



Cognitive underpinnings of beliefs and confidence in beliefs about fully automated vehicles



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ABSTRACT

A study investigated the cognitive underpinnings of consumers' beliefs and confidence in their beliefs about fully automated vehicles. Following previous research, opinions about self-driving cars tended to be mixed. The most negative views were held by consumers who had the least knowledge of self-driving cars. Low trust in technology was also associated with more negative views. Although consumers were generally confident in their views of self-driving cars, many were uninformed about them. Consumers' confidence in their beliefs was more strongly correlated with perceived knowledge and general confidence than real expertise. Thus, consumers' confidence in their opinions about fully automated vehicles appears to be driven by cognitions that are largely superfluous. A mediation analysis suggests that general self-confidence influences judgmental confidence by affecting perceived judgment relevant knowledge. Participants' confidence in negative beliefs about fully automated vehicles suggests their opinions will not be easily influenced via persuasion.

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1. Introduction

Self-driving vehicles are an emerging technology that will radically reshape transportation on our roads and highways. Fully automated, level 5 vehicles will be able to perform all aspects of driving under all roadway and environmental conditions without human control of the vehicle (SAE International, 2014). Unlike semi-automated vehicles (levels 2 and 3) that require drivers to monitor and take back operational control of the vehicle whenever system failure occurs, fully-automated driving systems will not require manual intervention. These vehicles are expected to be safer and more energy efficient than current automobiles, and reduce traffic congestion and insurance rates. Moreover, people will be better able to socialize, work, and relax as they travel because they will be freed of the task of driving. Finally, self-driving vehicles will increase the mobility of persons who are physically or visually impaired.

The views that are currently being formed of fully automated vehicles and the confidence with which these views are held are important because they will affect consumers' willingness to adopt these vehicles. Consumer opinions will also determine the support for the legal and physical infrastructure needed to put the technology on our roads.

Numerous national and local surveys have assessed public attitudes toward fully automated vehicles. The studies have revealed that there is a wide range of opinion about the technology (e.g., Bazilinskyy, Kyriakidis, & de Winter, 2015). While most consumers are willing to ride in a driverless car (e.g., Autoblog, 2013), most are not ready to buy one (Konig & Neumayr, 2017). Moreover, while the majority of consumers believe that fully automated vehicles will increase driving safety, over a

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third believe that roadways will be safer if vehicles continue to be operated by people (Kelly Blue Book, 2016). Many consumers are reluctant to relinquish control of their cars (Kelly Blue Book, 2016; König & Neumayr, 2017). Concerns about the expense of driverless vehicles and fears about software failure and security are also commonplace (Fagnant & Kockelman, 2015; König & Neumayr, 2017; Kyriakidis, Happee, & de Winter, 2015; Schoettle & Sivak, 2014).

While numerous studies have examined consumer beliefs about automated vehicles, studies have not examined consumers' confidence in their beliefs. As we discuss shortly, confidence or certainty is important because it determines the willingness of people to act on their beliefs and the extent to which their beliefs are susceptible to influence. There has also been little work on the cognitive underpinnings of consumer opinions about fully automated vehicles. In this study, we investigated how knowledge of self-driving vehicles, perceived knowledge of self-driving vehicles, general beliefs about the self, and beliefs about technology are shaping attitudes toward self-driving cars and the confidence with which these attitudes are held. As we shall see, consumers are generally confident in their opinions about fully automated vehicles. That is, they tend to be relatively certain that their beliefs about driverless cars are accurate or correct. However, their confidence is commonly grounded in cognitions that are irrelevant to their judgments. Negative views of fully automated vehicles, while confidently held, do not appear to be based on real knowledge of the technology.

1.1. Why judgmental confidence matters

Confidence is important because it affects the willingness to act on an attitude or belief. Studies have shown that attitudes are more likely to guide decision making and behavior when certainty is high (e.g., Fazio & Zanna, 1978a, 1978b; Glasman & Albarracín, 2006). Judgments that are confidently expressed are also more likely to influence others (e.g., Cramer, DeCoster, Harris, Fletcher, & Brodsky, 2011; Tenney, Small, Kondrad, Jaswal, & Spellman, 2011). More importantly, confidence or certainty affects the extent to which attitudes and beliefs are susceptible to influence and change (Babad, Ariav, Rosen, & Salomon, 1987; Krosnick & Abelson, 1992; Swann, Pelham, & Chidester, 1988; see also Briñol & Petty, 2009). Finally, confident views are often extreme views. Evaluations that are confidently held or that are perceived to be based on a large amount of information tend to be more polarized, that is, more positive or negative as opposed to middling (e.g., Sanbonmatsu, Kardes, Posavac, & Houghton, 1997). Thus, the confidence with which beliefs about fully automated vehicles are held is important because it will affect the adoption of and support for the technology. Confidence or certainty may also determine the extremity of opinions about fully automated vehicles and the degree to which these opinions can be influenced.

