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Does Length of Ride, Gender or Nationality Affect Willingness to Ride in a Driverless Ambulance?

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Running head: EMS

Does Length of Ride, Gender or Nationality Affect Willingness to Ride in a Driverless Ambulance?

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Abstract

Due to the frequent lack of ambulances and personnel, the purpose of this study was to examine consumers' willingness-to-ride in an ambulance that was either driven by a human driver or completely automated (with no human driver) based on the gender of the participant and their nationality, either Indian or American. A two-study experimental design was utilized using over 1,000 participants. In Study 1, the length of the ride and the type of driver were manipulated while in Study 2, the length of the ride was manipulated across genders and nationality. Study 2 also collected affect measures to complete a mediation analysis. The findings indicate that consumers' willingness-to-ride was significantly lower for longer rides when using the automated ambulance. There were significant interactions between nationality and gender and nationality, gender, and length of the ride. Affect was found to significantly mediate the relationship between willingness-to-ride and both nationality and gender. These findings are discussed in greater detail, along with recommendations for future research and limitations to the study.

Keywords: driverless vehicles, emergency medical services, willingness to ride, affect, mediation

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Does Length of Ride, Gender or Nationality

Affect Willingness to Ride in a Driverless Ambulance?

1. Background

Technology and automation are becoming increasingly more sophisticated and widely implemented in several aspects of daily life. Automation use in transportation is not a novel concept and has been prevalent in the aviation industry for years. However, aviation is not the only transportation industry that has seen major increases in automated technology implementation. Driverless car capabilities have been introduced into the consumer automobile market in recent years and have become increasingly popular. The current research involves the potential use of automated vehicles in an emergency medical services setting.

1.1 Problem Statement

One of the primary issues when considering driverless vehicles or highly automated vehicles is the novelty of the technology. With being a technology early in its infancy of application, the general public does not have a firm viewpoint on its safety, and this may influence their willingness to utilize said technology (Anania et al. in press; Davis 2018; Halsey 2017). However, there is a lack of sufficient emergency medical personnel. By eliminating the need for a paramedic to drive the ambulance, driverless vehicles could be a significant remedy to staffing issues. Furthermore, it is widely claimed by the driverless automation industry that driverless vehicles are safer than traditional vehicles. Thus, increasing safety and utilizing personnel more efficiently is beneficial to the field of emergency medical services (Hughes et al. 2016).

Research has been conducted on consumer and public perceptions of several different aspects of automation implementation in various settings (Mehta et al. 2014; Rice et al. 2014).

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Specifically, previous research in the field of emergency medical service vehicles has shown that passengers are less willing to ride in a driverless ambulance (Winter et al. 2018). The current research expands on previous research (Winter et al. 2018) with the goal of determining whether the length of the ambulance ride, the gender of the participant or the nationality of the participant has an effect on their willingness to ride.

1.2 Emergency Medical Services: Ambulances

Emergency medical services and personnel are necessary instruments of any nation to save lives. McQuade (2014) stated that many major US cities suffer from a frequent lack of ambulances and personnel to appropriately deal with the volume of situations. Although medical service vehicles are continually updated with new equipment and medical tools, advances have not moved beyond medical equipment to the vehicles themselves. Introducing automated technologies in the driving capabilities of the vehicle would be a novel approach to making improvements in EMS settings (Wickens and Hollands 2000).

The use of driverless ambulances would alleviate personnel loads, as individuals would be able to focus on providing necessary care to patients without having to be occupied with the auxiliary task of driving (Wickens and Hollands 2000). Most emergency medical personnel work in teams of two, with one person tending to the patient while the other drives. If both personnel were to stay with the patient, driverless ambulances will allow for teams to provide elevated medical care (Salas et al. 2009). Research has shown the benefit of people working in teams as opposed to working alone (Marks et al. 2001).

1.3 Automation in Transportation

The automation industry has seen exponential growth in recent decades. Automation can be defined as the completion of a task by a machine or system that would otherwise need to have

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been completed by a human operator (Wickens and Hollands 2000). Automation in transportation has seen widespread implementation in the aviation industry with new autopilot and automated navigation capabilities. In recent years, there has also been significant growth in the automobile automation industry.

Automobiles today have varying levels of automation integration including, but not limited to: autonomous braking, active lane assist, and self-driving "auto-pilot" capabilities, which could become universal industry standards in the next two decades (Litman 2014). A Business Insider report estimates that there will be an exponential increase in the number of cars on the road with self-driving capabilities with the projection to be in the range of 10 million cars (Greenough 2015). With the increase in consumer automobiles projected to increase at such high rates, it is anticipated that commercial vehicles will also see these technologies being implemented. The implementation of driverless/auto-pilot features in ambulances could benefit the industry by allowing emergency medical personnel to focus on care of the patient and not on driving the vehicle.

1.4 Gender

Previous research has found that males and females perceive situations differently and differ in their assessments of risk levels (Byrnes et al. 1999; Powell and Ansic 1997; Schubert et al. 1999). Powell and Ansic (1997) stated that females tend to be less risk seeking and more risk averse as compared to their male counterparts. This was found to be especially true for single women when faced with risk taking in financial decision-making (Schubert et al. 1999).

