the effect of income on parents' intention. Although Lee et al. [32] found a positive impact of income on parents' intention, Lee and Mirman [34] and Mao et al. [7] found a negative and not significant correlation, respectively. The effect of familiarity with automation technology is another demographic factor that has been examined by prior studies. In most of the studies, a significant and positive relation has been found [7,9,31]. The number of children and owning a driving license were other explanatory variables that were considered by Mao et al. [7], but no significant associations were found between these variables and parents' intentions to use automation.

Travel behavior characteristics is another category of explanatory variables that have been considered in previous studies. Experiencing any type of accident has been considered by Lee and Mirman [34] and Lee et al. [32]. However, two contradictory findings, including a negative and positive relationship, have been reported, respectively. In other words, they found that experiencing an accident could increase or decrease the likelihood of parent's intentions to use AVs for their children's school travel mode. In addition, Mao et al. [7] examined the influence of travel distance and driving frequency, and a positive and not significant correlation were found, respectively.

Attitudinal factors play a key role in exploring the intentions of individuals [17]. Consumer innovativeness, as an attitudinal construct, is the tendency of consumers to be early adopters of new products and services [37]. This factor has been considered as one of the main factors affecting individuals' intention to use AVs. A well-established positive relationship has been reported in prior research [9,31–34], indicating that individuals with higher innovativeness are more likely to adopt autonomous mobility for their children's school travel mode. Perceived usefulness refers to how much a person believes that using a particular technology will be beneficial to them [38]. Many studies have observed that perceived usefulness is one of the most critical factors in the acceptance of AVs [39–41]. The positive and significant relationship between perceived usefulness and parents' intentions to allow their children to use SAVs as a school travel mode has also been acknowledged in previous studies [1,7,34,42,43]. Perceived risk is a latent construct that explains how consumers make decisions when they are faced with uncertainty [44]. Consumers weigh the potential benefits and risks of an intention before making a decision. In the previous studies outlined in Table 1, perceived risk leads to a lower intention of parents to use AVs as the school travel mode for their children [1,7,42,43]. Safety measures refer to the tasks that are performed to reduce the risk of harm to people, property, and the environment [45]. Despite the numerous benefits of AVs, there are still many uncertainties regarding their acceptance. Therefore, parents were asked about their preferences for route control, assurance features, and other safety measures in the vehicles to help them trust AVs. Previous studies have also confirmed the positive impact of these measures on parents' usage intentions [9,31,32,43]. Attitude is another factor that refers to a person's overall liking or disliking for a particular behavior [46]. Mao et al. [7] and Jing et al. [1] have concluded that attitude is a factor positively affecting parents' intentions to use AVs.

Table 1. An overview of previous studies in parents' usage intentions of AVs as their children's school travel mode.

Author	Variable High			Mode [4]	Model [5]
	Demographic [1]	Travel-Related [2]	Attitudinal [3]		
Ayala et al. [33]	P.S.; P.A.	-	C.I.	AV	Chi-square
Lee and Mirman [34]	P.A.; In; C.A.; Edu; P.S.	E.A.	C.I.; P.U.;	AV	D.A.
Anania [36]	P.S.; Na.	-	-	AB	ANOVA
Hand et al. [35]	P.S.	-	-	AV	ANOVA
Mao et al. [7]	P.A.; P.S.; In; Edu; N.C.; D.L.; Kn.	D.F.; T.D.	Att.; P.R.; P.U.	AV	HCM
Ma et al. [42]	-	-	P.R.; P.U.	AV	SEM
Jing et al. [1]	-	-	P.U.; Att.; P.R.	AV	SEM
Lee et al. [32]	P.A.; Edu; In.	E.A.	S.M.; C.I.	AV	R.F.
Koppel et al. [9]	Edu.; Kn.	-	C.I.; S.M.	AV/R.S.	L.R.
Koppel et al. [31]	P.A.; P.S.; Edu.; Kn.	-	C.I.; S.M.	AV/R.S.	L.R.
Tremoulet et al. [43]	-	-	P.R.; P.U.; S.M.	AV	Interview and F.G.

Abbreviation: (1) ***P.S.***: parent sex; ***P.A.***: parent age; ***In***: income; ***C.A.***: child age; ***Edu***: education; ***Na.***: nationality; ***N.C.***: number of children; ***D.L.***: driving license; ***Kn.***: knowledge. (2) ***E.A.***: experience of accident; ***D.F.***: driving frequency; ***T.D.***: travel distance. (3) ***C.I.***: consumer innovativeness; ***P.U.***: perceived usefulness; ***Att.***: attitude; ***P.R.***: perceived risk; ***S.M.***: safety measure. (4) ***AV***: autonomous vehicle; ***AB***: autonomous bus; ***R.S.***: ridesharing. (5) ***HCM***: hybrid choice model; ***SEM***: structural equation modeling; ***R.F.***: random forest; ***L.R.***: logistic regression; ***F.G.***: focus group; ***D.A.***: descriptive analysis.

Based on the literature review, it was hypothesized that the following have negative effects on parents' high usage intention: respondents who have experienced any type of accident [34] (H1); those who are less educated [32] (H2); those who have a low income [34] (H3); those who are unemployed (H4); and those who are car-dependent [7] (H5). In contrast, it was hypothesized that the following have positive effects on parents' high usage intention: being a female student (H6); those who are innovative [33] (H7); those who are pro-environmental (H8); those who are well-educated [32] (H9); and those who find that SAVs have the possibility of monitoring students online [31] (H10) as well as a travel mode with safe operation and rapid response during emergency situations [43] (H11).

The limitation of each prior study (listed in Table 1) indicates that only a few studies [7,32,34] have considered all the categories of explanatory variables, while each still has its own limitations. For example, in the study by Lee and Mirman [34], only a descriptive analysis (correlation) was conducted, which does not provide much insight regarding the causality relationship and is also limited to only two variables. Although Mao et al. [7] provided insightful findings, their model (HCM) ignored the ordinal nature of the dependent variable (intention to use) and the existence of heterogeneity among the usage intention behavior levels. The latter limitation is also true for the study by Lee et al. [32], who used random forest. Other studies (e.g., Koppel et al. [9,31]) have neither considered the effects of all categories of explanatory variables nor the integration of AVs and ridesharing services.

Based on the aforementioned research gaps, it can be concluded that the majority of prior studies have focused on identifying the factors influencing parents' decisions about their intentions to use AVs [1,7,32,34–36,42,43], or to choose between AVs and rideshare services [9,31] to transport their unaccompanied child(ren) to and from school. However, little is known about the integration of automation and ridesharing services, which are called SAVs. This study contributes the following to the existing body of literature about children's school travel modes: (1) To our understanding, no studies have explored the integration of ridesharing services and automation, which could provide affordable, accessible, independent, and sustainable mobility for vulnerable groups, particularly students under the supervision of their parents. (2) Few studies [7,9,31] have taken into account socioeconomic characteristics, travel behavior, and psychological factors simultaneously. (3) Although most of the prior studies have estimated regression, logistic regression, and a multinomial logit model, the current authors propose a generalized ordered logit (GOL) model to consider the ordinal nature of respondents' usage intentions to understand the heterogeneity among the key factors associated with parents' intentions to use SAVs to transport their unaccompanied children (for further advantages of GOL, please refer to Section 3.1).