To what extent is confidence based on real knowledge of the judgmental topic? Research has shown that there is only a moderate to weak positive relation between confidence and accuracy in important judgmental domains such as eyewitness identification (e.g., Bothwell, Deffenbacher, & Brigham, 1987; Sporer, Penrod, Read, & Cutler, 1995), clinical assessment (e.g., Miller, Spengler, & Spengler, 2015), and impression formation (e.g., Ames, Kammrath, Suppes, & Bolger, 2010). People are generally overconfident about the accuracy of their beliefs and judgments (e.g., Lichtenstein, Fischhoff, & Phillips, 1977; Vallone, Griffin, Lin, & Ross, 1990). Although the relation between expertise and calibration is modest, individuals who are low in knowledge tend to be the most overconfident (Lichtenstein & Fischhoff, 1977). Related work has shown that individuals who are lacking in competency are most likely to overestimate their ability and performance (Dunning, Johnson, Ehrlinger, & Kruger, 2003; Kruger & Dunning, 1999). These findings suggest that consumers may be confident in their beliefs about fully automated vehicles even when they know little about the technology.

What else might contribute to confident beliefs about driverless vehicles? An important factor affecting judgmental confidence or certainty may be general self-confidence. General confidence is often conceived to be the sum of a person's confidence in specific domains (Shrauger & Schohn, 1995). General belief in the self is associated with the tendency to overestimate the favorableness of past and future performance (Morrison, Thomas, & Weaver, 1973; Shrauger, 1972). Hence, it may be associated with overconfidence in the accuracy or correctness of one's specific judgments. While general confidence may be unrelated to actual domain specific knowledge, it may contribute to greater perceived knowledge which may heighten estimations of judgmental accuracy (Trafimow & Sniezek, 1994).

1.2. A study of the cognitive underpinnings of beliefs about autonomous vehicles

A survey was conducted to measure consumers' beliefs about fully automated vehicles and their confidence in their beliefs. Consumers also expressed their intentions to purchase a driverless vehicle, and their support for legislation and policies to put these driving systems on our roadways. Additionally, consumers completed a measure of their perceived knowledge and a test of their actual knowledge of fully automated vehicles. They also filled out the general self-confidence scale developed by Shrauger and Schohn (1995). Finally, participants were asked to complete the trust in technology scale (McKnight, Carter, Thatcher, & Clay, 2011; McKnight, Choudhury, & Kacmar, 2002). Trust in technology is composed of two constructs – faith in general technology, which refers to the belief that technology is usually reliable, functional, and helpful, and trusting stance, which refers to the belief that positive outcomes will result from relying on technology. Participants completed a scale of both constructs.

The predictions of the study were grounded in previous research on automated vehicles and theory on attitudes and judgment. They were also derived from an unpublished survey we had conducted earlier in the year examining consumer attitudes toward advance driving assistance systems and fully automated vehicles. The survey of 200 consumers revealed mixed evaluations of self-driving cars. However, consumers were confident in their opinions regardless of their levels of expertise

or knowledge. Most consumers were not well informed about fully automated vehicles. Those who were lacking in knowledge tended to express the most negative views.

Although these data were intriguing, the findings were not publishable because the questions were embedded in a larger survey of advanced driving assistance systems that proved to be uninteresting. We did not want to selectively report the data on fully automated vehicles. In addition, the unpublished survey helped us to develop some novel hypotheses about the possible determinants of judgmental confidence that we sought to investigate in this follow-up. In many respects, though, the present study was an effort to replicate our prior findings.

Following our previous research, we predicted that consumers would generally be confident in their opinions about fully automated vehicles. However, they were not expected to be highly knowledgeable about them. It was anticipated that consumers' confidence would be more strongly associated with perceived knowledge of self-driving vehicles and general confidence than with actual knowledge. Consumers with the least expertise were expected to have the most negative opinions about self-driving cars. Finally, beliefs about fully automated driving systems were expected to be much more favorable when consumers generally trust technology.