Research conducted in the field of aviation automation implementation found that female participants were significantly less willing than male participants to fly on board a commercial airline flight with an entirely autonomous cockpit (Mehta et al. 2014). Similar research also

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found female participants significantly less willing to fly on commercial airline flights where cabin depressurization could be used as a hijacking mitigation tactic (Mehta et al. 2017). Together, these studies corroborate the risk averse nature of females, and also show the impact of advanced automation on female willingness to fly. It is therefore believed that female participants will be less willing to ride in a driverless ambulance compared to their male counterparts.

1.5 Nationality

An aim of the current research is to identify any potential differences between participants' willingness to ride in driverless ambulances based on their nationality. India and the United States represent two different cultures, and the people from these cultures often have differing opinions and perceptions of situations and scenarios. Trust, one of the underlying aspects of willingness, is said to be influenced by a person's upbringing and cultural environment (Hofstede, 1980). Indians and Americans represent cultures of collectivism and individualism respectively (Hofstede 1980, 2001; Markus and Kitayama 1991; Robbins and Judge 2013).

Collectivist cultures tend to be more trusting of other members of their community, while individualists tend to focus on personal successes and put their own needs before those of the community (Bochner 1994; Han and Shavitt 1994; Kashima and Callan 1994). Although these concepts of trust seem unique to human-to-human interactions, research has shown that there is a significant amount of crossover when dealing with trust in machines and automation. Mayer et al. (1995) states that trust is the relinquishment of control to another person or object to complete a task in one's best interest. Potential differences in trust based on nationality may be a plausible

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explanation as to any differences found between Indians and Americans in willingness to ride in driverless ambulances.

Winter et al. (2015) conducted a study on passengers' willingness to fly in an autonomous airplane and found that Indians, in general, were more willing to fly with a fully auto-piloted aircraft compared to their US counterparts, regardless of whether it was a commercial or corporate flight. Rice et al. (2014) found similar results and reported that Indians were more trusting of a fully autonomous airplane, regardless of whether they, their child, or their colleague was the passenger.

1.6 Affect and The Six Universal Emotions

The decision-making process is inextricably tied to emotions (Schwarz 2000; Sayegh et al. 2004). The current research focuses on trust in automation. When combined with the potential for emotional involvement in decision-making, affect-based trust could be considered a relevant factor in individuals deciding whether or not to ride in a driverless ambulance.

McAllister (1995) explains affect-based trust as established by support and concern. Hughes, Rice, Trafimow, and Clayton (2009) postulate that affect-based trust between humans and automation can be explained similarly to the trust between persons. Several prior research studies have studied affect as a potential mediator to give a plausible explanation to public perceptions (Babin and Attaway 2000; Baker and Cameron 1996; Winter et al. 2014).

In the current study, general affect is replaced with the use of the six universal emotions established by Ekman and Friesen (1971). The six universal emotions are anger, disgust, fear, happiness, sadness, and surprise (as depicted in Figure 1). [insert Figure 1 here]. Pictorial representations of each emotion are used to identify which specific emotions, if any, mediate between the independent and outcome variables. Rice and Winter (2015) used the six universal

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emotions to determine which emotions mediated the relationship between pilot configuration and willingness to fly in commercial aviation. They found that emotions did mediate that relationship.

1.7 Willingness

This study uses a willingness to ride scale previously validated by Winter, Rice, Keebler, and Mehta (2017), originally adapted from the Rice et al. (2015) willingness to fly scale. This scale was created out of the need for a scientifically valid instrument that would provide reliable data. The current instrument uses a 5-point Likert scale from strongly disagree (-2) to strongly agree (+2), with a neutral option (0). The instrument is attached for reference in Appendix A1.

Prior to the development of the willingness to ride scale, research was conducted in the field of aviation using the willingness to fly scale. In order to gain a better understanding of passenger perceptions on a number of different commercial airline flight scenarios, several of these research endeavors featured situations about automation implementation in airline cockpits (Rice et al. 2014; Winter et al. 2015). Some of the other studies conducted in the field of passenger willingness to fly included the effect of pilot anti-depressant usage (Rice et al. 2015), and passenger perceptions of cabin depressurization being used as a hijacking mitigation tactic (Mehta et al. 2017). The current research builds on this foundation, expanding knowledge of consumer perceptions to include driverless cars.