3. Methodology

In this section, firstly, an introduction to Kerman as the study area is presented (Section 3.1). Then, the research method, a generalized ordered logit model, is presented (Section 3.3), followed by the sample characteristic (Section 3.2). Finally, the questionnaire design and survey administration (Section 3.4) is presented.

3.1. Study Area

The city of Kerman, as one of the metropolises of Iran, has an area of over 130 km^2 and a population of over 738,000 people, located at a latitude 30.29 and a longitude 57.06 (Figure 1). Some major transportation-related problems of this city are car dependency, lack of suitable active travel mode infrastructure, and lack of public transportation networks, such as a subway, bus rapid transit, or light rail transit. The only public transportation system in Kerman is an insufficient and inefficient bus network, which leads to a high share of private cars (near 50%) in daily trips and an increasing trend in car ownership and dependency. In addition, the share of different school travel modes in Kerman (Figure 2) shows that almost 80% of school trips have been conducted using private cars and school vans, whereas transit accounts for only 1% of trips.

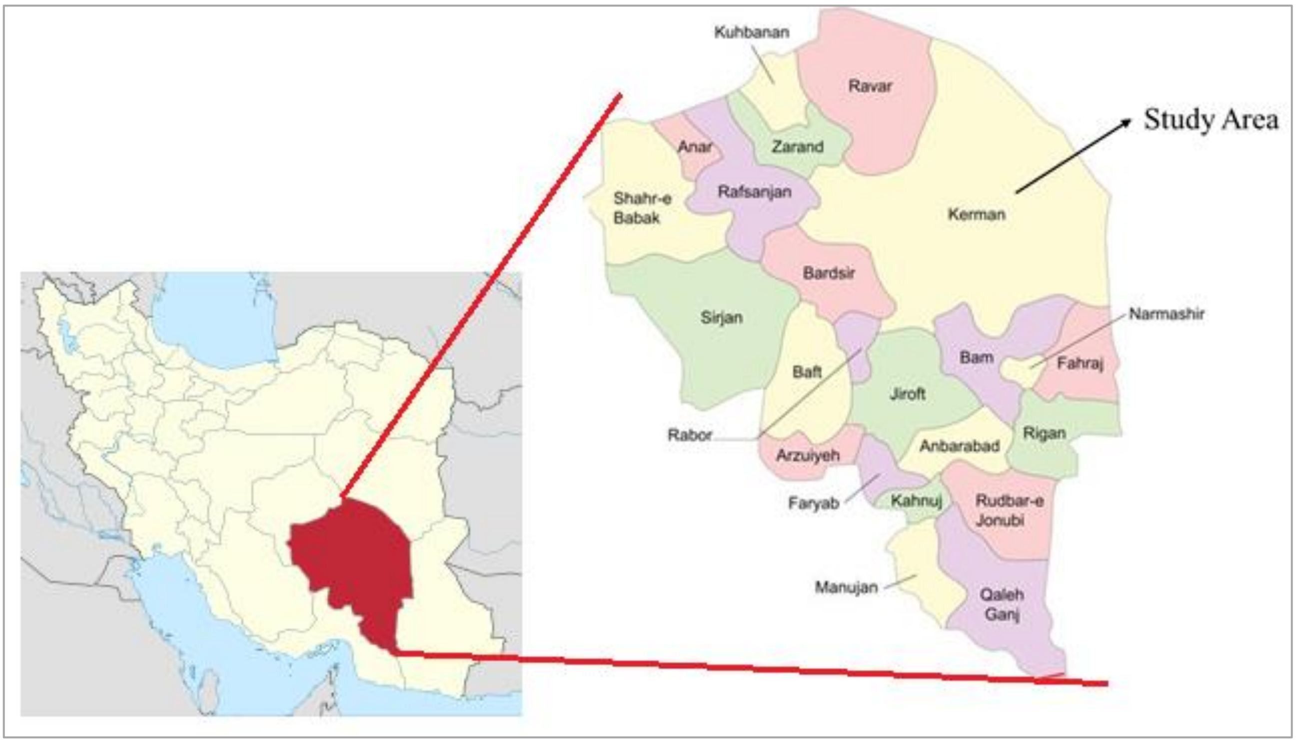

Figure 1. The location of Kerman city [47].

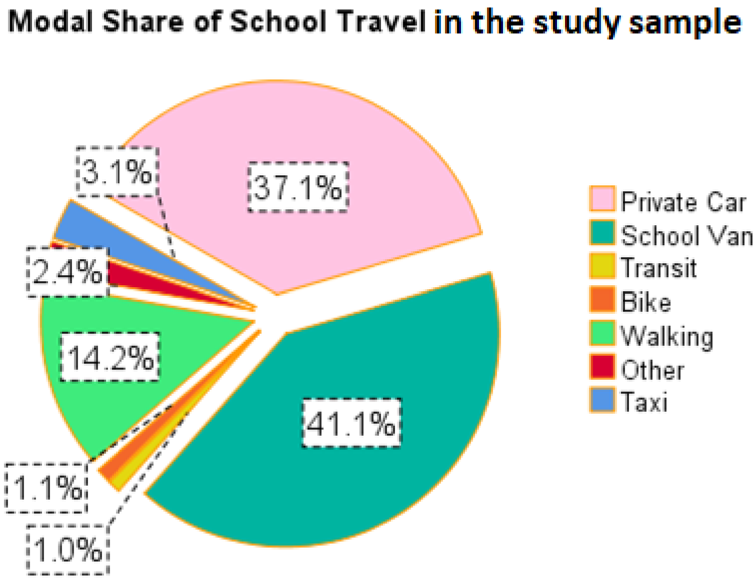

Figure 2. Shares of different school travel modes in Kerman.

3.2. Features of the Collected Sample

The total number of collected responses was 1468, and after removing invalid or incomplete responses, 1435 valid responses were used for further analysis. The incomplete questionnaires, the ones containing outlier answers, and questionnaires with an unusual completion time were the candidates for further screening or removal. The participants, on average, took about 10 min to complete the questionnaire, with a standard deviation of 2 min. This suggests that the participants answered the questions carefully.

The frequency analysis of the socio-demographic characteristics of the respondents (Table 2) shows that more than half (67.1%) of the parents were within the age range of 55–64 years. Regarding the number of children, about 794 (55.3%) respondents had two children. The majority of participants (69.9) had two driving licenses in their household. In terms of household size, 55% of the respondents belonged to four-member households. The majority of respondents (73.1%) owned at least one car. In terms of household income, the majority of respondents (about 90%) were, at most, a middle income. According to the characteristics of the children, girls comprised a slightly higher share of our sample (53%) than boys. In terms of school grades, the authors tried to equally collect data from different grades to prevent the biases of our findings for any specific group. Due to the existence of an unreliable, unsafe, old, and poor accessible public transportation system in Kerman, only 7.6% of parents send their children to school by transit/paratransit mode. On the other hand, about 80% of the parents choose a private car or school van (a van that is shared among students for transporting them to and from school) as the most frequent modes for their children's school trips.

Table 2. Descriptive analysis of explanatory variables: socio-demographic and travel-related characteristics of the respondents from Kerman.