2. Methods

2.1. Participants

One hundred fourteen (47 female, 66 male, and one unidentified) Amazon Mechanical Turk workers were paid three dollars to complete the survey. Participation was limited to workers in the United States who were "Masters" ("who have demonstrated excellence across a wide range of HITs" or human intelligence tasks). The ages of the participants were as follows: 2 were 16–24 years old, 62 were 25–34 years old, 28 were 35–44 years old, and 22 were 45 or older. All but three of the participants reported that they had a driver's license.

2.2. Procedure

The survey was administered on Qualtrics. A consent cover letter was presented to inform participants of the aims and procedures of the study, and their rights as participants. They were told: "The purpose of this research is to investigate peoples' attitudes toward emerging driving technologies. You will complete a survey of your opinions and beliefs about fully autonomous (self-driving) vehicles". The survey items were administered in 10 sections or blocks. Participants were allowed to skip questions. However, they were not allowed to return to questions in a previous block after moving to a new block. Afterwards, they were thanked for their participation and debriefed.

2.3. Measures

On the first measures of the survey, participants indicated their age, gender, and whether they had a driving license.

2.3.1. General confidence

Participants then completed the 7 items of the general self-confidence sub-scale of the Personal Evaluation Inventory (PEI; [Shrauger & Schohn, 1995](#)). They indicated their agreement with statements such as "I lack some important capabilities that may keep me from being successful" and "when things are going poorly, I am usually confident that I can successfully deal with them". The PEI has been shown to have high level of internal consistency and reliability ([Shrauger & Schohn, 1995](#)).

2.3.2. Beliefs and evaluation

In the next section of the survey, participants were informed: "you will be asked about your views of fully autonomous (self-driving) vehicles. These are the vehicles of the near future that are currently in development which will be completely autonomous and not require a human driver." They were asked to indicate their agreement or disagreement with the following statements: "The first generation of fully autonomous (self-driving) vehicles on our roads will be unsafe for many years because of problems with the technology"; "Fully autonomous (self-driving) vehicles will reduce traffic congestion and help to diminish energy consumption"; "Fully autonomous (self-driving) vehicles will be a threat to public safety because many drivers will not know how to operate them properly". Participants responded on a 7 point scale anchored by 1 = *strongly agree* and 7 = *strongly disagree*, with a midpoint of 4 = *neither agree nor disagree*. They also expressed their overall evaluation of autonomous vehicles on a 7 point scale anchored by 1 = *highly positive* and 7 = *highly negative*, with a midpoint of 3 = *neither positive nor negative*. Finally, participants indicated "How confident are you about your assessment of fully autonomous (self-driving) vehicles? That is, how confident are you that your assessments are correct?" on a 4 point scale where 1 = *not at all confident*, 2 = *a little confident*, 3 = *confident*, and 4 = *highly confident*. They also indicated "How certain are you about your judgments of fully autonomous (self-driving) vehicles? That is, how certain are you that your judgments are right?" on a 4 point scale where 1 = *not at all certain*, 2 = *a little certain*, 3 = *somewhat certain*, and 4 = *highly certain*.

2.3.3. Intentions and policy beliefs

Participants were asked to indicate their agreement with the following statements about their intentions and policy beliefs: “I am going to try to purchase or lease a fully autonomous (self-driving) vehicle as soon as they become available to consumers”; “I think that policy makers should begin planning and laying the groundwork for fully autonomous (self-driving) vehicles on our roadways”; “States should hold off on legalizing fully autonomous (self-driving) vehicles until they are more completely developed and tested”. They again responded on a 7 point scale anchored by 1 = *strongly agree* and 7 = *strongly disagree*.

2.3.4. Perceived knowledge of automated vehicles

Participants indicated “How much do you know about fully autonomous (self-driving) vehicles?” on a 5 point scale on which 1 = a *great deal*, 2 = a *lot*, 3 = a *moderate amount*, 4 = a *little*, and 5 = *nothing at all*.