1.8 Current Study

The overall purpose of this research project was to determine whether the length of the ambulance ride, the gender of the participant, or the nationality of the participant has an effect on passengers' willingness to ride in a driverless ambulance. In a previous research study (Winter et al. 2018), a general willingness to ride in driverless or human-operated ambulances was

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conducted. However, that study failed to consider the length of the ride nor nationality differences between a typically individualistic culture, such as the United States or a typically collectivistic culture, such as India (Hofstede 1980). The current study sought to address these concerns. In Study 1, participants' perceptions of willingness to ride were measured based on the length of the ride and the type of driver (i.e., human or autopilot). In Study 2, participants' perceptions of willingness to ride were measured based on the length of the ambulance ride, their gender, and their nationality. In Study 2, data was also collected regarding participants' emotions to conduct a mediation analysis. This is used to determine which emotions if any, mediate the relationship between the condition and the effect. We hypothesized the following in Study 1:

> H1: Consumers will be more willing to ride in a driverless ambulance for shorter distances compared to longer distances (Rice et al. 2014; Winter et al. 2015).
>
> H2: Consumers will be more willing to ride in an ambulance that is driven by a human (Rice et al. 2014; Winter et al. 2015).
>
> H3: There will be interactions in the data. This is a non-directional hypothesis.

2. Study 1

2.1 Methods

2.1.1 IRB Review. Both studies were examined by the Institutional Review Board (IRB) at Embry-Riddle and were found to meet criteria for exempt research (ERAU IRB 17-077). The study received a waiver of informed consent.

2.1.2 Participants. Eighty-two (43 females) people took part in the study. The mean age was 35.32 (*SD* = 11.29). All participants were recruited from the United States via a convenience sample using Amazon's ® Mechanical Turk ® (MTurk). MTurk provides a source of participants who can complete human intelligence tasks in exchange for monetary compensation.

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Prior research has shown that data from MTurk is as reliable as standard laboratory data (Buhrmester et al. 2011; Germine et al. 2012).

2.1.3 Materials and Procedure. Participants were first given an electronic consent form to sign, after which they read instructions about the study. They were then presented with one of four hypothetical scenarios based on the length of the ambulance ride and whether the driver was a human or autopilot. In one condition, they were told, "*Imagine a situation where you live in a small town. You have a broken wrist and have called 911 for help. An ambulance is coming to your house in order to take you to the hospital. The ride to the hospital is 5 minutes. The vehicle has a new configuration, whereby there is an autopilot driving the ambulance (no one else is in the front of the ambulance) and 2 human paramedics in the back who are caring for you. This is a change from the traditional configuration of 1 human driver and 1 human paramedic*." In another condition, the ride to the hospital was 30 minutes. These two conditions were crossed with two other conditions where the driver was a traditional human driver.

There were two independent variables. The first variable (length of ride) was manipulated to be either a short 5-minute ride or a longer 30-minute ride. The second variable (the type of driver) was manipulated to be either a human driver or an autopilot (driverless).

Following the reading of the scenario, participants were asked to fill out a Willingness to Ride Scale that was previously validated by Winter, Rice, Keebler and Mehta (2017). Upon completion, participants were debriefed, paid and dismissed.

2.1.4 Design. Participants were assigned to one of the two manipulated conditions (the type of driver) by simple random assignment. The length of ride variable was within-participants. Thus, we used a mixed two-way factorial design.

2.2 Results – Study 1

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Prior to the data analysis, the Willingness to Ride scale was subjected to a Cronbach's Alpha test to ensure high reliability of the data. The results of the traditional and driverless conditions were 0.91 and 0.97, respectively, indicating very high consistency in the data. The data for WTR is presented in Figure 2 [insert Figure 2 here].

The WTR data was subjected to a mixed two-way analysis of variance with Length of Ride as the within subjects factor and Condition as the between subjects factor. There was a significant main effect of Length, $F(1, 22.47) = 25.29$, $p < .001$, *partial-eta-squared* = 0.24, and a significant main effect of Condition, $F(1, 80) = 17.85$, $p < .001$, *partial-eta-squared* = 0.18. There was not a statistically significant interaction between Length and Condition, $F(1, 22.47) = 1.07$, $p = .305$, *partial-eta-squared* = 0.013.

2.3 Discussion – Study 1

The purpose of Study 1 was to determine if the willingness to ride in an ambulance would be differentially affected by the type of driver (human or autopilot) and the length of the ride in the ambulance. We predicted that participants would be less willing to ride in a driverless ambulance, particularly if the length of the ride were longer.

The first hypothesis was supported strongly by the data. Participants were clearly less willing to ride in a driverless ambulance. When a human drove the ambulance, participants were across the board favorable about riding in the ambulance. However, when it was driven by an autopilot, participants were more skeptical. The scores were not in the negative range, on average, but they were much lower than the human driver condition. These findings are in line with previous autopilot studies in aviation (Rice et al. 2014; Winter et al. 2015) as well as a previous study on EMS conducted by Winter, Rice, Keebler, and Mehta (2017). In previous

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studies on consumer perceptions of autopilots, participants typically are less willing to fly or ride in driverless vehicles.

The second hypothesis was also supported strongly by the data. As Figure 2 reveals, participants were much less willing to ride in the ambulance if the length of the ride was 30 minutes, compared to a 5-minute ride. This presumably has to do with the amount of time they are exposed to risk of being in a vehicle accident. Participants likely perceived that an autopilot would be able to handle a short ride more efficiently than a longer ride. With more time on the road, there is more time to have an accident, which could also be the case in a human-operated condition as well. While it is believed that autonomous vehicles will be safer in the long-term, the most difficult part will be the transition period where human-operated vehicles and autonomous vehicles are integrated on the roadways.

