Factors affecting trust in the autonomous vehicle: A survey of primary school students and parent perceptions

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***Abstract*—With the rapid development of autonomous driving technology, autonomous vehicles are expected to perform all driving functions under certain conditions. In fact, some people have even proposed the concept of autonomous school buses. Accordingly, autonomous vehicles exhibit the great potential to become not only the primary alternative to human-driven vehicles during a child's journey to school, but also the vehicles used by today's children as they enter adulthood. However, the acceptance of such vehicles depends on both the children and their parents' trust in this new technology. Hence, this study explores the relationships among perceived usefulness, defects, and risks as well as negative emotions and degree of trust in autonomous vehicles. Based on an online survey of 131 primary school students and 133 parents, the current study concludes that the perceived benefits, perceived risks, and emotional responses influence people's trust in this new technology. Moreover, the results of a regression analysis find two critical factors that influence trust in autonomous vehicles, namely, perceived risk of traffic safety and perceived defects in the vehicle. Additionally, while perceived usefulness is an exclusive predictor of adults' trust, negative emotions only significantly predict the trust of children in the vehicle. For trust in autonomous vehicles, these primary school students share similar perceptions with those of their parents. To our knowledge, the present study is the first to compare people's trust in autonomous vehicles between primary school students and their parents. These findings may inspire the design and promotion of autonomous vehicles for school journeys, thus resulting in increasingly more families trusting and accepting this new technology.**

Keywords—autonomous vehicle, trust, perceived risk, perceived usefulness, emotion

I. INTRODUCTION

Autonomous vehicles have drawn the attention of both technology companies and researchers from various areas. Researchers define autonomous vehicles as vehicles that possess the ability to perform all driving functions under certain conditions [1]. Accordingly, some researchers refer to them as self-driving vehicles [2]. This technology promises to improve comfort and efficiency and to free people from the responsibility of operating and driving the vehicle. In China, the automobile industry is shifting gradually from Advance Driver-Assisted Systems (ADAS) technology to autonomous driving technology.

Trust in a new technology creates a willingness to use it [3]. Therefore, promoting appropriate levels of trust in automation is always one of the main issues with respect to human-automation interaction [4, 5]. In this context, previous research has explored many psychological factors that influence people's level of trust in new technology. For example, a recent meta-analysis of factors influencing trust in automation suggests that both people's traits (e.g., age, gender, etc.) and attitudes towards automation affect trust in the human-automation interaction [6]. However, as this is only a theoretical model, there are still questions that must be addressed, especially with respect to trust in new technologies such as autonomous vehicles.

Although people accept the automatic train operation of rail transit, recent studies have found that parents express concerns regarding the use of autonomous vehicles to transport their children, including such factors as route control, assurance, child safety, and comfort [7]. Previous studies have

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indicated that only 11 to 13% of participants feel comfortable using empty, i.e., driverless, autonomous vehicles to transport their children [8, 9]. In a 2019 survey, 21% of parents surveyed said they would agree to allow their children to travel alone in autonomous vehicles, but they thought the minimum age for riding alone was 16-year-old [10]. While these autonomous vehicle experiencers like the convenience of the new technology, they are concerned about the possible safety risks. However, these findings are limited to parent perceptions.

To the best of our knowledge, few studies have explored the children's perceptions of autonomous vehicles. Thus, the current research has selected not only adults but also primary school students as the participants and explored the relationship between people's perceptions and emotions towards autonomous vehicles and their trust in autonomous vehicles according to different age groups. First, the current study is the first to focus on primary school students with respect to this issue. Although previous studies have explored the influence of age on attitudes towards autonomous vehicles, they focus primarily on adults and teenagers. We expanded the study to include children as they are the potential users of autonomous school buses, and thus, they differ from adults and teenagers not only with respect to age and driving experiences but also, perhaps, with respect to their opinions regarding the issue of autonomous school buses. Under the background of the rapid development of autonomous vehicles, it is necessary to distinguish between the perceptions of potential users based on the different age groups. Second, we synthesized and refined the factors affecting the attitudes towards autonomous vehicles and concluded that the following factors affecting trust in automation would be included in the current study: perceived benefits and concerns, risk perception, and emotion. Finally, our findings provide a reference for the future implementation of autonomous vehicles, and thus, to improve the trust levels of the various age groups of users towards autonomous vehicles, we discuss the design principle and ways to promote autonomous vehicles based on our findings.