2.3.5. Measure of knowledge of automated vehicles

Participants were asked to assess the truth or falsity of 8 statements about driverless vehicles. The 8 items are presented in [Appendix A](#). They were reminded in the instructions that “fully autonomous (self-driving) vehicles... are the vehicles of the near future that are currently in development which will be completely autonomous and not require a human driver”. The questions measured knowledge of fully automated vehicles as they are currently being designed. Obviously, exact knowledge of the driverless cars that will be on roads in the future cannot be measured because of the uncertainty of the precise technology that will be implemented.

2.3.6. Propensity to trust technology

Participants completed the 4 item “faith in general technology” and the 3 item “trusting stance” subscales constituting the propensity to trust technology ([McKnight et al., 2011](#)). They indicated their agreement with items such as “I believe that most technologies are effective at what they are designed to do” that reflect the degree to which technology is assumed to be reliable and helpful, and statements such as “I usually trust a technology until it gives me a reason not to trust it” that measure the expectation that positive outcomes will result from relying on technology. For the sake of brevity, the mean responses to the trusting stance and faith in general technology scales were averaged to create a single index of trust in technology.

3. Results

3.1. Mean responses to survey questions

3.1.1. Favorableness of beliefs and evaluations

[Table 1](#) presents the mean responses to the questions about fully automated vehicles. The means tended to be middling while the standard deviations were fairly high. For example, the mean belief that self-driving vehicles will be unsafe because of problems with the technology was 3.93 on a 1–7 scale with a midpoint of 4 while the standard deviation was 1.71. The middling means and sizeable standard deviations suggest that participants’ views about fully automated vehicles were highly variable.

Table 1
Mean responses and standard deviations.

	Mean	SD
“The first generation of fully autonomous (self-driving) vehicles on our roads will be unsafe for many years because of problems with the technology” (1 = <i>strongly agree</i> and 7 = <i>strongly disagree</i>)	3.93	1.718
“Fully autonomous (self-driving) vehicles will reduce traffic congestion and help to diminish energy consumption” (1 = <i>strongly agree</i> and 7 = <i>strongly disagree</i>)	2.73	1.604
“Fully autonomous (self-driving) vehicles will be a threat to public safety because many drivers will not know how to operate them properly” (1 = <i>strongly agree</i> and 7 = <i>strongly disagree</i>)	4.20	1.896
Evaluation of fully autonomous (self-driving) vehicles (1 = <i>highly positive</i> and 7 = <i>highly negative</i>)	2.92	1.630
Confidence in assessments of fully autonomous (self-driving) vehicles (1 = <i>not at all confident</i> and 4 = <i>highly confident</i>)	2.75	0.807
Certainty of judgments of fully autonomous (self-driving) vehicles (1 = <i>not at all certain</i> and 4 = <i>highly certain</i>)	2.87	0.815
“I am going to try to purchase or lease a fully autonomous (self-driving) vehicle as soon as they become available to consumers” (1 = <i>strongly agree</i> and 7 = <i>strongly disagree</i>)	5.04	1.752
“I think that policy makers should begin planning and laying the groundwork for fully autonomous (self-driving) vehicles on our roadways” (1 = <i>strongly agree</i> and 7 = <i>strongly disagree</i>)	2.46	1.608
“States should hold off on legalizing fully autonomous (self-driving) vehicles until they are more completely developed and tested” (1 = <i>strongly agree</i> and 7 = <i>strongly disagree</i>)	3.53	1.878
Perceived knowledge of fully autonomous (self-driving) vehicles (1 = a <i>great deal</i> and 5 = <i>nothing at all</i>)	3.30	0.775
Actual knowledge of fully autonomous (self-driving) vehicles (maximum possible score = 8)	5.70	1.20

Note: N = 114.

Nevertheless, on average, participants' opinions about fully automated vehicles tended to be positive. The judgments of the safeness of the technology, the impact of the vehicles on traffic congestion and energy use, and the safeness of drivers' operation of the vehicles, and evaluations of the vehicles (the first 4 items in Table 1) were averaged (with the first and third items reverse scored) to create an overall index of the favorableness of beliefs about automated vehicles. The mean assessment of self-driving cars was 3.38 on a 7 point scale where a lower score indicated more favorable beliefs. This mean was significantly less than the midpoint of 4, $t(113) = 4.54, p < 0.001$.

3.1.2. Intentions and policy beliefs

Most participants reported that they do not intend to lease or purchase a self-driving car when they first become available. While most favored planning and building the groundwork needed for fully automated vehicles, many tended to believe that "states should hold off on legalizing fully automated (self-driving) vehicles until they are more completely developed and tested".