The third hypothesis was not supported by the data; that is, there was not a significant interaction between the two independent variables. This was a bit surprising, as we had predicted that perhaps the difference between the short and long rides in the driverless condition would be more pronounced than in the human driver condition. However, this was not the case. Both conditions showed statistically equal differences between the short and long rides.

3. Introduction – Study 2

There were some limitations to the first study that the researchers wished to address in Study 2. First, the methodology used in Study 1 was within-participants for the length of ride variable. This could lead to hypothesis-guessing, whereby participants answered in a certain way because they suspected the study's goals and hypotheses. Study 2 addressed this limitation by using a fully between-participants design. Second, we wanted to see how gender and nationality might affect willingness to ride scores. In Study 2, we predicted the following:

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H1: Consumers would be more willing to ride in a driverless ambulance for shorter distances compared to longer distances (Rice et al. 2014; Winter et al. 2015).

H2: Males will be more willing to ride in a driverless ambulance compared to females (Mehta et al. 2017).

H3: Indians will be more willing to ride in a driverless ambulance compared to Americans (Winter et al. 2015).

H4a: There will be interactions in the data. This is a non-directional hypothesis.

H5a: The relationship between the IVs and DV will be mediated by at least one emotion (Winter et al. 2016).

3.1 Methods – Study 2

3.1.1 Participants. One thousand and three (404 females) people took part in the study. The mean age was 32.94 (*SD* = 8.80). All participants were recruited from India (480 participants) and the United States (523 participants) via a convenience sample using Amazon's ® Mechanical Turk ® (MTurk).

3.1.2 Materials and Procedure. Participants were first given an electronic consent form to sign, after which they read instructions about the study. They were then presented with one of two hypothetical scenarios based on the length of the ambulance ride. In one condition, they were told, "*Imagine a situation where you live in a small town. You have a broken wrist and have called 911 for help. An ambulance is coming to your house in order to take you to the hospital. The ride to the hospital is 5 minutes. The vehicle has a new configuration, whereby there is an autopilot driving the ambulance (no one else is in the front of the ambulance) and 2 human paramedics in the back who are caring for you. This is a change from the traditional configuration of 1 human driver and 1 human paramedic*." In the other condition, they were told the ambulance ride would be 30 minutes long.

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There were three independent variables. The first variable (length of ride) was manipulated to be either a short 5-minute ride or a longer 30-minute ride. The second variable was Gender, while the third variable was Nationality of the participant (USA or India).

Following the reading of the scenario, participants were asked to fill out a specific emotions scale which was based on images of facial expressions (see Figure 1) of the six universal emotions described by Ekman and Friesen (1971). Each image was presented to the participants in random order. They were asked, "*Based on the scenario above, how strongly do you feel like the image shown*?" Participants then manipulated a slider that had scale ends of "*I do not feel this way at all*" to "*I extremely feel this way*." The slider scored the responses on a numerical scale from 0 – 100; however, participants were not aware of this. This same methodology has been successfully used multiple times in the past (Cramer and Rice in press; Rice et al. in press; Rice and Winter 2015).

Following the measure of participants' emotions, they were asked to fill out a Willingness to Ride Scale that was previously validated by Winter, Rice, Keebler, and Mehta (2017). Upon completion, participants were debriefed, paid, and dismissed.

3.1.3 Design. Participants were assigned to one of the two manipulated conditions (length of ride) via simple random assignment. The variables of Gender and Nationality were also between-participants. Thus, we used a between-participants three-way factorial design.

3.2 Results – Study 2

Before the data analysis, the Willingness to Ride scale was subjected to a Cronbach's Alpha test in order to ensure high reliability of the data. The results of the conditions ranged from 0.93 to 0.97, indicating very high consistency in the data. The WTR data is presented in Figure 3 [insert Figure 3 here].

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The WTR data was subjected to a three-way factorial analysis of variance with Nationality, Gender, and Length of ride as the three factors. There was a significant main effect of Nationality, $F(1, 995) = 18.30$, $p < .001$, *partial-eta-squared* = 0.018, a significant main effect of Gender, $F(1, 955) = 9.37$, $p < .01$, *partial-eta-squared* = 0.009, and a significant main effect of Length of Ride, $F(1, 955) = 6.49$, $p < .05$, *partial-eta-squared* = 0.006. These main effects were qualified by a significant interaction between Nationality and Gender, $F(1, 955) = 10.53$, $p = .001$, *partial-eta-squared* = 0.01, indicating that WTR ratings differed across nationalities at least partially as a function of participant gender. There was also a statistically significant interaction between Nationality, Gender, and Length of Ride, $F(1, 955) = 6.35$, $p < .05$, *partial-eta-squared* = 0.006, indicating that WTR ratings differed across nationalities at least partially as a function of participant gender and the length of the ride. There was not a statistically significant interaction between Nationality and Length of Ride, $F(1, 955) = 0.45$, $p = .50$, *partial-eta-squared* = 0.000 nor Gender and Length of Ride, $F(1, 955) = 0.4$, $p = .84$, *partial-eta-squared* = 0.000.

