

THE EFFECT OF RELIGIOSITY ON DECISION
MAKING IN SELF-DRIVING CARS: THE
CASE OF “THE ETHICAL KNOB”

by

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ABSTRACT

This study focused on the ethical dilemmas of self-driving cars and how religiosity levels affect consumers' perceptions of morality. Specifically, this research examined how religiosity affects consumer's comfort levels and moral perceptions of the "ethical knob" and the "ethical knob's" settings, which would allow the passenger of a self-driving car to determine how the car reacts in an unavoidable accident. Most of the hypotheses concerning the effects of religiosity surprisingly were not supported; however, the vast majority of respondents, regardless of religiosity, believed the Impartial setting was most moral, and they were most comfortable with it. This study concluded that religiosity levels alone do not affect consumers' moral perceptions of the "ethical knob" and the "ethical knob" settings, and it revealed some interesting disconnects. One would believe that more religious individuals would prefer the Impartial setting over those that are not religious due to the many moral laws and principles laid out by their religion (e.g., the inaction principle), but this study did not support this assumption. It is likely that overall cultural differences affect consumers' moral perceptions rather than one element of culture, namely religion. We must conduct more research on society's cultural elements to fully understand the moral perceptions involved in self-driving cars.

INTRODUCTION

In March of 2018, a self-driving car operated by Uber hit and killed a woman in Tempe, Arizona. The woman was walking on the shoulder of the road with her bike, when the self-driving car struck her at approximately 40 miles per hour (Wakabayashi, 2018). This story is a tragic reminder that self-driving cars are not accident-proof, and they can still be dangerous.

Many people advocate for self-driving cars because they bring numerous benefits to society, and they will transform our lives. The most common argument is that roads will be safer for all. The adoption of autonomous vehicles would save thousands of lives. According to a study, if roughly 90 percent of the automobiles on American roads were driverless, the number of accidents a year would drop significantly from 6 million to 1.3 million (Thompson, 2016). Traffic and fuel emissions will also become more efficient with the adoption of self-driving cars. Adoption of autonomous vehicles in the U.S. would result in saved money, more free time for consumers, benefits to the economy, and reduced CO₂ emissions from cars by approximately 300 million tons a year (Thompson, 2016). According to Ozimek (2014), the sum of all automobile deaths, medical and work loss, accident injuries, non-injury crashes, and time spent in the car cost the United States around \$1.23 trillion. This figure suggests that if self-driving cars reduced accidents to 1.3 million a year, the United States would save about \$964 billion annually.

Governments and consumers have high incentives to implement self-driving cars worldwide; however, society must address several issues before making self-driving cars readily available to consumers on public roads. The Federal Ministry of Transport and Digital Infrastructure in Germany recently released the “Ethics Commission: Automated and Connected Driving Report.” This report outlines ethical rules for connected vehicular traffic. For example, one rule states, “In hazardous situations that prove to be unavoidable, despite all technological

precautions being taken, the protection of human life enjoys top priority in a balancing of legally protected interests” (Federal Ministry of Transport and Digital Infrastructure, 2017, p. 11). Other countries such as the United States have begun regulating the self-driving car industry as well. On September 12th, 2018, the “National Highway and Transportation Safety Administration released A Vision for Safety 2.0, which is new federal guidelines for automated driving systems” (“Autonomous Vehicles: Self-Driving”, 2018).

Because self-driving cars are a growing phenomenon in society, several academic researchers have focused on the ethical implications of autonomous vehicles. Specifically, many have examined the decision-making abilities of self-driving cars in the event of unavoidable harm. Literature has proposed several solutions, including a mandatory ethics setting, and many have surveyed consumers’ opinions and thoughts on these solutions (Gogoll & Muller, 2017). This topic is difficult and complex because while ethical dilemmas have no objective answer, our society must come to a conclusion of the “best” solution to implement in self-driving cars. In order for manufacturers to produce self-driving cars, society must arrive at an “acceptable” solution for the government and consumers. Self-driving cars could provide enormous benefits to society, but if we cannot agree on the best way to handle the cars’ ethics, the benefits may not materialize.