The paper is organized as follows. In Section II, we present the literature review and develop the hypotheses. In Sections III and IV, we describe the methods and results of the current study. In Section V, we discuss our current findings with those of previous studies, and finally, in Section VI, we provide the conclusions and implications of the present research.

II. Background and Related Work

On the one hand, increasingly more children are being driven to school by their parents or by buses due to the increasing distances between homes and schools in the last decades [11, 12]. In China, the parents of primary school students prefer to drive their children to school in private cars to provide time for studying or sleeping on the road. However, doing so costs the parents too much time. On the other hand, the autonomous driving technique is developing rapidly with autonomous taxis [13] and autonomous buses [14] quickly becoming a part of the reality, while the numbers and age ranges of target users of autonomous vehicles are both increasing. Teague, a design studio in Seattle, proposed the concept of autonomous school buses, indicating that using autonomous vehicles to transport children will be perceived as a symbol of trust in autonomous vehicles [15].

Hence, the autonomous vehicle has great potential to become the primary choice for school transportation in the future. However, as passengers, children have been absent in the majority of the previous relevant research, and as a result, the previous suggestions about autonomous vehicles have been based primarily on the demands of adult users. Thus, to provide valuable advice on future autonomous vehicles, the present study explores both children and their parents' attitudes towards autonomous vehicles, including their perceptions, emotions, and trust in the new technology.

Although previous studies have discussed age differences in attitudes towards new technology, there is no consensus among the studies. For example, while some previous studies have suggested that older adults are more likely to trust the automation than are younger adults [16-18], other studies have indicated that middle-aged and older adults express more concerns about autonomous vehicles than do younger adults [19]. These previous studies [16-19], however, have primarily explored the effect of age based on adults and teenagers. Until now, there have been no studies that have compared the perceptions of school-aged children with those of adults. Accordingly, by analyzing the factors affecting trust in autonomous vehicles, the current study explores whether school-age children and their parents share similar perceptions of trust in autonomous vehicles.

Researchers in the field of human-automation interaction have proposed theoretical models to illustrate the related factors affecting trust. For example, the Technology Acceptance Model (TAM), which was first proposed by Davis in 1989 [20], is one of the most widely used models to illustrate and predict technology adoption. The TAM suggests that perceived usefulness and perceived ease of use determine the intention to adopt a technology [21] with perceived usefulness, which refers to the benefits realized by using the technologies [22], being the more important of the two. For example, people expect autonomous vehicles will result in shorter traveling time because they do not have to search for a parking spot and a reduction of 30% in business district traffic [23]. Hence, the perceived usefulness of autonomous vehicles includes saving time. Perceived ease of use is also a factor as the new technology requires less effort on the part of the user [22]. Nonetheless, when people decide to accept and use new technology, there are always certain associated learning costs which may adjust their perceptions of benefits [24]. In this sense, perceived ease of use can be regarded as an antecedent to perceived usefulness.

Although 90% of all traffic accidents are caused by human error [25-27], recent studies indicate that most people believe that human-driven vehicles are safer than autonomous vehicles [28, 29]. Therefore, understanding the influencing factors affecting people's trust in autonomous vehicles is essential for promoting the new technology. To this end, researchers have noted that trust in new technology is the trade-off between risks and benefits.

On the one hand, as trust in a new technology depends on people's expectations of the effectiveness or usefulness of the technology [20, 30], the perceived usefulness and perceived defects of autonomous vehicles may affect people's trust in the new technology **(H1 & H2)**. Although previous studies have focused on the perceived usefulness of the technology, studies must also realize the perceived defects are critical when making trust judgments.

Hypothesis 1. Perceived usefulness has a positive effect on the participant's trust in autonomous vehicles.

Hypothesis 2. Perceived defects have a negative effect on the participant's trust.