3.2.1 Mediation Analyses.

3.2.1.1 Nationality. The standardized regression coefficient between nationality and affect was statistically significant, as was the relationship between affect and willingness to ride. Testing of the significance of the indirect effect was completed using Hayes (2013) bootstrapping procedures with 10,000 bootstrapped samples. For Anger, the 95% bootstrapped confidence interval ranged from -0.15 to -0.05. Therefore, the indirect effect was statistically significant, and there was mediation for Anger. For Happiness, the 95% bootstrapped confidence interval ranged from 0.15 to 0.27. Therefore, the indirect effect was statistically significant, and there was mediation for Happiness. For Surprise, the 95% bootstrapped confidence interval

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ranged from 0.01 to 0.04. Therefore, the indirect effect was statistically significant, and there was mediation for Surprise.

3.2.1.2 Gender. The standardized regression coefficient between participant gender and affect was statistically significant, as was the relationship between affect and willingness to ride. Testing of the significance of the indirect effect was completed using Hayes (2013) bootstrapping procedures with 10,000 bootstrapped samples. For Fear, the 95% bootstrapped confidence interval ranged from -0.12 to -0.03. Therefore, the indirect effect was statistically significant, and there was mediation for Fear. For Happiness, the 95% bootstrapped confidence interval ranged from -0.17 to -0.06. Therefore, the indirect effect was statistically significant, and there was mediation for Happiness. For Surprise, the 95% bootstrapped confidence interval ranged from -0.04 to -0.003. Therefore, the indirect effect was statistically significant, and there was mediation for Surprise.

3.2.1.3 Length of Ride. The standardized regression coefficient between length of ride and affect was not found to be statistically significant, thus there was no mediation for the relationship between length of ride and WTR.

3.3 Discussion – Study 2

The purpose of Study 2 was to determine if the willingness to ride in an ambulance would be affected by three different variables: length of ride (replicating Study 1), gender, and nationality. We predicted that WTR scores would be lower for longer rides, female participants, and American participants. We also predicted affect would mediate the relationship between the IVs and DV; that is, at least one emotion would explain why participants were less willing to ride in various circumstances.

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The first hypothesis was strongly supported by the data and replicated our findings from Study 1. Participants were again much less willing to ride in an ambulance that had to drive for 30 minutes compared to one that had to drive for 5 minutes. However, this was not the case in every condition. The second hypothesis was also strongly supported by the data. That is, female consumers were, on average, less willing to ride in a driverless ambulance compared to their male counterparts. However, as with the first hypothesis, this was not universal. The third hypothesis was not supported by the data, with several interactions in the data preventing us from making general conclusions about nationality and preference. The fourth hypothesis was strongly supported by the data, and we discuss the various interactions in the data in the General Discussion.

The final hypothesis was supported by the data. We see that affect does mediate the relationship between willingness to ride and both nationality and gender. For nationality, the mediating variables were Anger, Happiness, and Surprise. For Gender, the mediating variables were Fear, Happiness, and Surprise. We discuss this in more detail in the General Discussion.

4. General Discussion

The purpose of these two studies was to examine consumer willingness to ride in ambulances as a function of the driver mode, length or ride, nationality of the consumer, and gender of the consumer. We hypothesized that WTR scores would be affected by each of those variables and that the relationship between the IVs and WTR scores would be mediated by at least one of the six universal emotions.

In Study 1, the data strongly supported the hypothesis that WTR scores would be affected by the driver mode of the ambulance; that is, participants were far less willing to ride in a driverless ambulance compared to an ambulance driven by a traditional paramedic driver. This

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finding replicate that of Winter et al. (2017), who also showed that WTR scores go down when consumers are presented with the driverless option. Other studies examining consumer perceptions of autopilots in commercial aviation also confirm that, in general, consumers prefer human pilots/operators to fully autonomous pilots/operators (Rice et al. 2014; Winter et al. 2015).

Across both studies, we predicted that the length of the ride would affect WTR scores, and this hypothesis was supported by the data in both studies. Participants were clearly less willing to ride when the length of the ride was 30 minutes, compared to when it was 5 minutes. We must suppose that the longer they are in the driverless ambulance, the warier they are of trusting their lives to the autonomous driver.

In Study 2, we predicted that gender would affect WTR scores; that is, female participants would be less willing, on average, to ride in driverless ambulances. This prediction was founded on prior literature showing that women, on average, trust autopilots less than their male counterparts (Mehta et al. 2014; Mehta et al. 2017). The hypothesis was only partially confirmed by the data. While there were main effects of gender in the statistical analyses, this was qualified by a significant 3-way interaction between gender, nationality, and length of ride. Figure 3 reveals that US females were particularly wary of riding in the driverless ambulances regardless of the length of ride, while Indian females were only less willing if the length of the ride was 30 minutes. This finding is quite interesting, and further research should be conducted to examine these issues more closely.

