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Consumer innovativeness and intentioned autonomous car adoption

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ABSTRACT

This study analyzes the moderating effects of consumer innovativeness on the relationships between different antecedents of autonomous vehicle adoption and purchase intentions of autonomous cars by distinguishing between different levels of consumer innovativeness (high versus low). Drawing from research on consumer innovativeness and Venkatesh et al.'s (2003) unified theory of acceptance and use of technology (UTAUT), an empirical model was developed and tested with data collected through an online survey (n = 241) by the means of structural equation modelling (SEM) and multi-group analysis. The results provide evidence that performance expectancy, effort expectancy and social influence are positively related with purchase intentions of autonomous cars. Consumer innovativeness moderates the relationships between the constructs, whereas the effects are stronger when consumer innovativeness is high rather than when it is low.

1. Introduction

Many of the latest product innovations in the automotive industry relate to the automation of driving. An increasing number of car manufacturers have recently introduced semi-automatic driving features such as adaptive braking and assisted parking, and have already announced the mass market launch of fully self-driving cars in the near future. However, innovations sometimes meet resistance or refusal in the marketplace (Rogers, 2003). Therefore, a variety of empirical models has already been proposed to predict and analyze consumers' behavioral intentions (Venkatesh, Morris, Davis, & Davis, 2003). Previous research on technology acceptance (e.g. Arts, Frambach, & Bijmolt, 2011; Davis, 1986; Lee, Lee, & Garrett, 2013; Venkatesh & Davis, 2000) has for instance emphasized the positive effects of perceived product features and social influence on consumer intentions to adopt new products. Besides, there is evidence that early adopters can act as catalysts for the diffusion and acceptance of innovation (Rogers, 2003). However, consumers have differing propensities in the adoption of new products, whereas the degree of consumer innovativeness positively affects innovation adoption behavior (Roehrich, 2004; Wang, Dacko, & Gad, 2008). For this reason, the segmentation of consumer profiles according to different levels of innovativeness can be crucial for developing effective market launch strategies for high technology products such as self-driving cars (Lee et al., 2013; Ratchford & Barnhart, 2012).

Informed by technology acceptance theory and Venkatesh et al.'s (2003) unified theory of acceptance and use of technology (UTAUT), this study seeks to analyze the effects of consumer innovativeness on the relationships between different hypothetical antecedents of autonomous car adoption and purchase intentions of self-driving cars. Previous research on innovation adoption (e.g.

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Roehrich, 2004; Wang et al., 2008) suggests that consumers have differing levels of innovativeness and that asymmetrical psychological predispositions exert an impact on innovation acceptance behavior. The objective of this paper is thus to examine how different levels of innovativeness (high versus low) influence consumers' likelihood to adopt autonomous vehicles. According to Bartels and Reinders (2011), many innovations fail as firms have missing knowledge of consumer needs. Therefore, this study aims to provide insight into the factors that are relevant for the mass market adoption of autonomous cars.

Although there are first attempts to capture consumer sentiment about self-driving vehicles, little attention has been paid to the effects of consumers' inherent personality traits. The distinction between different levels of consumer innovativeness allows for a more detailed consideration of consumer acceptance of new products and, in this case, the development of more targeted marketing strategies for the market launch of autonomous cars. The paper starts with discussing the potential implications of using self-driving cars as a means of transportation. Drawing from technology acceptance theory and research on consumer innovativeness, an empirical model is then developed and data from an online survey are tested with structural equation modelling (SEM) and multi-group analysis. The paper concludes with discussing the findings and practical implications for technology firms.

2. Autonomous cars as disruptive innovation

There is consensus that autonomous cars are one of the most important strategic innovations for the car industry (e.g. Anderson et al., 2012). The dream of self-driving cars dates back to the early decades of the 20th century, and recently, significant advances have been made. The fast evolution of driving assistance has caused certain dilution about the term “autonomous” in the context of cars. Therefore, different taxonomies have been proposed for classifying the increasing automation of driving in stages. The first stage of the taxonomy of the SAE (Society of Automotive Engineers) for example is entitled “no automation”, and describes a situation in which the driver is responsible for the whole driving task. “Driving assistance”, “partial automation”, “conditional automation”, and “high automation” are the next phases. Finally, stage six describes the “full automation” of driving (SAE, 2014):

> “Full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver.”
>
> (SAE, 2014)

Several car brands have already presented research vehicles that are able to match this criterion and announced the mass market launch of fully self-driving cars in the near future. However, high development costs pose issues for the development of self-driving vehicles. Autonomous cars require highly precise navigation maps, sensors, radars, and vehicle-to-vehicle communication infrastructures (Anderson et al., 2012). At many places worldwide, the traffic legislation currently still relies on historic frameworks that prohibit fully self-driving cars, which means that legal guidelines will need to evolve. The market adoption of self-driving cars might therefore be preceded by a transition period in which autonomous driving is mixed with non-autonomous driving. This may lead to a trade-off between comfort and velocity because autonomous cars tend to accelerate and decelerate more slowly than non-autonomous cars (Gao, Hensley, & Zielke, 2014). When self-driving cars predominate, however, four times as many cars could use the road infrastructure. Autonomous cars are supposed to increase productivity, since people can focus on activities other than driving. Besides, autonomous cars are supposed to decrease fuel consumption and pollution thanks to a more ecologically sound driving pattern. Therefore, autonomous cars could decrease the costs of driving, which could, however, increase the total number of vehicle miles traveled and so boomerang the (positive) effects on the negative externalities of driving (e.g. emissions) (Anderson et al., 2012).

Autonomous cars are supposed to increase road safety. According to the statistics, > 90% of today's road accidents are caused by human mistakes. There is evidence that cars equipped with driving assistance features are involved in fewer accidents (Fagnant & Kockelman, 2013). Although autonomous cars are not supposed to be involved in road accidents, liability and data security issues still need to be clarified, since self-driving cars are ought to register driver data (Browning, 2014). From a business perspective, however, new target groups (e.g. visually impaired people) could be attracted by autonomous cars (Gao et al., 2014). High technology firms (i.e. equipment provider), and car rental or car sharing companies could also benefit from the launch of automated cars, but jobs in the transportation sector (e.g. taxi drivers) may get lost (Anderson et al., 2012).

Autonomous driving technology is supposed to follow a tickle-down effect leading to its common usage in the future. However, certain examples of other innovative driver assistance systems show that little consumer acceptance and consideration in the pre-purchase evaluation can endanger the mass market adoption despite greater technological performance (Arndt & Engeln, 2008). Consumer adoption of driver assistance systems is multifaceted and mostly relies on subjective and emotional evaluations instead of factitious assessments of the technological readiness of the product. Different behavioral variables, as well as perceived product attributes are likely to influence consumer acceptance of driving assistance systems as disruptive innovations (Arndt, 2011).

2.1. Technology acceptance theory

Innovation can be defined as a process of making changes to something established by introducing something that adds value for customers (O'Sullivan & Dooley, 2008). It can be distinguished between radical and incremental innovation. Incrementally new innovations (INI) and products (INP) enhance existing products without discontinuities in technology or the marketplace. Radical innovations concern new innovations (RNI) and products (RNP) that cause discontinuity in technology or the marketplace (Hoeffler, 2003; Zhenfeng, Zhiyong, & Mourali, 2014). Disruptive innovation is a kind of radical innovation that occurs when new technology is introduced to a market. Such new technology is able to set-off the limits of existing technology (O'Sullivan & Dooley, 2008).

Innovations generally confront consumers with a dilemma in which consumers need to choose between keeping the existing