This paper examines a proposed solution that each car has a customizable and changeable ethics setting, or an “ethical knob.” Italian researchers Contissa, Lagioia, and Sartor proposed the ethical knob in 2017, so little research currently exists on consumers’ perceptions of it. The ethical knob allows for three ethical settings: Altruist, Impartial, and Egoist. Each of the settings determines whose lives the driverless car gives priority to in a situation with certain harm. This study will additionally include a fourth option (Random). The researcher chose to include a

random option to test whether individuals preferred the car to take the situation into account or not.

This paper examines consumers' perceptions of the ethical knob by studying the effect of religiosity on the consumers' choices. Specifically, the study will measure consumers' religiosity and analyze how moral consumers think the ethical knob settings are and which setting they prefer in relation to their religiosity levels. Religiosity is an important factor to consider when developing conclusions on user preference for ethical decision making in autonomous cars, as religion is an important driver of many people's actions. Often, religion is a construct that people will never go against; therefore, governments and manufacturers must understand how consumers' religion will affect driverless technology. Further, different areas of the world have different levels of religiosity and different types of religion. In Awad et al.'s (2018) research, several situations were analyzed, and the study concluded that the many aspects of culture affect people's ethical perceptions. Religion is one of the many aspects of culture that must be researched further. This research will assist governments in further research to decide which driverless car ethical knob setting is more suitable for specific regions. Only one region is analyzed in this study, but it is a good starting point for further research.

The remainder of this paper includes a literature review on self-driving cars, the decision-making process in self-driving cars, the ethical dilemma of self-driving cars, the ethical knob, and religiosity's effect on decision-making and morals. After reviewing the research, the paper explains the research model used for the structure of a survey for a group of Texas Christian University participants. The survey will extrapolate information from Texas Christian University students and faculty as well as colleagues and peers of the researcher to draw conclusions about people's religiosity and its effect on their perceptions and decisions involving the ethical knob.

The paper will conclude with an analysis of the survey data, conclusions, limitations, and implications drawn from the results.

LITERATURE REVIEW

Self-Driving Cars

Self-driving cars are no longer considered a technology of the future. The industry is already well established, estimated to be worth \$54.23 billion in 2019, and it will continue to increase to \$556.67 billion in 2026 based on current research (Garsten, 2018). Many companies and organizations are already taking advantage of autonomous vehicle technology. Companies such as FedEx, Walmart, and Sysco have already bought Tesla's partial self-driving semi-truck, the Semi. PesiCo recently placed the largest Semi order, reserving 100 trucks in late 2017 (Matousek, 2018). Although consumers are hearing about self-driving cars more in the media, some studies show that people are growing more apprehensive about the technology. Nearly half of those surveyed said they would never buy a fully-autonomous car, while two years ago only 30 percent expressed this opinion (Edelstein, 2018). Based on these data, consumers are not ready to trust self-driving cars; however, many manufacturers are racing to begin producing them. Officials in California have given approval to fifty-two companies (Apple, Honda, BMW, Nissan, etc.) to test driverless vehicles on the road (Miller, 2018). Manufacturers must find a way to help consumers feel comfortable and in control while riding in autonomous cars.

When discussing self-driving cars, an important distinction must be made. Self-driving vehicles make use of five different "levels" of automation, according to The US National Highway Traffic Safety Administration. These levels include cars with no automated control systems, cars with certain autonomous features such as automatic braking, and fully automated

cars (National Highway Traffic Safety Administration, 2013). In this paper, self-driving cars are considered fully autonomous.

Decision Making Process in Self-Driving Cars

In order to qualify as fully autonomous, a car must replace the human driver. The problem with this notion is that cars will not go through the same thought process as a human driver would. When comparing decision making processes of humans and cars/computers, one must recognize an important difference in the feedback loop through which humans and cars can learn. Every time a human completes an action, he or she learns from the outcome and adjusts the actions in the future while a computer would complete an action and could not adjust behavior until the manufacturer updated its software (Holstein, Dodig-Crnkovic, & Pelliccione 2018). This risk is slowly being mitigated through updated technology like machine learning, however.