3.1.3. Confidence and certainty

Although there were a broad range of opinions about fully automated vehicles, participants tended to be confident about their views. The mean levels of confidence and certainty both approached 3 on a 4 point scale. 65.8% of participants indicated that they were "confident" or "highly confident" and 72.0% indicated they were "somewhat certain" or "highly certain" about their views of fully automated vehicles. Only 8% of respondents indicated they were "not at all confident" and only 7% indicated they were "not at all certain". The measures of confidence and certainty were highly correlated $r(113) = 0.77, p < 0.001$. Consequently, the measures were averaged to create a single index of confidence and certainty that was used in the correlational analyses.

3.1.4. Knowledge and perceived knowledge

Participants' knowledge of autonomous vehicles was assessed by eight questions. Because the items were true or false, there was a 0.50 chance of guessing the correct answer to any question. Thus, the chance score was 4 out of 8. Overall, participants were not highly knowledgeable of fully automated systems. For example, only 32.5% knew that self-driving vehicles may not offer a steering wheel, and 44.7% believed that human control of fully automated vehicles will be necessary in inclement weather or bumper to bumper traffic. 42.1% of participants scored 5 (slightly above chance) or worse.

Participants reported modest levels of knowledge of fully automated vehicles; 47.4% indicated that they had "a moderate amount" of knowledge of self-driving vehicles while 36.8% indicated they knew "a little". The correlation between actual knowledge and perceived knowledge was significant, $r(113) = -0.266, p = 0.004$, as participants who reported knowledge generally knew more about fully automated vehicles.

3.2. Presumed determinants of beliefs about autonomous vehicles

Correlational analyses were performed to examine the cognitive factors that may shape consumers' beliefs about driverless cars. The correlations between participants' knowledge and perceived knowledge of autonomous vehicles, and their trust in technology, and their beliefs about autonomous vehicles are presented in Table 2.

As actual knowledge of fully automated vehicles increased, beliefs about the technology were more positive. For example, the mean favorableness (index) of beliefs about driverless cars was significantly positively correlated with expertise. Thus, participants who had the most negative views of fully automated vehicles tended to have the least actual knowledge of them.

Table 2

Correlations between beliefs about fully automated vehicles, and knowledge, perceived knowledge, trust in technology, and confidence and uncertainty (p values in parentheses).

	Knowledge	Perceived knowledge	Trust in tech	Confidence and certainty
Self-driving vehicles will be unsafe because of problems with the technology	0.222 (0.018)	-0.237 (0.011)	-0.285 (0.002)	0.206 (0.028)
Self-driving vehicles will reduce traffic congestion & energy consumption	-0.282 (0.002)	0.251 (0.007)	0.370 (0.000)	-0.192 (0.041)
Self-driving vehicles will be a threat to public safety because drivers will not know how to operate them	0.245 (0.009)	-0.288 (0.002)	-0.322 (0.000)	0.275 (0.003)
Evaluation of self-driving vehicles	-0.153 (0.105)	0.236 (0.011)	0.355 (0.000)	-0.133 (0.157)
Mean favorableness of beliefs about and evaluation of self-driving vehicles (index)	-0.265 (0.004)	0.298 (0.001)	0.389 (0.000)	-0.240 (0.010)
Intention to lease or purchase a self-driving vehicle	-0.004 (0.639)	0.297 (0.001)	0.297 (0.001)	-0.179 (0.057)
Policy makers should begin laying the groundwork for self-driving vehicles	-0.180 (0.055)	0.250 (0.007)	0.269 (0.004)	-0.236 (0.011)
States should hold off on legalizing self-driving vehicles	0.126 (0.183)	-0.218 (0.020)	-0.233 (0.013)	0.322 (0.000)

Note: N = 114.

The pattern was identical for perceived knowledge of fully automated vehicles. As self-ratings of expertise increased, assessments were more positive. Thus, participants who reported the lowest levels of perceived knowledge tended to evaluate self-driving vehicles most negatively. Perceived knowledge was also significantly correlated with intentions and policy beliefs; as self-ratings of expertise increased, the endorsement of legal and political support for the technology, and the intention to lease or purchase a self-driving vehicle also increased.