Variable Description	Value *	Frequency	
		Absolute	Relative (%)
Parents' Socio-Demographic Characteristics			
Age group (years)	35–44	12	0.8
	45–54	160	11.1
	55–64	963	67.1
	≥65	300	20.9

Table 2. *Cont.*

Variable Description	Value *	Frequency	
		Absolute	Relative (%)
Parents' Socio-Demographic Characteristics			
Number of children	1	180	12.5
	2	794	55.3
	3	369	25.7
	≥4	92	6.4
Household size	2	14	1.0
	3	187	13.0
	4	790	55.1
	5	374	26.1
	≥6	70	4.9
Household car ownership	0	87	6.1
	1	1049	73.1
	2	272	19.0
	≥3	27	1.9
Father's education level	At most, high school diploma	707	49.2
	Apprenticeship diploma	190	13.2
	Bachelor's	340	23.6
	Master's	155	10.8
	PhD	43	3.0
Number of household members possessing a driving license	0	16	1.1
	1	261	18.2
	2	1003	69.9
	3+	155	10.8
Household income level	Very low	210	14.6
	Low	434	30.2
	Medium	646	45.0
	High	132	9.2
	Very high	13	0.9
Household bike ownership	0	1118	77.9
	1	302	21.0
	≥2	15	1.0
Child characteristics			
Gender	Male (Boy)	674	47.0
	Female (Girl)	761	53.0
School grade (age)	4th (10)	289	20.1
	5th (11)	259	18.0
	6th (12)	270	18.8
	7th (13)	213	14.8
	8th (14)	202	14.1
	9th (15)	202	14.1
Most frequent transportation mode to school	School van	590	41.1
	Private car	532	37.1
	Walking	204	14.2
	Transit and paratransit	109	7.6

* The prevalent categories are highlighted in grey.

Moreover, the importance of various factors, such as environmental concerns, travel cost, accident risk, the possibility of online monitoring of children at any moment, and the safety of children on the way to school (Figure 3) were explored based on the most frequent children school modes (i.e., walking, private car, transit, and school van). It can be seen that the lowest accident risk, the possibility of monitoring children online, and their safety are the most important factors for parents who use their private car to transport their children to school. In contrast, environmental concerns and costs are of greater concern to parents whose children travel to school by walking or using transit.

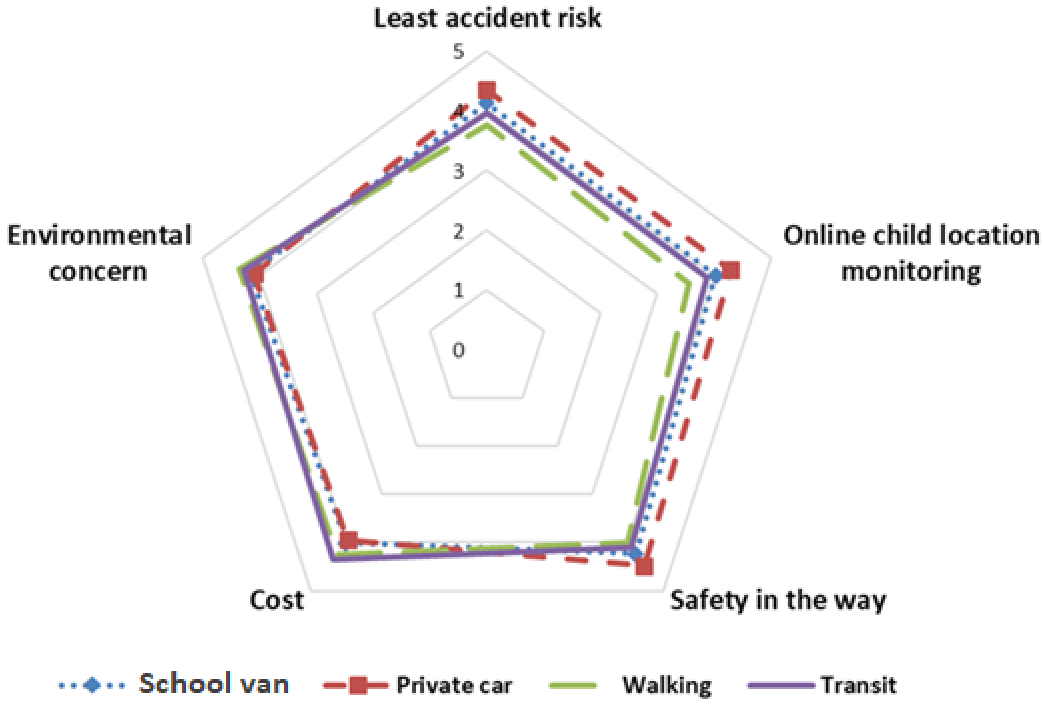

Figure 3. Importance of various factors in choosing school travel mode.

3.3. Generalized Ordered Logit (GOL)

This study models the intention to use SAVs as a school travel mode in children's educational trips by applying the prominent approach of discrete choice models.

In this study, parents' intention to use SAVs was measured as an ordinal variable. The authors have encoded this variable into three levels, namely low = 1, moderate = 2, and high = 3, to better understand the influential factors of parents' usage intentions of SAVs.

Given the discrete and ordinal nature of the dependent variable, the authors first estimated an ordered logit model (OLM) [48,49]. The probability of parents' usage intention can be calculated as Equation (1):

$$P(y_i > j) = \frac{\exp(X_i\beta' - \phi_j)}{1 + \exp(X_i\beta' - \phi_j)} \quad j = 1, 2, \ldots, M - 1 \tag{1}$$

where j is the parents' intention category, X_i is a vector containing the observed explanatory variables, β represents the vector of parameters that need to be estimated, ϕ_j are the cut-off points that determine the thresholds in the OLM, and M signifies the number of categories within the ordered-response variables.

One of the assumptions associated with the OLM is proportional odds, implying equal relationships between each pair of intention categories [49]. However, this assumption often has been violated and highlights the necessity of GOL model estimation. Using the OLM was required prior to utilizing the GOL model so that the authors could determine if the parallel lines assumption (or the proportional odds assumption) was violated. To confirm whether a GOL model should be employed instead of an OLM, the Brant test was utilized to examine the parallel assumption [50]. Using the Brant test, it is possible to check whether all the estimated coefficients are the same across different levels of the ordered dependent variable. When the GOL model works appropriately, the variables that satisfy the proportional odds assumption will be interpreted in the same way as in the OLM. As an advantage of GOL model, it can also handle independent variables that vary in size and direction of their effects. Furthermore, it can help researchers avoid major mistakes related to statistical significance, which could lead them to incorrectly assume that an explanatory variable has minimal or no impact on the outcome variable. Moreover, it can sometimes tackle issues of reporting heterogeneity, where different groups respond to questions in different ways. This can prevent differences in measurement across groups from being misinterpreted as differences in effects [51].

If the data satisfy the proportional odds assumption, then the OLM is considered an appropriate method for data description; otherwise, the GOL model should be used. Therefore, the coefficients of independent variables vary across different cut points of the dependent variable. The probability of parents' intention for allowing their children to use SAVs is expressed as Equation (2) [52]:

$$P(y_i > j) = \frac{\exp(X_i\beta_j' - \phi_j)}{1 + \exp(X_i\beta_j' - \phi_j)} \quad j = 1, 2, \ldots, M-1 \tag{2}$$

where β_j' represents a set of parameters that are adjusted based on the specific threshold point of the model.

3.4. Questionnaire

A web-based questionnaire was designed in Google Forms to assess parents' intentions to use SAVs as a school travel mode for their children in the city of Kerman, Iran. Before the main survey administration, 45 parents were randomly selected to participate in a pilot study, which resulted in a more comprehensible and less ambiguous questionnaire, based on their comments and feedback.