In Study 2, we also predicted that the nationality of the consumer would affect WTR scores; that is, we hypothesized that Indians would be, on average, more willing to ride in driverless ambulances compared to their US counterparts. This finding was partially supported

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by the data. While there was a significant main effect of Nationality, this was qualified by the significant 3-way interaction in the data. Figure 2 reveals that Indian males were no more willing to ride in a driverless ambulance than their US male counterparts, but that Indian females were much more willing to ride compared to their US female counterparts. We also note that US males differed in their WTR scores based on the length of the ride, while Indian males were fairly positive regardless of the length of ride. We note that in previous commercial aviation studies, Indians have shown to be more accepting of autonomous pilots (autopilots) compared to their US counterparts (Rice et al. 2014; Winter et al. 2015). More research should examine the relationships between Nationality and other variables to determine exactly when and why Indians are more positive about auto-piloted vehicles.

Lastly, we predicted that the relationship between the IVs and WTR scores would be mediated by at least one universal emotion. This prediction was based on previous studies in aviation (Cramer and Rice in press; Rice et al. in press; Rice and Winter 2015) and EMS (Winter et al. 2017), whereby researchers found that many decisions made by consumers are based on emotional responses. This hypothesis was strongly supported by the data for Nationality and Gender but not for Length of Ride. For Nationality, the mediating variables were Anger, Happiness, and Surprise. For Gender, the mediating variables were Fear, Happiness, and Surprise. These findings are in line with Winter et al.'s (2017) study that also highlighted Anger, Fear, and Happiness as strong mediators between the type of driver and WTR scores. Humans are emotional creatures, and when presented with a novel scenario, we tend to react emotionally rather than rationally (Sayegh et al. 2004; Schwarz 2000). An unknown situation such as a driverless ambulance may cause negative emotional responses like anger and fear, or positive

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responses like happiness for people who think it will be exciting or interesting. Surprise is a more neutral response, but not a surprising one, no pun intended.

5. Theoretical Findings

Similarly, to previous research, this study demonstrates that individuals are less willing to ride in driverless ambulances compared to 'normal' human-driven ambulances. However, automated driving will arguably be safer (Thompson 2016) and healthcare provided by two agents is likely safer for a patient than healthcare provided by one agent (Salas et al. 2009). This research further supports the role of affect when predicting willingness to ride in regard to automated transport, which aligns with previous work by Winter et al. (2017). Of interest is that participants were more willing to ride when the drive was shorter (5 min. versus 30 min.), demonstrating that humans are arguably comfortable with automation in this context for short periods of time, but not longer. This study only examined a 5 minute versus a 30-minute ride, so future work could better elucidate where the break is between willing to ride and not. In other words, is there a length of ride in which individuals switch from willing to unwilling? Or is the relationship linear with simply more time leading to less willingness?

An interesting outcome of the second study was the complex relationship found between nationality, length of ride, gender, and willingness to ride. Although previous work has shown that females are less willing to ride than males, the interactive effects found in this research instead demonstrated that the relationship is nuanced and depends on culture, gender, and length of ride. This has important implications in regard to cultural norms for acceptance of automation in transportation. As stated above, we are unsure where the 'breaking point' is in regard to length of ride, and why human affect changes in regard to this information. Research could examine

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how variations in collectivist versus individualistic culture affects the way different genders perceive their safety in regard to automated ambulances.

Theoretically, this research leaves us with more questions than answers. Specifically, we are unsure why the particular emotional responses we found mediated the relationship between the IVs and willingness to ride. The fact that a wide array of emotions played a role in decision making, versus just one emotion (e.g., fear), shows that individual's respond to automation in the context in complex ways that are not entirely intuitive. Future research will need to better understand why a particular emotional reaction was elicited, and how we can mitigate those responses to best foster positive responses to automated transport in this context.

6. Practical Applications

This research has numerous practical implications. First, this set of studies allows insight into automated ambulance system design and the constraints that will likely be faced due to perceptions of healthcare consumers. In regard to length of ride, it is clear that a thirty-minute ambulance ride is disconcerting for most participants. This indicates that it might be prudent to first introduce this technology in smaller cities or areas within a short drive of hospitals. Second, the cultural differences clearly indicate that our sample of westerners (US) and easterners (Indians) perceive this technology differently.

In regard to implementing an automated ambulance, it might be best to initially introduce the technology in a place like India where individuals are more willing to utilize and trust the technology compared to western cultures, which are apparently warier of automation in this context. A third practical implication relies on the fact that an individual's emotional responses seem to be a causal reason why they are less willing to ride. This can provide a path forward through educational practices that focus on reducing bias and emotional responses by providing

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facts about the potential safety of automated ambulances. Targeting consumers' fears and surprise in regard to automation through educational resources could help reduce the bias they experience and potentially mitigate the effects of their emotional response on their willingness to ride.