Finally, trust in technology was positively correlated with beliefs about fully automated vehicles. Participants who trust technology tended to judge driverless cars more favorably. For example, they were more likely to believe that fully automated vehicles will reduce traffic congestion and energy consumption. They also were more likely to convey legal and political support for autonomous vehicles, and express the intention to lease or purchase a driverless car.

3.3. Confidence in beliefs about autonomous vehicles

3.3.1. The relation between confidence and beliefs

Table 2 presents the correlations between belief favorableness and confidence. As beliefs about driverless cars became more positive, confidence and certainty tended to be higher. For example, participants who believed that fully automated vehicles will reduce congestion and energy consumption expressed high levels of confidence in their views. However a closer examination of the data revealed that the levels of confidence of participants who expressed negative views about fully automated driving systems were also relatively high. In fact, on average, their confidence was almost identical to that of participants reporting positive views. For example, participants who evaluated self-driving cars negatively were not less confident than participants who expressed neutral or positive evaluations, $M = 2.78$ vs. $M = 2.93$, $t(112) = 0.853$, $p = 0.395$. A regression analysis indicated that there was a quadratic trend characterizing the relation between the mean favorableness of the index of beliefs about automated vehicles and confidence, $F(2, 111) = 3.96$, $p = 0.022$, in which confidence was higher for participants whose evaluations were more positive and more negative as opposed to near the midpoint.

This pattern was more directly captured by the analysis of the relation between judgmental confidence and extremity. The extremity of the favorableness of the index of beliefs about fully automated vehicles was calculated by subtracting the index from the midpoint (4) and calculating the absolute value. As expected confidence and certainty was highly correlated with extremity, $r(113) = 0.445$, $p < 0.0001$; participants who were confident about their beliefs tended to express greater positivity or greater negativity about self-driving systems.

3.3.2. Predictors of confidence

Correlational analyses were conducted to examine the possible determinants of participants' confidence in their beliefs about automated vehicles. From Table 3, it is apparent that judgmental confidence was predicted by perceived knowledge but not by actual knowledge of self-driving systems. A comparison of the correlation coefficients indicates that perceived judgment relevant knowledge was much more strongly correlated with confidence than was actual knowledge, $z = 3.27$, $p = 0.001$. Judgmental confidence was also significantly correlated with general confidence. The correlation between perceived knowledge and general self-confidence was marginally significant, $r(113) = -0.176$, $p = 0.061$. Finally, participants' confidence in their beliefs about fully automated vehicles was marginally significantly correlated with trust in technology.

We speculated that general confidence may contribute to judgmental confidence by increasing perceived judgment relevant knowledge. An analysis was conducted to test whether the relation between general self-confidence, and judgmental confidence and certainty is mediated by perceived knowledge. Bootstrapping ($N = 114$, 10,000 bootstrap resamples) indicated that perceived knowledge partially mediated this relation (indirect effect = 0.01, $SE = 0.006$, 95% $CI = 0.0007$ to 0.0245). The total effect of general self-confidence on judgmental confidence remained significant when perceived knowledge was included in the model (direct effect = 0.031, $SE = 0.012$, 95% $CI = 0.0073$ to 0.0541).

In sum, participants' confidence in their beliefs about fully automated vehicles does not appear to have been based on actual knowledge. Rather, their confidence or certainty was predicted most strongly by how much they thought they know and general self-confidence – factors that are largely irrelevant to certainty about judgments of driverless cars. The mediation analysis suggests that general confidence affects judgmental confidence, in part, by increasing how much consumers think they know.

Table 3

Correlations between confidence and certainty in automated vehicle judgments, and knowledge, perceived knowledge, general confidence, and trust in technology (p values in parentheses).

	Confidence and certainty
Knowledge	0.053 (0.577)
Perceived Knowledge	-0.456 (0.000)
General self-confidence	0.290 (0.002)
Trust in Technology	-0.162 (0.085)

Note: $N = 114$.

4. Discussion

Beliefs about fully automated vehicles tend to be favorable (e.g., [Konig & Neumayr, 2017](#); [Schoettle & Sivak, 2014](#)). Nevertheless, a sizeable proportion of consumers appear to minimize the benefits of the technology and believe that driverless cars will be unsafe. Our findings indicate that the most unfavorable views of fully automated vehicles are held by the least knowledgeable consumers. Thus, a significant contributor to negativity toward self-driving vehicles appears to be ignorance. The favorableness of beliefs about fully automated vehicles was also related to trust in technology; consumers who do not perceive that technology is helpful and reliable, and who do not believe that positive outcomes result from relying on technology evaluate self-driving cars less positively.