The final survey link was distributed among parents through the administration of schools in their social media groups from 12 April to 13 May 2021. Since the one-month data collection process was during the pandemic period, all the classes were held online, and all the important notifications from school were reported to the parents in Telegram groups. As a further explanation, using clustered sampling, the survey was distributed in different districts of Kerman. To avoid duplicate responses, we asked parents to fill out the school name and student ID.

The questionnaire included three main sections: (1) the travel behavior of parents and their children; (2) psychological factors; and (3) the socioeconomic characteristics of parents and their children. All the questions in the survey were derived from the literature or were customized for our study. It is worth mentioning that the objective of the survey was clearly announced to the participants, and they were assured that their responses would be anonymous and confidential. In the first section, we asked about the travel-related characteristics of the respondents using questions that have been used in previous studies (each question is cited to the corresponding paper(s)) or that were customized for this research. The respondents were asked about their travel behavior (five questions) including their most frequent school travel mode [36], monthly frequency of using a private car [7], accident experience and the corresponding severity [32,34], and frequency of using a seat belt while traveling [53]. In the second section, since SAV technology is new to the city of Kerman, a video clip preceded before asking parents' intention to use SAVs as a school travel mode for their unaccompanied children trip to go to school using a five-point Likert scale ranging from (1) strongly disagree to (5) strongly agree [17,19]. The following is an elaboration of the video: *"A self-driving vehicle, also known as an autonomous vehicle (AV), has the capability to operate and perform essential tasks independently without the need for human intervention, thanks to its ability to perceive its environment. The vehicle is equipped with a fully automated driving system that enables it to react to external circumstances in the same way a human driver would. Users can no longer drive themselves in such a vehicle, as there* *are no steering wheels or pedals. In the future, because of the high purchase costs of AVs, their use is expected to be more widely shared. In other words, there is no ownership of the vehicle and it is rented to the user on a temporary basis or on a predetermined schedule at specific times. Students will share their travel plans with others, and other students with similar origins and destinations join them to share their trips".* Then, psychological factors, such as attitude toward technology (six questions), attitude toward driving (five question), perceived usefulness (six question), and safety benefits (five questions) of SAVs were asked. The corresponding references of each question are presented in Table 3. Finally, the third section asked about the socio-economic characteristics (twelve questions) of the parents, such as their age, number of children, education, occupation, household car and bike ownership level, household size, status of driving license, and income, as well as their children's characteristics (seven questions), such as gender and school grade. It should be noted that these factors were derived from the previous studies outlined in Table 1.

4. Estimation Results and Discussion

In Section 4.1, using a maximum likelihood estimator (MLE) and AMOS, the authors provide an analysis of the results obtained from a confirmatory factor analysis (CFA) to identify the significant items in the corresponding latent constructs as a prerequisite of using psychological factors in the GOL model. Following this, the estimation result of GOL as a discrete choice modeling approach (Section 4.2) is presented to determine the effect of each exogenous variable on parents' intentions to use SAVs as their children's school travel mode. In Section 4.3, a critical discussion of our findings is presented. Finally, a number of policy and practice recommendations are provided in Section 4.4 to increase the likelihood of using SAVs as a school travel mode.

4.1. Confirmatory Factor Analysis

To determine the relationships between latent constructs and indicators, the authors conducted a CFA using AMOS software version 24 [54]. Table 3 provides a summary of the CFA results, which include the factor loadings of items, averages, and other measures of model fit, as well as indices of validity and reliability. In order to assess the validity and reliability of the latent constructs, the authors considered the content, convergent, and discriminant validity measures. Since the items were derived from the literature, their content validity is supported. Convergent validity was examined through item reliability, average variance extracted (AVE), and composite construct reliability (CR). According to Hair et al. [55], values greater than 0.5 and 0.7 are required to demonstrate convergent validity for AVE and CR, respectively [56]. Ideally, a Cronbach's alpha (CA) value should be 0.8 or above; however, a value between 0.5 and 0.7 is considered acceptable. In addition to CA, McDonald's Omega (ω) was also calculated since, unlike CA, ω operates under fewer and more realistic assumptions [57]. The acceptable threshold of ω is similar to that of CA. Based on Table 3, it can be concluded that the all the aforementioned measures are greater than the acceptable thresholds. Hence, the convergent validity is also supported. According to Table 4, discriminant validity describes how constructs differ from each other. The square root of the AVEs, which is in bold font, is greater that the correlation coefficient in the corresponding rows and columns. This suggests that the test for discriminant validity is also confirmed [58].

To determine whether the hypothetical model is supported by the data, the authors used model identification indices, including chi-squares (X^2), normed chi-squares (*CMIN/df*), normed fit indexes (*NFI*), comparative fit indexes (*CFI*), and the root mean square error of approximation (*RMSEA*) as part of the model goodness-of-fit evaluation [17]. Based on the estimated values, it can be concluded that all the necessary criteria have been satisfied.

Table 3. The results of reliability and validity evaluation of the measurement model.

Construct	Item	Mean	Factor Loadings	CA (ω)	CR	AVE
Attitude toward technology	The disadvantages of technologies are more than their advantages [59].	3.04	0.958	0.880 (0.889)	0.865	0.572
	I am not open-minded toward new products [60].	3.21	0.749			
	I am excited about the possibilities offered by new technologies [61]	3.36	−0.848			
	If I heard about new technologies, I would look for ways to try it [59].	3.49	−0.626			
	Among my peers, I am usually the first to try out new technologies [59].	3.39	−0.522			
Attitude toward driving	I prefer not to be responsible for driving a car [62].	2.76	0.951	0.805 (0.823)	0.821	0.545
	In a car, I prefer being the driver rather than the passenger [62].	3.40	−0.742			
	I like driving a car [62].	3.17	−0.683			
	I prefer not to drive in a regular path [63].	2.89	0.509			
Perceived usefulness	SAVs will reduce traffic congestion [64].	3.74	0.798	0.905 (0.905)	0.906	0.616
	SAVs would enable me to save time [64].	3.66	0.807			
	SAVs will reduce emissions [64].	3.81	0.774			
	Using SAVs would increase my productivity [65].	3.99	0.785			
	SAVs will reduce parking spaces [63].	3.82	0.766			
	SAVs will enhance my well-being [63].	3.97	0.779			

$$\chi^2 = 1194.866\ (p < 0.001);\ \frac{CMIN}{df} = 3.112;\ GFI = 0.946;\ NFI = 0.958;\ CFI = 0.971;\ RMSEA = 0.038\ (CI90* : [0.036, 0.41])$$

* CI90 indicate the confidence interval at a 10% significance level.

Table 4. Correlation matrix and discriminant validity results.

	Construct	1	2	3
1	Attitude toward technology	0.756 *		
2	Attitude toward driving	−0.081	0.738	
3	Perceived usefulness	0.108	−0.063	0.784

* Bold numbers are the square root of AVE.

4.2. Estimation Results of GOL Model

Initially, an OLM was estimated to investigate how various explanatory variables affect parents' intentions to use SAVs as a school travel mode for their children. For the purpose of checking the parallel slope assumption, the Brant test was performed. The authors performed the Brant test on all coefficients, utilizing the estimated coefficients and their variances for the calculation. In addition, a test was conducted separately for each individual coefficient. According to the Brant test, the proportional odds hypothesis is rejected (χ^2 = 20.77, p-value = 0.049), suggesting that at least one variable rejects the hypothesis. The OLM was thus respecified using a GOL model, which allowed each outcome of the endogenous variable to have a unique coefficient (refer to Table 5). In order to assess the model's goodness of fit, pseudo-R^2 was used [66].