On the other hand, trust is also affected by the risk perception of new technology. Considering users' concerns about physical safety and information safety, [24] proposes that perceived safety risk and perceived privacy risk are the two types of risk affecting the adoption of autonomous vehicles. [31] proposes that perceived risk negatively influences general acceptance associated with autonomous vehicles. However, while the measurement of perceived risk includes the perceived risk of traffic safety and privacy safety in [31], it does not distinguish the two concepts. Given that fine-grained data of the surrounding environments are collected in real-time with multiple stakeholders, the users of autonomous vehicles would question the respect of privacy. Accordingly, considering the differences between physical safety and privacy safety, current research measures the two factors separately and hypothesizes that perceived risk of traffic safety and privacy safety negatively affect people's trust in autonomous vehicles **(H3 & H4)**.

Hypothesis 3. Perceived risk of traffic safety has a negative effect on the participant's trust.

Hypothesis 4. Perceived risk of privacy safety has a negative effect on the participant's trust.

Moreover, emotional experiences are important factors that affect judgment and evaluation. For example, the positive and negative emotions evoked by a technology impact people's acceptance of and willingness to use a particular technological device [32-34], and as previously stated, previous research has concluded that trust has a positive influence on technology acceptance and on the willingness to use it [34]. As a result, we suggest that emotional experiences and responses towards a specific technological tool affect people's intent to trust the device. Thus, to the extent that people feel joy or anxiety may well influence their trust in autonomous vehicles **(H5)**.

Hypothesis 5. The negative emotions have a negative effect on the participant's trust.

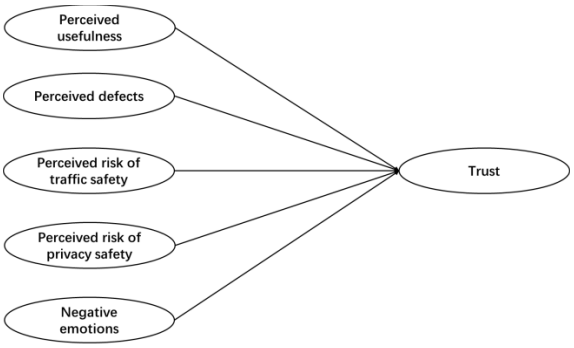

Fig. 1. Hypothesis model of trust in autonomous vehicles.

In sum, additional research regarding the development of autonomous vehicles is necessary, especially with respect to the demands of children for long-distance travel. As potential users of future autonomous vehicles, it is essential that children's attitudes towards autonomous vehicles be included in the research, as it has not been part of any previous studies. Based on the findings of previous research, however, we selected perceived usefulness, perceived defects, perceived risk of traffic safety, perceived risk of privacy safety, and negative emotions as predictors of trust in autonomous vehicles and explored the relationships between each of the five factors and trust as expressed by both adults and children. Additionally, the current study, which is the first to explore children's attitudes towards autonomous vehicles, may give us the inspiration to investigate the differences in attitudes between diverse groups of potential users of the new technology. Furthermore, to promote people's trust in autonomous vehicles and enhance their willingness to use them, we could propose guidelines based on children's attitudes regarding future autonomous vehicles.

The hypothesis model was illustrated in Figure 1.

III. Methods

A. Participants

The experimental data were collected via an online questionnaire platform. The participants included primary school students in grades 1 to 6 and their parents. The recruited participants were asked to complete the online questionnaire independently. The website addresses for the child version and adult version of the questionnaire were sent at different times. Two students did not complete the full questionnaire and were excluded from subsequent analysis. We totally received 264 valid answers, 133 were from parents, and 131 were from their children as school-aged students. Among the adults, 66 were male (49.6%), and 67 were female (50.4%). The mean age was 34.21, and the standard deviation was 1.801. Among the children, 71 were male (54.2%), and 60 were female (45.8%). The mean age was 8.91, and the standard deviation was 1.931.

B. Procedure

All subjects participated in the online survey voluntarily, and permission for the participation of children was obtained from the guardians in advance. At the outset of the online questionnaire, we presented a dynamic graph displaying the operation of an autonomous vehicle on the road (Figure 2) so the participants could have a better understanding of the autonomous vehicle. The participants were then asked to complete a subsequent online questionnaire.

