Patient perceptions on the use of driverless ambulances: An affective perspective ☆

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ABSTRACT

Emergency medical transports provide life-saving services to their patients; however, staffing levels in the United States are leading to reduced capabilities or even in extreme situations, an inability to provide ambulance services. As technology continues to increase, driverless vehicles are becoming a reality. It is possible, in the near future, that technology may be able to support an ambulance operated autonomously. Therefore, the purpose of this study was to try and determine patient's willingness to ride on an ambulance operated autonomously as opposed to one driven by a human. Affect measures were also collected to determine if affect mediated the relationship between willingness to ride and the type of ambulance configuration. Through the use of 3 studies, the findings indicate that patients were less willing to ride in the scenario where the ambulance was operated autonomously than in the traditional configuration, and there was a significant interaction between gender and type of ambulance configuration with females being less willing to ride in the autonomous ambulance than males. Affect was found to act as a mediator between willingness to ride and the type of ambulance. Additionally, through the use of the six universal facial expressions, it was determined that the mediating emotions for males were fear and happiness, and the mediating emotion for females was anger. The authors propose practical implications of these research findings and suggest areas of future research.

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1. Introduction and background on EMS operations

EMS services fill an integral role in healthcare within the U.S. and worldwide. Usually, at the front line of healthcare in traumatic injuries and disasters, EMS agencies are often understaffed and unequipped to respond to all incidences. In fact, major US cities often run out of ambulances on a daily basis (McQuade, 2014). With the advent of automated driving technology, there is a potential for automated ambulances that can deliver the same level of care (i.e., still have two EMS providers onboard) while being able to self-drive from the scene of injury to a local hospital. Therefore, it appears that there is a valid need for this technology due to the growing number of aging individuals and the fact that EMS agencies are being burdened with a low number of vehicles and qualified professionals to operate them. Access to self-driving ambulances could revolutionize the EMS industry, and aid in keeping ambulance services running smoothly and efficiently at all times.

Automated ambulances would further enhance care because the usual two provider team can stay intact with the patient, rather than the more common situation of one agent driving while the other administers care. The importance of teamwork cannot be overstated – individuals working towards a shared goal as a team are capable of achieving outcomes that are beyond the capabilities of individuals working alone (Marks, Mathieu, & Zaccaro, 2001). Further, according to Salas, Rosen, Burke, and Goodwin (2009) "teamwork is the means by which individual task expertise is translated, magnified, and synergistically combined to yield superior performance outcomes" (p. 42). Current EMS agencies tend towards a 2-person team of providers often with one acting as the driver and the other as the medical provider administering care en route to a hospital. With the advent of automated driving capabilities, this current setup could change for the better. In other words, where two providers have to fulfill separate, and in many ways unrelated duties, with the introduction of a self-driving ambulance, the providers could instead act as a team in the delivery of care – which should directly improve patient outcomes (Hughes et al., 2016).

This leads to an important question: Would an injured person be willing to ride in an automated ambulance? Understanding consumer perceptions, in this case, are of utmost importance. If individuals are unwilling to ride, it might be difficult to institute ambulance services with automated vehicles. Further, through studying why individuals are or are not willing to ride can aid in developing educational initiatives and interventions to prepare potential patients for when this technology becomes a reality. Therefore, this set of studies will assess consumer perceptions and willingness to ride in automated ambulances to better understand under what conditions people will ride, and if not, why they are wary of using said technology.

2. Background

2.1. Increases in automation

In today's world of technological advancements being revealed on almost a daily basis, it is unsurprising that we see the implementation of automation in several new, unique and innovative manners to increase efficiency and decrease workload. Automation has been defined in many different ways, but the most applicable definition is the accomplishment of work or a mechanical or electrical task that otherwise would need to be accomplished by a human being (Wickens, & Hollands, 2000).

The benefits of automation are numerous. However there are certain aspects and situations where the implementation of automation brings about a sense of apprehension in human beings. Studies have shown that humans' perception of automation reliability directly influences their trust and, in turn, their dependence on said automation (Geels-Blair, Rice, & Schwark, 2013; Parasuraman & Riley, 1997; Rice & Geels, 2010; Rice, 2009). The psychological construct of trust is described as predictability in another person or object to perform as expected (Deutsch, 1958; Eckel & Wilson, 2004; Ergeneli, Saglam, & Metin, 2007). This concept of trust can also be applied to humans' trust in automation (Parasuraman & Riley, 1997; Reeves & Nass, 1996; Rice, 2009).

In the context of this research setting, the most applicable understanding of the relationship between trust and automation comes from Mayer, Davis, and Schoorman (1995) which states that when control in a situation is relinquished to another person or object, the trustor (i.e., the person giving trust) believes that said person/object will perform what is expected and that this relinquishment is in their best interest. Previous studies have been conducted in the aviation industry regarding the trust of passengers in the automation. In said studies, the researchers measure the willingness of passengers to fly onboard flights in different scenarios with manipulated levels of automation use (Rice et al., 2014; Winter et al., 2015). In these studies, the data suggests that as more automation is implemented in the cockpit, the passengers' willingness to fly decreases. It is inferred that this decrease in willingness is due to the passengers' emotions and their lack of trust in the automation. Similar to airline cockpits, the implementation of automated capabilities in emergency medical service vehicles may lead to the same level of unwillingness in its potential passengers most likely due to emotional reasons even though there may be clear benefits with no decrease in safety.

Studies have also been conducted on public perceptions of self-driving vehicles, and have found a variety of results. Most respondents were unwilling to pay more for a vehicle to have self-driving capabilities, indicating that cost of the feature was an important factor to most people (Kyriakidis, Happee, & De Winter, 2015). This is important to the current study as well, as the price of the feature may be a factor in participants' minds when visualizing the potential scenario. In regards to the topic of self-driving vehicles, studies have found that the areas that the public are most concerned about are the safety, legal liabilities, control, and software hacking/misuse (Howard & Dai, 2014; Kyriakidis et al., 2015). Therefore, this paper will examine willingness to ride in participants who are told they would be entering an automated ambulance or a "normal" ambulance driven by a human. Below we will highlight some of the major contributing factors in regards to willingness to ride, including gender and affect.

2.2. Gender differences in risk perception

It is possible that perceptions toward ambulance configurations may be affected by participants' gender. Males and females sometimes perceive things differently, and the literature does offer some examples of gender differences across risk perception (Byrnes, Miller, & Schafer, 1999; Powell & Ansic, 1997; Schubert, Brown, Gysler, & Brachinger, 1999). Powell and