Based on the GOL estimation results, a series of attitudinal, travel-related, and socioeconomic characteristics significantly affect parents' intentions to use SAVs as a school travel mode for their unaccompanied children trips. The marginal effect values were also estimated, which allows for a more detailed interpretation of the results. Based on the marginal effect values, the critical factors are the interaction effect of the father's education level (MSc degree) and environmental concern, extremely strong belief in SAV safety for passengers, the capability of SAV in quick assistance during emergency situations (e.g., accidents), experiencing property damage crash as a pedestrian, the possibility of monitoring children online in the school path (particularly girls), and the interaction effect of parents' innovativeness and strong belief in the safe operation of SAVs, respectively. Meanwhile, in descending order, the interaction effect of education level (i.e., illiterate) and perceived usefulness, driver property damage crash experience, father's occupation (i.e., unemployed), the interaction effect of low income and importance of travel cost, fatal crash experience, and interaction effect of attitude toward driving and using a private car as a school travel mode significantly decrease the high intentions of using SAVs as a school travel mode among parents, respectively.

Table 5. Estimation results of GOL model of parents' intentions to use SAVs as a school travel mode.

Variable	Moderate		High		Marginal Effect		
	Coef.	P > |z|	Coef.	P > |z|	Low	Moderate	High
Experiencing property damage crash several times as a driver	−0.592	0.067	−0.521	0.020	0.043	0.066	−0.109
Experiencing fatal crashes more than two times	−0.670	0.014	−0.282	0.151	0.048	0.010	−0.059
Father's occupation: Unemployed	−0.654	0.086	−0.523	0.062	0.047	0.062	−0.109
Attitude toward technology × Strong belief in the safe operation of SAVs	0.034	0.142	0.024	0.081	−0.002	−0.003	0.005
Attitude toward driving × Use a private car as school travel mode	−0.155	0.053	−0.137	0.010	0.011	0.017	−0.029
$\frac{Illiterate\ Father}{\sqrt{Perceived\ Usefulness}}$	−0.576	0.280	−0.950	0.023	0.042	0.157	−0.198
Strongly perceive SAVs as enhanced emergent-assisted technology during accidents	−0.082	0.582	0.195	0.028	0.006	−0.047	0.041
Strong and very strong belief in SAV as a safe travel mode for passengers	0.373	0.009	0.406	0.000	−0.027	−0.058	0.085
Father with M.Sc. degree × Having high environmental concern	0.662	0.367	0.655	0.086	−0.048	−0.089	0.137
Having low income × High importance of cost in choosing school travel mode	−0.711	0.138	−0.422	0.102	0.051	0.037	−0.088
Girl student × High importance of online monitoring of student location	0.071	0.100	0.042	0.144	−0.005	−0.004	0.009
Constant	1.332	0.000	−1.581	0.000			
Model statistics							
Number of observations			1435				
Log-likelihood at convergence			−1078.663				
Restricted log-likelihood			−1162.22				
Pseudo R^2			0.0711				

4.3. Discussion

Marginal effects indicate that parents who have previously experienced property damage crash as drivers are less likely to allow their children to use SAVs. In the same way, experiencing fatal crashes two times among parents significantly decreases their high likelihood of allowing their children to be transported to and from school using SAVs. In other words, being such a parent reduces the likelihood of having a high intention of using SAVs by 5.9%. In accordance with previous studies [26], this may be due to the lower trust level of respondents to automation. The increase in innovativeness among parents who have a strong belief in the safe operation of SAVs is another factor that is positively correlated with the high intention of parents to use SAVs as their children's school transportation mode. This is due to the fact that pro-technology parents have higher knowledge and familiarity with technologies, which has been demonstrated in previous studies [32], too. Based on the marginal effect value, it can be seen that a one-unit increase in this systematic heterogeneity is associated with a 0.5% increase in the high intention of parents. This finding is also in accordance with previous studies.

As an indication of car dependency among parents, it can be seen that increasing the attitude toward driving among parents who use a private car as their children's school travel mode increases the likelihood of lower and moderate intentions rather than high ones. This is also aligned with the findings of Aboutorabi Kashani et al. [19]. Based on the marginal effects, an increase of one unit in this systematic heterogeneity reduces the probability of high intention by 2.9%, while it increases the likelihood of low and moderate usage intentions by 1.1% and 1.7%, respectively.

A decrease in the perception of the potential benefits of SAVs among fathers who are illiterate leads to lower and moderate intentions of letting their children travel with SAVs to school. This is due to the lower knowledge and income of these individuals, which is in accordance with the findings of Jing et al. [1] and Ma et al. [42]. However, the marginal effect value indicates that a one-unit increase in this interactive variable decreases the high intentions of parents to use SAVs as a service for their children by 19.8%.

A strong belief in the quick response of SAVs during accidents is positively related to high intentions of letting their children utilize SAVs as a school travel mode. This might be due to the facilitation conditions that are provided by SAVs, leading to a higher level of trust. According to the marginal effect value, a one-unit increase in this interactive variable increases high intentions by 4.1%. People who strongly believe that SAVs are a safe travel mode for passengers are less likely to have lower and moderate intentions, which is line with previous studies [1,42]. When this variable rises by a single unit, there are decreases in the likelihood of low and moderate intentions to use SAVs by 2.7% and 5.8%, respectively. However, the likelihood of high usage intention rises by 8.5%.

Fathers with M.Sc. degrees who are environmentally friendly are less likely to have lower and moderate intentions. This is due to the fact that SAVs are well aligned with sustainable development, and parents who are worried about the environment are more likely to use SAVs, as has been documented in prior research [19]. If this variable goes up by one unit, the likelihood of high usage intention sees a rise of 13.7% based on marginal effects. On the other hand, the probabilities of low and moderate usage intentions experience drops of 4.8% and 8.9%, respectively.

A lower likelihood of high usage intention was observed among the low-income parents who care about their children's travel cost to school, which is in accordance with the findings of Bansal et al. [67]. In other words, being such respondents increases low and moderate intentions by 5.1% and 3.7%, respectively. Parents with daughters who prefer to continuously monitoring their student's location are less likely to have lower and moderate intentions. Due to their fears of abuse, imaginary harassment, and social halo associated with their gender, women may be less likely to use shared mobility services [17]. Considering the marginal effect value, it should be noted that a one-unit increase in this systematic heterogeneity will increase high usage intentions by 0.9%.

4.4. Implications for Policy and Practice

Parent's intentions to use SAVs for their unaccompanied children trips are significantly affected by their accident experiences. The manufacturer should issue a statement explaining how AVs are designed to protect passengers in the following circumstances, in order to reduce parental concerns regarding the functional risk of SAVs. Additionally, manufacturers should support the research and development of automatic driving technologies in order to ensure the safety of SAVs in a variety of situations.

Parents' innovativeness is a psychological factor that positively influences their intentions to use SAVs as their children's school travel mode. As an implication, by inspiring a sense of innovation among individuals, policymakers may be able to encourage them to use SAVs as a school travel mode. A free trial can be offered to first-time users as a means to encourage them to try out the service. In this way, they will be more inclined to continue to use the service in the future.

Attitudes toward driving and car dependency among parents decrease the likelihood of letting their children use SAVs. It is recommended to establish travel demand management (TDM) policies to reduce the dependency on private cars of parents and encourage them to use more sustainable travel modes, reducing their dependence on private cars. In addition to increasing taxes and related costs associated with households' additional cars, congestion pricing, and parking management may also be implemented to encourage car users to use shared vehicles.