Fig. 2. A screenshot of the dynamic graph displayed the operation of an autonomous vehicle on the road (retrieved from https://www.sohu.com/a/235039179_260956)

C. Measures

The online questionnaire assessed six aspects using a 5-point Likert scale. The six factors included perceived usefulness, perceived defects, perceived risk of traffic safety, perceived risk of privacy safety, negative emotions, and trust in autonomous vehicles. The full version of the questionnaire

can be found online at https://github.com/Mr-Unknown0/articles.

To ensure that the school-aged children could understand the items, we modified the expressions in the children's version of the questionnaire under the premise that the original meaning was being maintained. Furthermore, the modified children's version was then evaluated by the primary school teachers of these children to guarantee validity and reliability. We also calculated the internal consistency reliability (Cronbach's alpha) of every subscale (Table 1) to reflect whether the questionnaire was reliable.

1) Perceived usefulness. Perceived usefulness of autonomous vehicles is critical to the intention to use, and great benefits will positively influence willingness to use. As a result, we selected four items modified from [34] to measure this variable, such as reducing traffic jams, air pollution, and transport cost. The scores were ranging from 4-20, with higher scores indicating higher levels of perceived usefulness. The Cronbach's alpha of the adult version was 0.825, and the Cronbach's alpha of the child version was 0.854. Both of them indicated that reliability was acceptable.

2) Perceived defects. Besides the benefits, there may be defects in the performance of autonomous vehicles. We used two items which were self-designed to measure the perceived defects (e.g., "it is difficult to recover the breakdown of an autonomous vehicle"), and the reliability was acceptable (0.766 in the adult version, 0.763 in the child version). The scores were ranging from 2-10, with higher scores indicating higher levels of perceived defects.

3) Perceived risk of traffic safety. Road safety is the fundamental requirement of driving, especially in autonomous vehicles, people have to entrust their safety to the system. In the present research, the perceived risk of traffic safety was measured by four items selected from previous studies on autonomous vehicles and ADAS [19, 34, 35]. For example, autonomous vehicles can reduce traffic crashes. The scores were ranging from 4-20, with higher scores indicating lower levels of the perceived risk of traffic safety. The Cronbach's alpha was 0.825 in the adult version and 0.850 in the child version.

4) Perceived risk of privacy safety. Privacy safety is becoming more and more important, especially in new techniques like autonomous vehicles. We selected two items from [34] to measure the perceived risk of privacy safety of participants (e.g., "I am concerned that the computer systems of autonomous vehicles can be hacked"). The Cronbach's alpha was 0.688 in the adult version. However, considering the limited understanding ability of children, only 1 item was used to measure the perceived risk of privacy safety in the child version (e.g., "I am concerned about autonomous vehicle travelers' privacy disclosure"). The scores were ranging from 2-10, with higher scores indicating higher levels of the perceived risk of privacy safety.

5) Negative emotions. This subscale includes four items. Three of them were selected from [34], including frightened, worried, and anxious. We added one reverse coded item (e.g., "I will be delighted if I ride in an autonomous vehicle"), which is self-designed to escape the acquiescence bias and screen out careless participants. The Cronbach's alpha was 0.793 in the adult version and 0.861 in the child version. The scores were ranging from 4-20, with higher scores indicating higher levels of negative emotions.

6) Trust. We used three items modified from [36] to measure this variable (e.g., "the autonomous vehicle is dependable/reliable"). The same items were used in the research of [24, 34, 37, 38] as well. In our research, the Cronbach's alpha of this subscale was 0.787 in the adult version and 0.780 in the child version. The scores were ranging from 3-15, with higher scores indicating higher levels of trust.