Consumers are generally confident about their views of fully automated vehicles even though many are uninformed about them. 72% of our respondents indicated they were “somewhat certain” or “highly certain” about their beliefs, even though 42.1% performed barely above chance or worse on our measure of knowledge of driverless cars. The findings indicated there is little relation between actual knowledge of fully automated vehicles and judgmental confidence. Nonetheless, confidence appears to contribute to more polarized opinions about self-driving vehicles. Participants who were high in judgmental confidence tended to express much more positive or much more negative views than participants who were less certain.

The study furthered the judgment literature by showing the relative contributions of knowledge, perceived knowledge, and general self-confidence to judgmental confidence. The confidence expressed by participants was more strongly correlated with perceived judgment relevant knowledge and general self-confidence than real expertise. Thus, consumers' confidence in their opinions about automated vehicles appears to be driven heavily by factors that are largely superfluous. Prior research has shown that perceived knowledge contributes to judgmental confidence ([Trafimow & Sniezek, 1994](#)). The mediation analyses suggest that general confidence influences judgmental confidence by affecting perceived judgment relevant knowledge. Finally, although the least knowledgeable consumers expressed the most negative opinions about driverless cars, they tended to hold these views with a high degree of confidence.

The development of measures for the timely study of emerging phenomena such as automated vehicles does not always permit careful psychometric testing. Our measure of knowledge of self-driving vehicles was not systematically assessed for validity and reliability. However, we believe that the measure has a high level of face validity (see [Appendix A](#)). Moreover, it was significantly correlated with perceived knowledge, with both measures indicating that beliefs about fully automated vehicles become less positive as knowledge decreases. This convergence, as well as the consistency of the findings with the pilot study that was conducted, suggests that the findings involving expertise are valid and reliable.

Why do consumers with lower knowledge of driverless cars tend to have less favorable views? Consumers who are relatively ignorant may harbor unwarranted beliefs about the risks of self-driving vehicles. Indeed, low knowledge participants tended to agree with erroneous statements such as “fully autonomous (self-driving) vehicles will require a human driver in inclement (bad) weather conditions, and bumper to bumper traffic”. However, interest in and liking of fully automated vehicles may also affect knowledge. Consumers who are drawn to automated systems may be more apt to seek out information about them which may contribute to the positive relation between expertise and the favorableness of beliefs.

Fully automated vehicles are expected to be safer and more energy efficient than current automobiles, and are expected to reduce traffic congestion and insurance rates. The adoption of fully automated vehicles and the support for policies to put these vehicles on our roads is heavily dependent on public attitudes toward this emerging technology. Unfortunately, beliefs about driverless cars are mixed. Our study indicates that misconceptions and ignorance are responsible for much of the negativity. Consequently, education and communication about fully automated vehicles could be effective in changing consumer attitudes. However, the high levels of confidence of consumers harboring negative views of driverless vehicles suggest that these opinions may be resistant to persuasion. Direct experience (e.g., [Fazio & Zanna, 1978b](#)) with fully automated vehicles, rather than communication, may be necessary to convince skeptical consumers of the merits of the technology.

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Appendix A

Measure of Knowledge of Automated Vehicles

1. Fully autonomous (self-driving) vehicles will rely heavily on GPS (global positioning systems) for navigation. (true)
2. Fully autonomous (self-driving) vehicles will require a human driver in inclement (bad) weather conditions, and bumper to bumper traffic. (false)
3. Fully autonomous (self-driving) vehicles will require the installation of an extensive network of beacons embedded every 10 to 20 yards in every road and street to guide traffic. (false)

4. Fully autonomous (self-driving) vehicles may not even offer a steering wheel. (true)
5. Fully autonomous (self-driving vehicles) will utilize radar, laser sensors, and cameras to detect and track other vehicles. (true)
6. Some states such as California have passed laws allowing fully autonomous (self-driving) vehicles to operate on the road, including those without an accelerator pedal or brake pedal. (true)
7. Fully autonomous (self-driving) vehicles are being developed not only by automobile manufacturers, but also by tech companies such as Google. (true)
8. Most fully autonomous (self-driving) vehicles will have electrical rather than gas combustion engines. (true)

Appendix B. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.trf.2018.02.029>.

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