Self-driving cars rely on different information inputs than human drivers would. These inputs include computer vision, parallel computing, machine learning, and more. Based on the inputs, self-driving cars make calculations based on an *abstraction* of the real world. Of course, to have the abstraction match reality as closely as possible, more data is helpful; however, too much data may require more filtering to find the useful information, or the computer may pass by key points (Holstein et al., 2018). Software engineers, therefore, have the responsibility to decide which data the cars should use in the decision-making process.

Programmers take two common approaches to automate moral decision-making in artificial intelligence. Game theory is used to represent decision scenarios where multiple parties have different interests. Different sequences of actions lead to certain parties gaining or losing from the scenario; however, it is necessary to extend game theory's concept in order to

encompass moral behavior (Borg, Contizer, Deng, Kramer, & Sinnott-Armstrong, 2017).

Machine learning is another approach. With this approach, a programmer must “assemble a training set of moral decision problem instances labeled with human judgments of the morally correct decision(s), and allow our AI system to generalize” (Borg et al., 2017, p. 4834).

Ethical Dilemmas of Self-Driving Cars

Although self-driving cars are altogether safer for society than human operated vehicles, not all accidents can or will be avoided. At times, self-driving cars will have to make a moral choice even though they do not have a moral compass by nature. A common example of this situation is represented through three situations in Bonnefon, Shariff, and Rahwan’s article (2015). A self-driving car is driving on the road when it meets pedestrians/a pedestrian in the middle of the street. The situations/options are as follows:

- a) The car can stay on course and kill several pedestrians, or swerve and kill one passerby
- b) The car can stay on course and kill one pedestrian, or swerve and kill its passenger
- c) The car can stay on course and kill several pedestrians, or swerve and kill its passenger.

We realize the ethical dilemma when avoiding harm is not possible, so the harm must be distributed. In the situations above, the car must have built in moral algorithms in order to make a decision, and the moral algorithms must align with society’s moral attitudes.

Moral attitudes are not universal. In fact, human societies embrace many different moral doctrines, and this complicates how self-driving cars should be programmed. One of the most common and accepted moral doctrines is utilitarianism or the consequentialist approach. This

approach examines the outcome of the options and chooses the one with the best outcome (Shou & Song, 2017). In situations a) and b) above, the utilitarian perspective would be in favor of killing one person (the passerby/passenger) versus many people. Another competing view is the deontological approach. The deontological approach focuses on whether “an act is consistent with a moral principle or duty” (Shou & Song, 2017, p. 481). An example of a moral principle would be to never kill another person. From the deontological perspective, regardless of how many people could be saved, it would be morally wrong to kill another. In the situations presented above and in the ethical dilemma of self-driving cars overall, the deontological approach is difficult to apply. Self-driving cars make decisions on how to react in an accident long before the crash occurs. Currently, humans make decisions in split seconds during accident scenarios, and they likely do not have the time to consider moral consequences.

A recent study, conducted by Awad et al. (2018), dove deeper into the moral dilemmas faced by autonomous vehicles with their “Moral Machine.” The article captures the high dimensionality of the self-driving car ethical dilemma. The Moral Machine is a ‘game’ that allows for worldwide collection of data about individuals’ ethical preferences on autonomous vehicles in different areas of the world. The people playing the “game” choose one of two options in accident scenarios. The article focused on nine factors: saving humans versus pets, staying on course versus swerving, sparing more or fewer lives, sparing men or women, sparing young or old; sparing pedestrians who cross legally versus jaywalkers, sparing fit versus not, and sparing higher social status individuals versus lower (Awad et al., 2018).