Table 1. Summary of measures

Variables	Cronbach's alpha (adult version)	Cronbach's alpha (child version)	Sources
Perceived usefulness	0.825	0.854	Modified from Liu et al. (2019), Zhang et al. (2019)
Perceived defects	0.766	0.763	Self-designed
Perceived risk of traffic safety	0.825	0.850	Charness et al., 2018, Liu et al., 2019, and Hannan et al., 2018
Perceived risk of privacy safety	0.688	——*	Liu et al., 2019
Negative emotions	0.793	0.861	Liu et al., 2019
Trust	0.787	0.780	Modified from Choi & Ji (2015). Liu et al. (2019), Xu et al. (2018), Zhang et al. (2019), and Zoellick et al. (2019) used these items in their research

*Note: Considering the children's comprehension ability, we selected only 1 item to measure the perceived risk of privacy safety in the child version of the questionnaire.

Table 2. Correlation matrix of the variables in adults

	1	2	3	4	5
1.Perceived usefulness	—				
2.Perceived defects	0.707**	—			
3.Perceived risk of traffic safety	0.818**	0.718**	—		
4.Perceived risk of privacy safety	-0.756**	-0.647**	-0.714**	—	
5.Negative emotions	-0.841**	-0.744**	-0.843**	0.766**	—
6.Trust	0.756**	0.748**	0.799**	-0.659**	-0.756**

Table 3. Correlation matrix of the variables in children

	1	2	3	4	5
1.Perceived usefulness	—				
2.Perceived defects	0.817**	—			
3.Perceived risk of traffic safety	0.855**	0.800**	—		
4.Perceived risk of privacy safety	0.762**	0.688**	0.716**	—	
5.Negative emotions	-0.848**	-0.800**	-0.836**	-0.748**	—
6.Trust	0.819**	0.797**	0.834**	0.742**	-0.868**

IV. Results

A. Analysis of Variance (ANOVA)

A two-way between-subjects ANOVA was conducted to compare the effects of different age groups (adults and children) and gender on the trust towards autonomous vehicles. The results showed that the main effect of age group on trust was not significant, $F = 0.166$, $p = 0.684$, $\eta_p^2 = 0.001$. The main effect of gender on trust was not significant as well, $F = 0.191$, $p = 0.662$, $\eta_p^2 = 0.001$. And there was no sign of interaction of age and gender on trust either, $F = 0.892$, $p = 0.346$, $\eta_p^2 = 0.003$.

B. Correlation Analysis

We first calculated the correlation coefficient between school-aged children and their parents regarding their attitudes towards autonomous vehicles and determined that there was no correlation between the two groups ($r = -0.158 \sim -0.089$, $p = 0.072 \sim 0.312$).

We conducted a correlation analysis to explore the relationships among the six variables (perceived usefulness, perceived defects, perceived risk of traffic safety, perceived risk of privacy safety, negative emotions, and trust) and present the results of the analysis in Tables 2 and 3.

With respect to the parents' group, we found that perceived usefulness, perceived defects, and perceived risk of traffic safety were all positively correlated with trust in autonomous vehicles, whereas both perceived risk of privacy safety and negative emotions were negatively correlated with trust. These correlations were all significant, and all of the R-values were larger than 0.6 (Table 2).

Similarly, regarding the children's group, perceived usefulness, perceived defects, and perceived risk of traffic safety were positively correlated with trust, while the correlation between negative emotions and trust was determined to be negative as was the correlation between the perceived risk of privacy safety and trust in autonomous vehicles. These correlations were all significant, and all of the R-values were larger than 0.6 (Table 3).

C. Regression Analysis

A multiple regression analysis was conducted to explore how perceived usefulness, perceived defects, perceived risk of traffic safety, perceived risk of privacy safety, and negative emotions would predict trust in the autonomous vehicle among the two groups of participants, i.e., parents and children. The regression model did not include the interactions among the predictors as there was no evidence of an interaction.

With respect to the parents' group, the variance inflation factor (VIF) values were acceptable ($VIF = 2.470 \sim 5.238$), thus indicating that there was no serious multicollinearity problem [39], and the regression model was determined to be significant, $F(5,127) = 63.099$, $p < 0.001$, $R^2 = 0.713$. As shown in Table 4, a higher level of road safety was associated with increased trust ($\beta = 0.394$, $p < 0.001$). However, a higher level of perceived defects was associated with greater trust as well ($\beta = 0.299$, $p < 0.001$), and perceived usefulness was found to be a marginal predictor of trust in autonomous vehicles ($\beta = 0.171$, $p = 0.087$).

