Trust in AVs: The Impact of Expectations and Individual Differences

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Abstract
Trust has been identified as an important determinant of the acceptance of autonomous vehicles. However, individual differences such as age, gender, and education have shown to impact the development of trust in automation. From prior literature on technology acceptance, we know that human expectations of technology may also be important to the acceptance of autonomous vehicles. Yet, we know very little with regards to the impact of individual differences or expectations on the trust and acceptance of autonomous vehicles. To address this shortcoming, we propose a theoretical framework based on expectation-confirmation theory which explains the relationships between individual differences, expectations, trust and the acceptance of autonomous vehicles. To empirically examine this theoretical framework, we propose a study employing a 2 x 2 factorial within-subject experiment with four conditions representing different driving environments. We believe our results will contribute significantly to the literature on the acceptance of autonomous vehicles.

Author Keywords
Trust in autonomous vehicle; Expectation-conformation theory; Individual differences; Driving conditions

ACM Classification Keywords
General and references[Surveys and Overviews]; Social and professional topics[User characteristics];

Introduction
Autonomous vehicles have the potential to both reduce the use of fossil fuels and accidents [3, 6, 4]. Trust has been identified as a key determinant of the acceptance of autonomous vehicles [6, 4, 12]. However, many studies have found that individual differences including age, gender, education, and propensity to trust all have important roles in the development of trust in automation [14, 9]. We also know from prior literature on technology acceptance [1, 2, 15]that human expectation of technology may also be an important determinant on the acceptance of autonomous vehicles. Yet, we know very little about the impact of expectation on the acceptance of autonomous vehicle.

The purpose of this study is to propose a theoretical framework which combinines individual differences with pre and post experience expectation of autonomous vehicles to better understand acceptance of autonomous vehicles. The theoretical framework is based on expectation-confirmation theory, which is widely used to explain consumers' satisfaction and re-purchase decisions [5]. To test the proposed hypothesis, we are conducting a factorial study. Next, we present details of the research model, study design, and our expected results.

Research model and Hypothesis
A theoretical research framework derived from the expectation-confirmation theory is proposed (see Fig. 1). The framework consists of two stages: pre-experience and post-experience. In the expectation-confirmation process, people first have their positive or negative levels of expectation in the pre-experience stage based on individual differences.

In the post-experience process, people update their expectations as well as the level of satisfaction after experiencing different driving environmental conditions. The trust intention, in turn, will be directly and indirectly affected by post-expectations and satisfaction [5]. Individual difference refers to people 's traits including age, gender, education, and trust propensity that lead to generalized expectations about the autonomous vehicle in the pre-experience stage. Thus, we posit that:

- Hypothesis 1: Individual differences at pre-experience stage are associated with the level of expectation of the autonomous vehicle.

Once the participants have the experience with the autonomous vehicle, post-expectations including perceived safety and perceived performance, satisfaction, and trust intention will be formed which can be also impacted by individual differences. Young drivers are the most open to driverless vehicles and women are more worried than men about riding in a self-driving car [13]. In addition, education, exposure, and experience will likely help ease consumer fears [11]. Due to different lifelong experiences, physical differences, and cultural background, people differ in their perceptions of driving with autonomous vehicles. Therefore, this study proposed that:

- Hypothesis 2: Individual differences at the post-experience stage are associated with the level of perceived performance of the autonomous vehicle.
- Hypothesis 3: Individual differences at the post-experience stage are associated with their perceived safety.
- Hypothesis 4: Individual differences at the post-experience stage are associated with their intentions of trusting the AVs.

People satisfaction decisions are determined by two major constructs: initial expectations on a product/service, and discrepancies between expectations and product/service performance (Confirmation) [5]. The confirmation of their previous expectation leads to a positive influence on their satisfaction level. Thus, the study proposed that:

- Hypothesis 5: People's expectation influences their confirmations.
- Hypothesis 6: People's expectation influences their satisfaction.
- Hypothesis 7: People's extent of confirmation is associated with their perceived safety.
- Hypothesis 8: People's confirmation affects their satisfaction.

Post-expectation has been consistently found as the most important determinant of users' adoption intention[16]. In the meanwhile, satisfaction is a result of the comparison between the pre-experience and post-experience expectations, which in turn affects people trust intentions. Therefore, this study proposed that:

- Hypothesis 9: People's perceived safety is associated with their intentions of trusting the AVs.
- Hypothesis 10: People's perceived safety is associated with their level of satisfaction with experiencing the AVs.
- Hypothesis 11: People's satisfaction affects their willingness to trust.

Method

Measurement Development

The seven constructs measured in our study were trusted propensity, expectation, perceived performance, confirmation, satisfaction, perceived safety, and trust intention. All

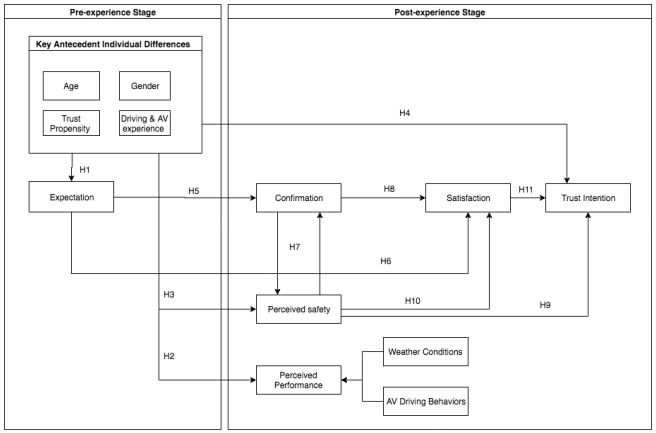

Figure 1: A Research Model.

constructs were measured using multi-item scales. Each construct was measured by at least three observable indicators. To measure trust propensity, we used scale items from Stephanie et al.(2013) [10]. Items used to measure trust intention were adapted from Jian et al.(2000) [7]. Expectation, perceived performance, confirmation, and satisfaction were assessed using measures adapted from previous studies on Lee et al.(2015). [8] Most items of constructs were measured on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree).

Experimental Design

A 2 x 2 factorial within-subject experiment with four conditions representing two types of driving behavior (normal vs. aggressive) and two kinds of driving weather condition (sunny vs. snowy) was conducted. Participants were asked to watch four videos and observe driving performances and style of the artificial agent. Example video of the four conditions can be found at https://youtu.be/Fd0lvWNxJFo. A

online survey was used to collect data. Questions related to pre-experience stage including demographic information, trust propensity, and expectation were collected from the first-round survey. After watching each of the videos, survey questions related to the post-experience stage were collected, which included perceived performance, perceived safety, confirmation, satisfaction, and trust in the autonomous vehicle.

Data Analysis

Partial least squares analysis via SmartPLS 3.0 will be used to test the the proposed model. Specifically, PLS will be used to analyze the effects of individual differences and driving conditions on dependent variables including expectation, perceived safety, perceived performance, confirmation,satisfaction, and trust in autonomous vehicle.

Expected Results

We expect to find significant effects of different driving conditions and individual differences on trust in autonomous vehicle. Generally, we hypothesize that people will trust the autonomous vehicle more with the normal driving behavior in the sunny weather condition, while the least trustworthy scenario should be that people drive in the snow with an aggressive driving manner. In addition, we speculate that people with different characteristics will have significant differences in dependent variables in this study including expectation, perceptions,satisfaction, and trust intention.We expect this study can provide a framework explaining the subsequent relationships of expectation, confirmation, satisfaction, post-expectation including perceived performance and perceived safety, and trust intention across pre-experience and post-experience stages.

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