To encourage parents to use SAVs for the transportation of their children to and from school, it is critical to improve their overall evaluation of SAVs. A positive introduction to the usefulness, attributes, and performance of AVs could be made by SAV manufacturers and relevant government agencies. As a result, parents may be able to better appreciate the advantages of using SAVs for child transportation, such as an improvement in parents' time utilization value and an enhancement in the mobility of their children's travel. A public awareness campaign about the benefits of using SAVs for child transportation might have a positive effect on parents' attitudes and intentions toward using them.

It is critical to note that respondents' intention to use SAVs is significantly influenced by their belief that SAVs could provide emergency services during accidents. As an implication, it is recommended that SAVs are equipped with enhanced audio and video assistant systems that can quickly assist passengers in emergency situations. Also, it is recommended that parents are invited to try SAVs through simulators and to compare how SAVs and parents react in emergency situations. When parents perceive SAVs as quick and responsive technologies, they are more likely to allow their children to use them as a mode of transportation to and from school.

Having a high environmental concern among fathers with MSc degrees is positively correlated with their usage intentions. To encourage parents to consider SAVs as a means for their children's school commute, it is suggested that policymakers highlight the environmental advantages, such as the reduction of noise and air pollution.

The authors propose that by giving passengers the choice to select the desired number of children to share the journey with at different travel costs, service providers can potentially broaden the use of SAVs among individuals of various income levels. This approach could also contribute to more sustainable development. An additional critical factor in shaping parents' high usage intention is the possibility of tracking their children online. It is suggested that manufacturers consider equipping SAVs with cameras to monitor the interior. This would allow parents to use their mobile phones to ensure their children's safety while in the car. If an unusual situation arises, parents could use the camera feed to assess the situation and activate the car's alarm via their mobile phones, potentially attracting the attention of passersby or police officers.

5. Conclusions

5.1. Findings

The estimation results of the generalized ordered logit (GOL) model reveal the significant influence of several factors on parents' intentions to use shared autonomous vehicles (SAVs) for their unaccompanied children's trips to school, including accident experience, parent occupation, education level, income level, the children's gender, the possibility of monitoring the children online, the importance of cost and safety, perceiving SAVs as a quick responsive technology, attitude toward driving, perceived usefulness, and parents' innovativeness. Among the aforementioned factors, we found that individuals who have encountered any form of accident, are less educated, have a low income, are jobless, or are car-dependent are less likely to consider SAVs for their children's school commute. However, females, innovative individuals, environmental enthusiasts, and well-educated individuals, with the addition of the possibility of online student monitoring and ensuring the safe operation of SAVs, along with quick emergency responses, had higher intentions of using SAVs. Here is a list of some important findings:

- Experiencing property damage/fatal accidents decreases the parents' intentions to use SAVs;

- Fathers with no occupation/education are less likely to allow their children to use SAVs;
- Innovative parents who strongly believe in the safe operation of SAVs are more likely to use this technology for their children's school travel mode;
- Car-dependent parents have a lower intention of using SAVs for their children;
- Parents who find that SAVs are a beneficial technology are more likely to allow their children to use SAVs;
- Providing safety measures (e.g., online monitoring of student's location, and rapid assistance during emergency situations) by SAVs' service providers increases the usage intention of parents; and
- Being a pro-environmental parent increases the likelihood of using SAVs as a school travel mode.

In terms of the most influential factors in each intention level (low, moderate, and high), the variable of low-income parents concerned about their children's school travel costs has the greatest marginal effect value at the low intention level, indicating their lowest intentions of using SAVs. Furthermore, among the various factors that influence the moderate usage intentions of SAVs, the decrease in the perception of the potential benefits of SAVs among illiterate fathers has the greatest impact. However, fathers with an M.Sc. degree who are environmentally friendly have the highest intentions of letting their children use SAVs.

Taking a practical perspective, the research results provide us with additional insights into parents' intentions and provide manufacturers and government officials with valuable ideas for promoting the use of SAVs for school travel.

5.2. Limitations and Suggestions for Future Studies

This study contributes to the existing body of literature about the usage intentions of SAVs for school transportation by filling previous gaps. In addition to providing insight into some of the underlying issues, this study also raises some new questions that require further investigation.

Although the modeling framework of our research can be used as the basis of future studies in other contexts, the generalization of our findings to other contexts is limited. Therefore, it is recommended to conduct a comparative study with other cities to understand the effects of context on the impact of explanatory variables.

This study used psychological, sociodemographic, and travel-related variables to examine factors associated with the intentions to use SAVs for school trips. However, the model could not take into account certain travel-related attributes found in stated preference surveys, such as travel time, waiting time, and travel cost. It is, therefore, recommended that future research examines the impact of these variables on parent's usage intention of SAVs.

Due to the fact that the authors provided a description of SAVs, there is some uncertainty regarding how they affected the respondents' judgments in this study. The respondents' subjective judgments about SAVs may have been influenced to some extent by the description of SAV concepts, even though it may have provided an overview of the research topic and made them more familiar with it. Other methods can be used to help respondents better understand SAVs, such as using simulators to experience autonomous vehicles.

Finally, since SAVs are not still available in Iran's market, this research employed a stated preference (SP) survey. Since the SP approach is based on a hypothetical situation, it is recommended to explore the revealed preferences of respondents in the future when SAVs are available on the market to better understand the determinants behind the acceptance of SAVs.