Regarding the children's group, the level of multicollinearity among the predictors was acceptable ($VIF = 2.643 \sim 5.590$). The regression model was significant, $F(5,125) = 106.066$, $p < 0.001$, $R^2 = 0.809$. Greater perceived risk of traffic safety and perceived defects promoted greater trust ($\beta = 0.239$, $p < 0.01$; $\beta = 0.155$, $p < 0.05$), while a higher level of negative emotions was associated with decreased trust ($\beta = -0.421$, $p < 0.001$). Besides, greater perceived risk of privacy safety predicted greater trust marginally ($\beta = 0.118$, $p = 0.066$).

V. Discussion

Overall, this research indicates that primary school students and their parents share similar perceptions of trust in autonomous vehicles. Perceived usefulness, perceived defects, perceived risk of traffic safety, perceived risk of

Table 4. Multiple regression analysis of trust in autonomous vehicles in different groups

Group	Predictor	β	t	*p*	VIF
Adults	Perceived usefulness	0.171	1.727	0.087	4.346
	Perceived defects	0.299	4.001	**<0.001**	2.470
	Perceived risk of traffic safety	0.394	4.044	**<0.001**	4.195
	Perceived risk of privacy safety	-0.026	-0.328	0.743	2.749
	Negative emotions	-0.038	-0.347	0.729	5.238
Children	Perceived usefulness	0.040	0.436	0.664	5.590
	Perceived defects	0.155	2.088	**0.039**	3.633
	Perceived risk of traffic safety	0.239	2.823	**<0.01**	4.705
	Perceived risk of privacy safety	0.118	1.854	0.066	2.643
	Negative emotions	-0.421	-4.936	**<0.001**	4.771

Note: Significant *p*-values ($p < 0.05$) are shown in bold.

privacy safety, and negative emotions are all factors that influence people's trust in automatic vehicles. Moreover, our current results reveal that perceived defects and perceived risk of traffic safety are two of the most critical factors that impact the levels of trust not only among adults but also among children. Furthermore, negative emotions is also a predictor of trust among children, but not among adults.

The current study provides empirical support for the theoretical model of trust in new technology. People's perceptions of usefulness and defects, their risk perceptions of traffic and privacy safety, and their negative emotions significantly correlate with trust in autonomous vehicles. Furthermore, the current study expands the proposed model into different age groups. In the children's group, a positive correlation between perceived risk of privacy safety and trust is found, a result that differs from those of the adult group and is also inconsistent with Hypothesis 4. The limited comprehensive ability and a lack of knowledge among children regarding privacy safety may be the reason for this phenomenon as they may not understand the meaning of privacy safety and may not realize the importance of privacy safety in their daily lives. Although the influence of perceived risk of privacy safety on trust may be affected by the individual's knowledge of privacy safety, it remains an area worthy of future research.

Moreover, the results of the regression analysis indicate that the perceived risk of traffic safety and the perceived defects influence not only adults but also children's levels of trust in autonomous vehicles. Specifically, the results reveal that the perceived risk of traffic safety is the most important predictor of people's level of trust in autonomous vehicles. These findings, which are consistent with Hypothesis 3, can be explained by the fundamental status of road safety with respect to driving. This is especially true for autonomous vehicles as they are linked with risks, uncertainty, and loss of control. Hence, people demand greater safety features in self-driving vehicles [37, 40]. The other critical predictor is perceived defects. However, the direction of prediction is contrary to that of Hypothesis 2. In studies of interpersonal relationships, the pratfall effect states that a person who commits a mistake is perceived as more attractive [41]. Similarly, in the area of human-computer interactions, [42] found that participants liked the faulty robot significantly better than they did the flawless robot. Accordingly, the pratfall effect indicates that a product that is infinitely close to perfection may invoke user fear and distrust, a phenomenon similar to the uncanny valley [43]. As a result, with respect to autonomous vehicles, a few acceptable defects may increase trust rather than decrease it.