Finally, there is a practical implication of this research in regard to EMS agencies and acquisition of automated ambulances. When self-driving ambulances become commercially viable, agencies may benefit by revisiting the ideas presented here in regard to their potential customers. Understanding consumer concerns in terms of length of ride may inform agencies about placement of automated ambulances in regard to dispatch and local hospitals.

7. Limitations

Every study comes with limitations, and this set of experiments is no exception. The first major limitation is that we used a convenience sample from MTurk limited to two nationalities: Americans and Indians. Thus, we need to be cautious about generalizing the findings to larger populations. Further research should expand to include additional countries for nationality effects. A second major limitation is the use of hypothetical scenarios and measurement of attitudes and opinions, rather than collection of behavioral data in real life situations. This was done out of necessity, as it is impossible to collect behavioral data in a scenario that does not yet exist in the real world. We do note, however, that attitudinal data correlates quite reasonably with actual behaviors. Additional research could manipulate the type of injury, and the condition of the patient, conscious or unconscious. Third, we chose only to use the six universal emotions posited by Ekman and Friesen (1971). There have been other studies which suggest that there may be more universal emotions, and we believe that further research should examine these as well. Lastly, we chose two particular driver configurations out of many possible ones. Our

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reasoning was that driverless ambulances will allow EMS professionals to re-allocate personnel from a driving position to a patient care position. We felt that this was the most likely possible configuration. Further research should be conducted to determine what other factors may predict the type of person willing to ride in a driverless ambulance. There are many other possible variables such as ethnic status, age, educational level which may be significant predictors of willingness to ride.

8. Conclusions

The purpose of the current set of experiments was to determine whether participants' willingness to ride in an ambulance would be affected by the type of driver configuration, the length of ride, gender, and nationality. US males and Indian females were less willing to ride if the ambulance was driverless, while US females were less willing to ride in both driverless configurations compared to the other groups. Mediation analyses provide evidence that these effects are largely due to emotional reactions. These data provide a starting point for future research on the topic of driverless ambulances as it relates to the length of ride, gender, and nationality of the patients.

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Figure 1. Six emotions from Ekman and Friesen's (1971) work are represented here with images. These images were re-validated in a separate pilot study. They represent anger, disgust, fear, happiness, sadness and surprise.

Figure 2. Data from Study 1 as a function of Length of Ride and Type of Driver. Standard error bars are included.

Figure 3. Data from Study 2 as a function of Length of Ride, Gender, and Nationality. Standard error bars are included.

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Appendix A1 - Consumer Willingness to Ride Scale (concurrent validity with Consumer Willingness to Fly Scale; Rice et al. 2015)

Please respond how strongly you agree or disagree with the following statements.

1. I would be willing to ride in this situation.

Strongly Disagree Disagree Neutral Agree Strongly Agree

2. I would be comfortable riding in this situation.

Strongly Disagree Disagree Neutral Agree Strongly Agree

3. I would have no problem riding in this situation.

Strongly Disagree Disagree Neutral Agree Strongly Agree

4. I would be happy to ride in this situation.

Strongly Disagree Disagree Neutral Agree Strongly Agree

5. I would feel safe riding in this situation.

Strongly Disagree Disagree Neutral Agree Strongly Agree

6. I have no fear of riding in this situation.

Strongly Disagree Disagree Neutral Agree Strongly Agree

7. I feel confident riding in this situation.

Strongly Disagree Disagree Neutral Agree Strongly Agree

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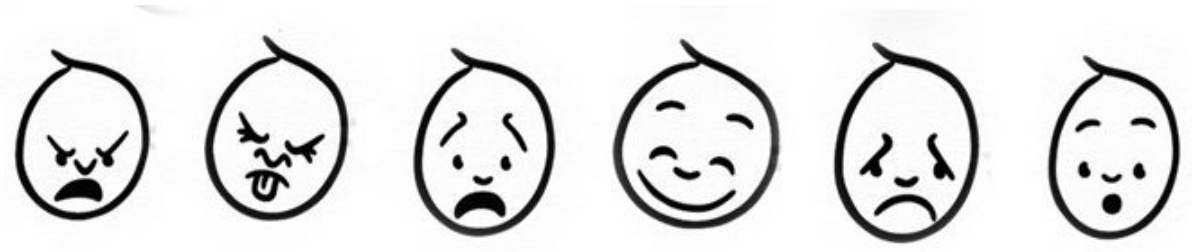