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References

1. Jing, P.; Du, L.; Chen, Y.; Shi, Y.; Zhan, F.; Xie, J. Factors that influence parents' intentions of using autonomous vehicles to transport children to and from school. *Accid. Anal. Prev.* **2021**, *152*, 105991. [CrossRef] [PubMed]
2. Wang, S.; Wang, J.; Li, J.; Wang, J.; Liang, L. Policy implications for promoting the adoption of electric vehicles: Do consumer's knowledge, perceived risk and financial incentive policy matter? *Transp. Res. Part A Policy Pract.* **2018**, *117*, 58–69. [CrossRef]
3. Mehdizadeh, M.; Fallah Zavareh, M.; Nordfjaern, T. School travel mode use: Direct and indirect effects through parental attitudes and transport priorities. *Transp. A Transp. Sci.* **2019**, *15*, 749–775. [CrossRef]
4. Mehdizadeh, M.; Nordfjaern, T.; Mamdoohi, A. Environmental norms and sustainable transport mode choice on children's school travels: The norm-activation theory. *Int. J. Sustain. Transp.* **2020**, *14*, 137–149. [CrossRef]
5. Ho, S.S.; Tan, W. Mapping mental models of parents' risk perceptions of autonomous public transport use by young children: A social representations theory approach. *J. Risk Res.* **2023**, *26*, 989–1005. [CrossRef]
6. He, S.Y. Will you escort your child to school? The effect of spatial and temporal constraints of parental employment. *Appl. Geogr.* **2013**, *42*, 116–123. [CrossRef]
7. Mao, Y.; Mei, Q.; Jing, P.; Zha, Y.; Xue, Y.; Huang, J.; Shao, D.; Luo, P. Factors Affecting the Parental Intention of Using AVs to Escort Children: An Integrated SEM–Hybrid Choice Model Approach. *Sustainability* **2022**, *14*, 11640.
8. McMillan, T.E. The relative influence of urban form on a child's travel mode to school. *Transp. Res. Part A Policy Pract.* **2007**, *41*, 69–79. [CrossRef]
9. Koppel, S.; McDonald, H.; Peiris, S.; Zou, X.; Logan, D.B. Parents’ Willingness to Allow Their Unaccompanied Children to Use Emerging and Future Travel Modes. *Sustainability* **2022**, *14*, 1585.
10. Webb, J.; Wilson, C.; Kularatne, T. Will people accept shared autonomous electric vehicles? A survey before and after receipt of the costs and benefits. *Econ. Anal. Policy* **2019**, *61*, 118–135. [CrossRef]
11. Jing, P.; Xu, G.; Chen, Y.; Shi, Y.; Zhan, F. The determinants behind the acceptance of autonomous vehicles: A systematic review. *Sustainability* **2020**, *12*, 1719. [CrossRef]
12. Anderson, J.M.; Nidhi, K.; Stanley, K.D.; Sorensen, P.; Samaras, C.; Oluwatola, O.A. *Autonomous Vehicle Technology: A Guide for Policymakers*; Rand Corporation: Santa Monica, CA, USA, 2014.
13. Pudāne, B.; Rataj, M.; Molin, E.J.; Mouter, N.; van Cranenburgh, S.; Chorus, C.G. How will automated vehicles shape users' daily activities? Insights from focus groups with commuters in the Netherlands. *Transp. Res. Part D Transp. Environ.* **2019**, *71*, 222–235. [CrossRef]
14. Fagnant, D.J.; Kockelman, K. Preparing a nation for autonomous vehicles: Opportunities, barriers and policy recommendations. *Transp. Res. Part A Policy Pract.* **2015**, *77*, 167–181. [CrossRef]
15. Paddeu, D.; Tsouros, I.; Parkhurst, G.; Polydoropoulou, A.; Shergold, I. A study of users' preferences after a brief exposure in a Shared Autonomous Vehicle (SAV). *Transp. Res. Procedia* **2021**, *52*, 533–540. [CrossRef]
16. Farzin, I.; Mamdoohi, A.R.; Abbasi, M.; Baghestani, A.; Ciari, F. Determinants behind the acceptance of autonomous vehicles in mandatory and optional trips. In Proceedings of the Institution of Civil Engineers—Engineering Sustainability; Emerald Publishing Limited: Bingley, UK, 2023; pp. 1–10. [CrossRef]

17. Abbasi, M.; Mamdoohi, A.R.; Sierpiński, G.; Ciari, F. Usage Intention of Shared Autonomous Vehicles with Dynamic Ride Sharing on Long-Distance Trips. *Sustainability* **2023**, *15*, 1649. [CrossRef]
18. Golbabaei, F.; Yigitcanlar, T.; Paz, A.; Bunker, J. Understanding Autonomous Shuttle Adoption Intention: Predictive Power of Pre-Trial Perceptions and Attitudes. *Sensors* **2022**, *22*, 9193. [CrossRef]
19. Aboutorabi Kashani, M.; Abbasi, M.; Mamdoohi, A.R.; Sierpiński, G. The Role of Attitude, Travel-Related, and Socioeconomic Characteristics in Modal Shift to Shared Autonomous Vehicles with Ride Sharing. *World Electr. Veh. J.* **2023**, *14*, 23. [CrossRef]
20. Meyer, J.; Becker, H.; Bösch, P.M.; Axhausen, K.W. Autonomous vehicles: The next jump in accessibilities? *Res. Transp. Econ.* **2017**, *62*, 80–91. [CrossRef]
21. Adnan, N.; Nordin, S.M.; bin Bahruddin, M.A.; Ali, M. How trust can drive forward the user acceptance to the technology? In-vehicle technology for autonomous vehicle. *Transp. Res. Part A Policy Pract.* **2018**, *118*, 819–836. [CrossRef]
22. Li, M.; Holthausen, B.E.; Stuck, R.E.; Walker, B.N. No risk no trust: Investigating perceived risk in highly automated driving. In Proceedings of the 11th international conference on automotive user interfaces and interactive vehicular applications, Utrecht, The Netherlands, 21–25 September 2019; pp. 177–185.
23. Menon, N.; Pinjari, A.; Zhang, Y.; Zou, L. *Consumer Perception and Intended Adoption of Autonomous-Vehicle Technology: Findings from A University Population Survey*; TRID: Ludwigsfelde, Germany, 2016.
24. Nees, M.A. Acceptance of self-driving cars: An examination of idealized versus realistic portrayals with a self-driving car acceptance scale. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting, Washington, DC, USA, 19–23 September 2016; pp. 1449–1453.
25. Ayoub, J.; Mason, B.; Morse, K.; Kirchner, A.; Tumanyan, N.; Zhou, F. Otto: An autonomous school bus system for parents and children. In Proceedings of the Extended Abstracts of the 2020 Chi Conference on Human Factors in Computing Systems, Honolulu, HI, USA, 25–30 April 2020; pp. 1–7.
26. Kyriakidis, M.; Happee, R.; de Winter, J.C. Public opinion on automated driving: Results of an international questionnaire among 5000 respondents. *Transp. Res. Part F Traffic Psychol. Behav.* **2015**, *32*, 127–140. [CrossRef]
27. Farzin, I.; Abbasi, M.; Macioszek, E.; Mamdoohi, A.R.; Ciari, F. Moving toward a More Sustainable Autonomous Mobility, Case of Heterogeneity in Preferences. *Sustainability* **2023**, *15*, 460. [CrossRef]
28. Acheampong, R.A.; Cugurullo, F.; Gueriau, M.; Dusparic, I. Can autonomous vehicles enable sustainable mobility in future cities? Insights and policy challenges from user preferences over different urban transport options. *Cities* **2021**, *112*, 103134. [CrossRef]
29. Nordhoff, S.; De Winter, J.; Kyriakidis, M.; Van Arem, B.; Happee, R. Acceptance of driverless vehicles: Results from a large cross-national questionnaire study. *J. Adv. Transp.* **2018**, *2018*, 5382192. [CrossRef]
30. Nordhoff, S.; Kyriakidis, M.; Van Arem, B.; Happee, R. A multi-level model on automated vehicle acceptance (MAVA): A review-based study. *Theor. Issues Ergon. Sci.* **2019**, *20*, 682–710. [CrossRef]
31. Koppel, S.; Lee, Y.-C.; Mirman, J.H.; Peiris, S.; Tremoulet, P. Key factors associated with Australian parents' willingness to use an automated vehicle to transport their unaccompanied children. *Transp. Res. Part F Traffic Psychol. Behav.* **2021**, *78*, 137–152. [CrossRef]
32. Lee, Y.-C.; Hand, S.H.; Lilly, H. Are parents ready to use autonomous vehicles to transport children? Concerns and safety features. *J. Saf. Res.* **2020**, *72*, 287–297. [CrossRef]
33. Ayala, A.; Hickerson, K.; Lettie, H.; Lee, Y.-C. The impact of peer influence on parent willingness to transport children in autonomous vehicles. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting, Atlanta, GA, USA, 10–14 October 2022; pp. 692–696.
34. Lee, Y.-C.; Mirman, J.H. Parents' perspectives on using autonomous vehicles to enhance children's mobility. *Transp. Res. Part C Emerg. Technol.* **2018**, *96*, 415–431. [CrossRef]
35. Hand, S.; Lee, Y.-C. Who would put their child alone in an autonomous vehicle? Preliminary look at gender differences. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting, Philadelphia, PA, USA, 1–5 October 2018; pp. 256–259.
36. Anania, E.C.; Rice, S.; Winter, S.R.; Milner, M.N.; Walters, N.W.; Pierce, M. Why People Are Not Willing to Let Their Children Ride in Driverless School Buses: A Gender and Nationality Comparison. *Soc. Sci.* **2018**, *7*, 34. [CrossRef]
37. Roehrich, G. Consumer innovativeness: Concepts and measurements. *J. Bus. Res.* **2004**, *57*, 671–677. [CrossRef]
38. Venkatesh, V.; Morris, M.G.; Davis, G.B.; Davis, F.D. User acceptance of information technology: Toward a unified view. *MIS Q.* **2003**, *27*, 425–478. [CrossRef]
39. Yuen, K.F.; Choo, L.Q.; Li, X.; Wong, Y.D.; Ma, F.; Wang, X. A theoretical investigation of user acceptance of autonomous public transport. *Transportation* **2022**, *50*, 545–569. [CrossRef]
40. Smyth, J.; Chen, H.; Donzella, V.; Woodman, R. Public acceptance of driver state monitoring for automated vehicles: Applying the UTAUT framework. *Transp. Res. Part F Traffic Psychol. Behav.* **2021**, *83*, 179–191. [CrossRef]
41. Zhang, T.; Tao, D.; Qu, X.; Zhang, X.; Zeng, J.; Zhu, H.; Zhu, H. Automated vehicle acceptance in China: Social influence and initial trust are key determinants. *Transp. Res. Part C Emerg. Technol.* **2020**, *112*, 220–233. [CrossRef]
42. Ma, Y.; Li, S.; Qin, S.; Qi, Y. Factors affecting trust in the autonomous vehicle: A survey of primary school students and parent perceptions. In Proceedings of the 2020 IEEE 19th International Conference on Trust, Security and Privacy in Computing and Communications (TrustCom), Guangzhou, China, 29 December 2020; pp. 2020–2027.