Additionally, the results reveal that emotional factors are important for school-aged children but not for their parents when evaluating trust in autonomous vehicles. Specifically, among the children's group, more negative emotions predict a lower level of trust, a result that is consistent with Hypothesis 5. However, the results for adults with respect to negative emotions do not support this hypothesis. A reason for this disparity regarding negative emotions between children and adults may well due to the differences between the two groups with respect to age and the level of mental development, i.e., put simply, children are not as mature as adults. Hence, the emotional factor has a more significant influence on children's trust in autonomous vehicles, whereas the adults' trust is independent of emotional responses. Thus, the design of autonomous vehicles should take the emotional factor of children into account. Given these findings, future research should explore the effect of reducing negative emotions or inducing positive emotions to improve children's trust in autonomous vehicles.

Similarly, perceived usefulness also has different effects on trust between children and adults despite the positive correlation between perceived usefulness and trust in both groups, which is consistent with Hypothesis 1. Compared with children, perceived usefulness plays a more significant role in the adult group. This phenomenon may be explained again by the differences between the two groups. Faced with new technology, adults may focus more on the functions and practicability of the vehicle, while children focus more on the emotional experiences and the fun associated with its use.

Based on the findings of the current research, we propose some guidelines regarding the design of future autonomous vehicles. First, the perceived risk of traffic safety and perceived defects, which are significant predictors of trust among both the adult and children's group, must be addressed. To reduce the perceived risk of traffic safety, on the one hand, it is advised that short tutorials and brief explanations be provided prior to one's first experience using autonomous vehicles [44]. On the other hand, improving the traffic norms, e.g., reducing unplanned trip interruptions by defining autonomous driving areas, is necessary. From the aspect of perceived defects, allowing for the existence of a few acceptable defects, such as lower velocity, can increase trust rather than impair it. Second, the design and publicity of the vehicle should target the various user groups. For example, with respect to adult users, the superiority, benefits, and usefulness of autonomous vehicles should be emphasized, while for children, the focus should target the emotional experiences and enjoyment during the ride by adding cartoon elements and simplifying the interactions in the design of future autonomous vehicles. Third, although the perceived risk of privacy safety was not a significant predictor of trust in autonomous vehicles in the current study, it is still necessary to protect users' privacy. This is especially relevant for children, as they do not have a clear understanding of privacy nor do they have the ability to protect themselves. Finally, protecting personal data such as travel routes is critically important.

VI. Conclusion and Furtrue Work

As the first research to compare primary school students' and adults' attitudes towards autonomous vehicles, the current study revealed that perceived usefulness and defects, perceived risks of traffic safety and privacy safety, and emotional responses are all significantly correlated with trust in autonomous vehicles. Moreover, perceived defects and perceived risk of traffic safety were the two most critical factors affecting people's trust in autonomous vehicles in both groups, although perceived usefulness was more important in adults, while emotional experiences played a significant role among children. These findings may inspire the design of autonomous vehicles and the promotional techniques adopted with respect to such vehicles, and thereby promote increased trust and acceptance of increasingly more people when evaluating autonomous vehicles.

As future studies, efforts should be invested in examining the cultural differences and diverse measurements of trust given that much of the existing research was based on Chinese participants and did not consider the cultural differences in attitudes towards autonomous vehicles. However, Chien et al. [45] indicated that cultural characteristics significantly affect trust in automation among the populations of the U.S. and Turkey, and Yerdon et al. [46] further indicated the cross-cultural differences in trust levels and attitudes towards automation. As a result, our findings may not be generalizable or suitable for other cultural environments. Thus, in future research, we will compare the cultural differences in trust and attitudes towards autonomous vehicles among different age groups.

Second, the measurement of trust in autonomous vehicles was comprised of relatively basic items. Future research should further subdivide this concept and measure human-automation trust from various aspects. For example, Marsh and Dibben [47] divided trust into three layers, namely, dispositional trust, learned trust, and situational trust. Additionally, future studies could use methods other than a brief questionnaire. More specifically, it is suggested that future research use questionnaires that involve multiple factors [48, 49] as well as behavioral and physiological measurement methods, such as eye-tracking [50] and EEG [51]. This would allow researchers in this area to use more comprehensive indexes to further enrich the measurement of trust.

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