The article by Awad et al. (2018) gathered a large data set and developed three different clusters (Western, Eastern, and Southern) based on location of the respondents. Based on the cluster to which the researcher assigned them, respondents allocated largely different weights to

their ethical preferences, which likely resulted from differences in culture and the economies of the countries in the clusters. For example, people view some cultures as more individualistic (versus collectivistic) had a stronger preference for saving the largest number of people. Further, the study found another strong preference overall to spare young lives versus old lives, and it found that respondents who identified with high levels of religiosity preferred saving humans over animals.

Although the literature did not attempt to pinpoint the reason behind the findings across cultures, it provided valuable insight into the correlations for future research. Some literature alludes that individuals that identify with higher levels of religiosity also are more collectivistic. One study found that non-religious people have lower levels of collectivism than religious individuals (Protestants and Catholics) (Stark, 2009).

In order to resolve the disparity in moral opinions, one study suggests a mandatory ethics setting for self-driving cars (Gogoll & Muller, 2017). Based on literature and research, people tend to believe that the best option is to program all self-driving cars with utilitarian ethics; however, the same people would prefer to ride in cars programmed to protect the passengers and would not buy a car programmed otherwise (Bonnefon et al., 2016). Noothigattu et al. (2017) offer three suggestions on how to deal with the self-driving car ethical dilemma: impose a mandatory ethics setting on self-driving cars, allow manufacturers/programmers to decide, or create a personal ethics setting for passengers (“the ethical knob”), which will be the focus of the following section. Some literature suggests aggregating people’s opinions on ethical dilemmas and creating a concrete approach for ethical decision making based on it (Noothigattu et al., 2017). Each of these suggestions comes with pros and cons, and manufacturers and regulators will need to manage three incompatible goals: being consistent, not causing public outrage, and

not discouraging buyers (Bonneton et al., 2016). Consumers must feel comfortable with autonomous cars' ethical decision making because a study in Korea found that as consumers' ethical expectations for autonomous vehicles increase, consumers' positive thinking about autonomous vehicles also increases. The study defined ethical expectations by observing whether consumers thought the self-driving cars would make desirable decisions, ethical decisions, and whether the consumers trusted the ethics of autonomous cars (Ha & Ro, 2017).

The Ethical Knob

The trolley problem is a common ethical thought experiment used for years to discuss the concept of "killing versus letting die." Ethicists established the original trolley problem as follows:

Edward is the driver of a trolley, whose brakes have just failed. On the track ahead of him are five people; the banks are so steep that they will not be able to get off the track in time. The track has a spur leading off to the right, and Edward can turn the trolley onto it. Unfortunately there is one person on the right-hand track. Edward can turn the trolley, killing the one; or he can refrain from turning the trolley, killing the five (Thomson, 1976, p. 206).

Researchers have altered the trolley problem for many different ethical thought experiments including for self-driving cars. The problem poses the difficult idea that deciding to kill one will save multiple, but if you do not act, then you are letting five individuals die. A version of the trolley problem used for self-driving cars was stated earlier (Bonneton et al., 2015).

Researchers have proposed the concept of an "ethical knob" in an attempt to solve the self-driving car ethical dilemma, and it grew from the trolley problem's ethical options. Some people fear that a mandatory ethics setting in all self-driving cars will discourage consumers

from buying them since, based on studies, people prefer to ride in a vehicle that protects the passengers (Bonnefon et al., 2016). Millar (2015) also discusses the problem with removing the users of self-driving cars from the decision-making process. In the event of an unavoidable accident, the situation has a direct implication on the users, and if governments and manufacturers do not consider their input, automating self-driving cars' ethical decision making threatens the moral autonomy of the consumer. To allow artificial intelligence to choose the outcomes of moral dilemmas amounts to a form of paternalism which is ethically undesirable because it excludes the user from the decision-making process (Millar, 2016). Contissa et al. (2017) were the first to propose the concept of the "Ethical Knob" in their article. Their scenario assumes that the passenger will have the task of picking the ethical approach that the car takes in the event of an accident, and the self-driving car will only *implement* the ethical choice rather than make the decision. To execute this idea, the self-driving cars would be equipped with a knob with three settings (see Figure 1):