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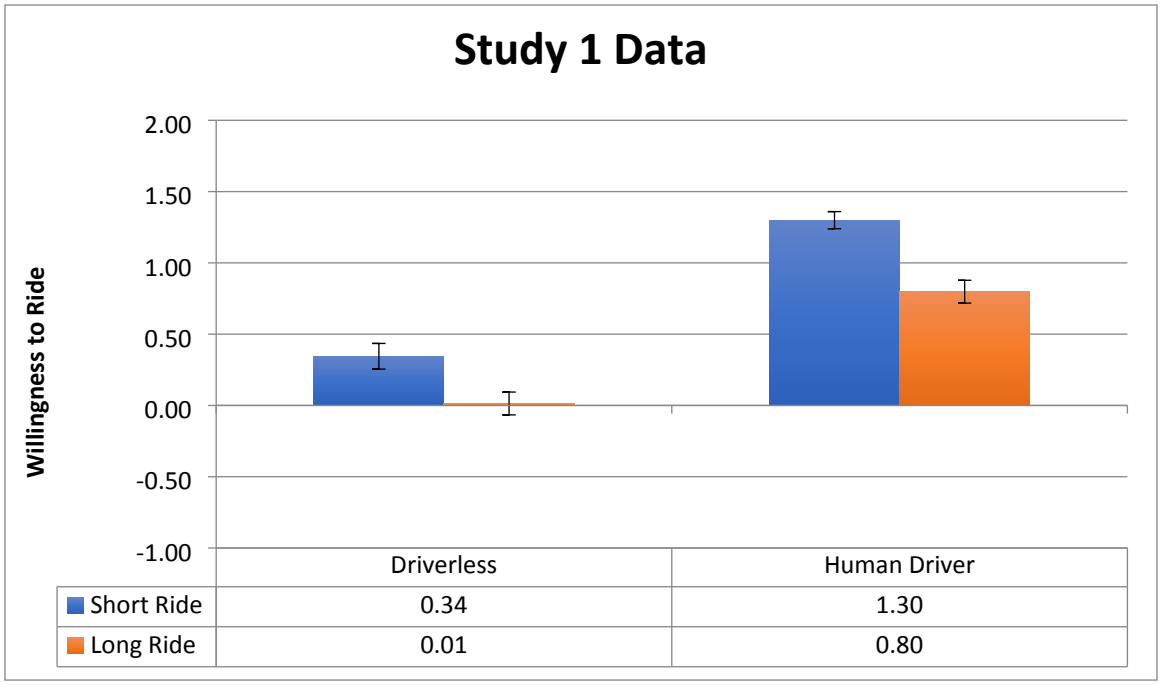

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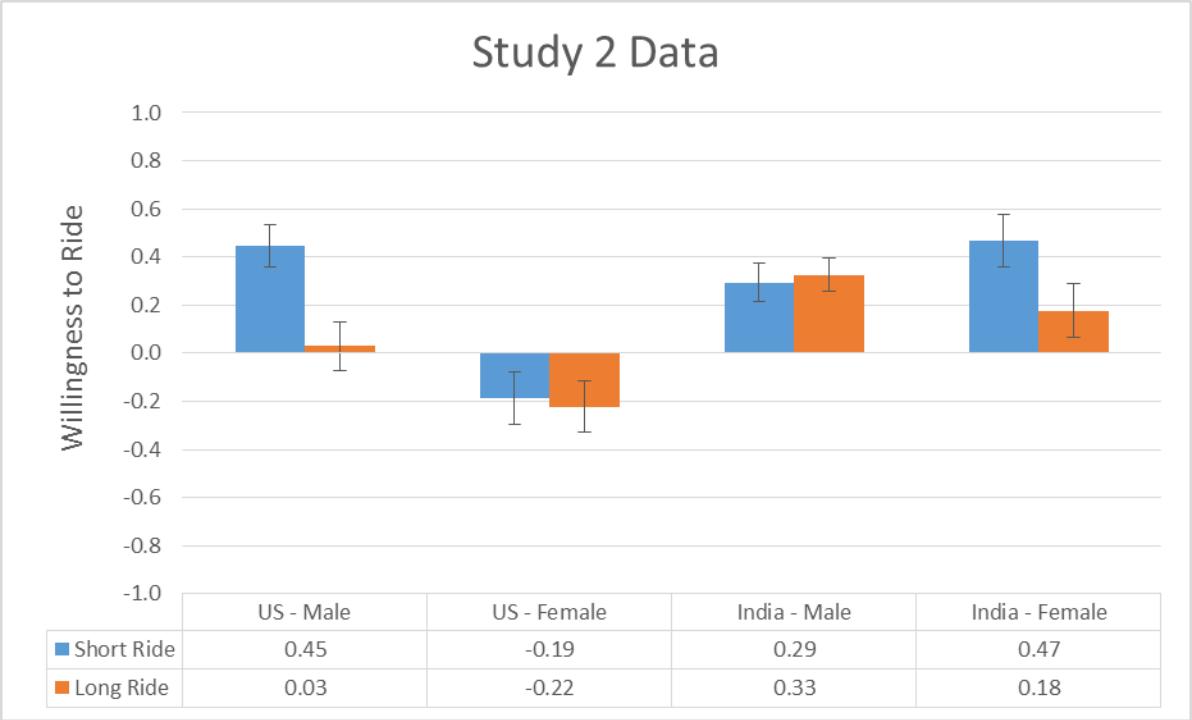

	US - Male	US - Female	India - Male	India - Female
Short Ride	0.45	-0.19	0.29	0.47
Long Ride	0.03	-0.22	0.33	0.18