43. Tremoulet, P.D.; Seacrist, T.; Ward McIntosh, C.; Loeb, H.; DiPietro, A.; Tushak, S. Transporting children in autonomous vehicles: An exploratory study. *Hum. Factors* **2020**, *62*, 278–287. [CrossRef]
44. Dowling, G.R.; Staelin, R. A model of perceived risk and intended risk-handling activity. *J. Consum. Res.* **1994**, *21*, 119–134. [CrossRef]
45. Zhang, P.; Guan, Z.; Sun, J. Performance Evaluation of New Energy Vehicles with Human-Machine Interaction in Intelligent Transportation Systems. *Strateg. Plan. Energy Environ.* **2021**, *40*, 331–362. [CrossRef]
46. Davis, F.D. User acceptance of information systems: The technology acceptance model (TAM). *Int. J. Man-Mach. Stud.* **1993**, *38*, 475–487. [CrossRef]
47. Mirshekar, A.; Madjdzadeh, S.M.; Khayrandish, M. Spider wasps (Hymenoptera, Pompilidae) from the Southeastern Iran, Kerman. *J. Insect Biodivers. Syst.* **2020**, *6*, 9–19. [CrossRef]
48. Greene, W.H.; Hensher, D.A. *Modeling Ordered Choices: A Primer*; Cambridge University Press: Cambridge, UK, 2010.
49. Washington, S.; Karlaftis, M.G.; Mannering, F.; Anastasopoulos, P. *Statistical and Econometric Methods for Transportation Data Analysis*; CRC press: Boca Raton, FA, USA, 2020.
50. Brant, R. Assessing proportionality in the proportional odds model for ordinal logistic regression. *Biometrics* **1990**, *46*, 1171–1178. [CrossRef]
51. Williams, R. Understanding and interpreting generalized ordered logit models. *J. Math. Sociol.* **2016**, *40*, 7–20. [CrossRef]
52. Long, J.S. *Regression Models for Categorical and Limited Dependent Variables*; Advanced Quantitative Techniques in the Social Sciences; SAGE: Thousand Oaks, CA, USA, 1997; Volume 7, p. 219.
53. Beck, L.F.; Nguyen, D.D. School transportation mode, by distance between home and school, United States, ConsumerStyles 2012. *J. Saf. Res.* **2017**, *62*, 245–251. [CrossRef] [PubMed]
54. AArbuckle, J.L. *Amos*, version 23.0; [computer program]; IBM SpSS: Chicago, IL, USA, 2014.
55. Hair, J.F.; Page, M.; Brunsveld, N. *Essentials of Business Research Methods*; Routledge: London, UK, 2019.
56. Hair, J.F.; Ringle, C.M.; Sarstedt, M. PLS-SEM: Indeed a silver bullet. *J. Mark. Theory Pract.* **2011**, *19*, 139–152. [CrossRef]
57. McKay, M.T.; Perry, J.L.; Cole, J.C.; Magee, J. Adolescents consider the future differently depending on the domain in question: Results of an exploratory study in the United Kingdom. *Personal. Individ. Differ.* **2017**, *104*, 448–452. [CrossRef]
58. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **1981**, *18*, 39–50. [CrossRef]
59. Keszey, T. Behavioural intention to use autonomous vehicles: Systematic review and empirical extension. *Transp. Res. Part C Emerg. Technol.* **2020**, *119*, 102732. [CrossRef]
60. Leicht, T.; Chtourou, A.; Youssef, K.B. Consumer innovativeness and intentioned autonomous car adoption. *J. High Technol. Manag. Res.* **2018**, *29*, 1–11. [CrossRef]
61. Chen, J.; Li, R.; Gan, M.; Fu, Z.; Yuan, F. Public acceptance of driverless buses in China: An empirical analysis based on an extended UTAUT model. *Discret. Dyn. Nat. Soc.* **2020**, *2020*, 4318182. [CrossRef]
62. Garidis, K.; Ulbricht, L.; Rossmann, A.; Schmäh, M. Toward a user acceptance model of autonomous driving. In Proceedings of the 53rd Hawaii International Conference on System Sciences, Wailea-Makena, HI, USA, 7–10 January 2020; pp. 1381–1390.
63. Mason, J.; Classen, S.; Wersal, J.; Sisiopiku, V.P. Establishing face and content validity of a survey to assess users' perceptions of automated vehicles. *Transp. Res. Rec.* **2020**, *2674*, 538–547. [CrossRef]
64. Liu, H.; Yang, R.; Wang, L.; Liu, P. Evaluating initial public acceptance of highly and fully autonomous vehicles. *Int. J. Hum.–Comput. Interact.* **2019**, *35*, 919–931. [CrossRef]
65. Acheampong, R.A.; Cugurullo, F. Capturing the behavioural determinants behind the adoption of autonomous vehicles: Conceptual frameworks and measurement models to predict public transport, sharing and ownership trends of self-driving cars. *Transp. Res. Part F Traffic Psychol. Behav.* **2019**, *62*, 349–375. [CrossRef]
66. McKelvey, R.D.; Zavoina, W. A statistical model for the analysis of ordinal level dependent variables. *J. Math. Sociol.* **1975**, *4*, 103–120. [CrossRef]
67. Bansal, P.; Kockelman, K.M.; Singh, A. Assessing public opinions of and interest in new vehicle technologies: An Austin perspective. *Transp. Res. Part C Emerg. Technol.* **2016**, *67*, 1–14. [CrossRef]