1. Altruistic mode: Gives the preference for third parties (always sacrifices the self-driving car's passenger(s) lives)
2. Impartial mode: Gives equal importance to passengers and third parties (by basing the decision of who lives on the utilitarian principle – saving the most people)
3. Egoistic mode: Gives preference for passengers (always sacrifices third parties and pedestrians)

If a passenger sets the knob to the Impartial mode, and there is equilibrium when evaluating the situation using the utilitarian principle, the car could make the decision based on presumption or random choice. Contissa et al. (2017) discuss the possibility of the ethical knob having continuous settings to assign weights to certain people's lives. For the case of this article, the

ethical knob will only have the three distinct options, and the author has added a fourth “Random” option. The random option will instruct the vehicle to pick an option randomly. The image below shows the original options proposed by Contissa et al. (2017).

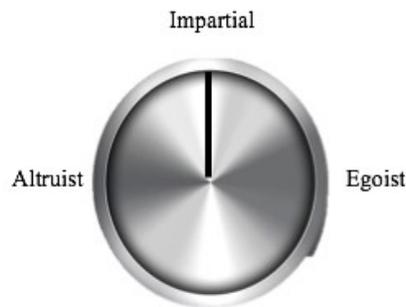


Figure 1: The Ethical Knob

Some may question what the difference is between having cars with an ethical knob and allowing consumers to buy cars with their ethical preference pre-programmed. With the ethical knob, passengers can establish kin altruism. Setting the knob to Egoist would allow for kin altruism to take place because the self-driving car would act to protect the passenger and loved ones riding in the car as well (Contissa et al., 2017). The car’s ethical setting can be changed according to the situation or the driver. Also, some literature suggests applying the ethical knob to other industries with ethical dilemmas coming from autonomous technology, e.g., healthcare and manufacturing (Beall, 2017).

As discussed earlier, the ethical decision must be in someone’s hands: the manufacturer, government, or consumer. A personal ethics setting such as the ethical knob is desirable because if it is what customers want, manufacturers must produce self-driving cars with ethical knobs, and governments should only pass laws and regulations that align with the morals of their citizens. Ethical preferences are too diverse to create a regulation that pleases most, if not all, citizens (Gogoll & Muller, 2017).

Religiosity's Effect on Decision Making and Morals

As discussed previously, deontological ethics focus on duty rather than outcome. Some actions are right or wrong regardless of the consequences or results. Based on literature, more religious individuals generally are more likely to make deontological judgments over utilitarian/consequentialist judgements. This conviction is likely due to the belief that morality is founded on divine authority and “moral rules” found in most religions instead of reasoning (Piazza & Landy, 2013). Some of these value frameworks include Islam's Sharia, Catholicism's Canon Law, and Judaism's Halacha (Esptein, 2010). Different rules govern different religions, but most religions share common principles. Most important to this study is the prohibition of killing and the *inaction principle*. The *inaction principle* states that consequences caused by doing something (action) are worse than consequences caused by inaction (Zamir, 2014). In contrast, the indirectness principle prohibits an action if it uses a person as a means to an end. (Cushman, Hauser, & Young, 2006).

Some religions have different ideas of what it means to be moral. Protestants view thoughts just as important as actions; therefore, if you think of doing something immoral, then you are being immoral. By contrast, Judaism cares more about the actual actions (Cohen, Wu, & Miller, 2016). This distinction becomes important when one studies the ethical knob since the thought is an important factor in the choice.

This study combines the findings of previous literature with new proposed solutions such as the ethical knob. It examines the effect of religiosity on participants' perceptions of the ethical knob settings and which they would select. Previous research provided valuable insight into the research methods and conclusions drawn from this study.

RESEARCH METHODS

Research Model

The survey used for this research will examine the correlation between religiosity and participants' moral perceptions of the ethical knob settings as well as which self-driving car ethical knob settings they would prefer to be on the road around them.

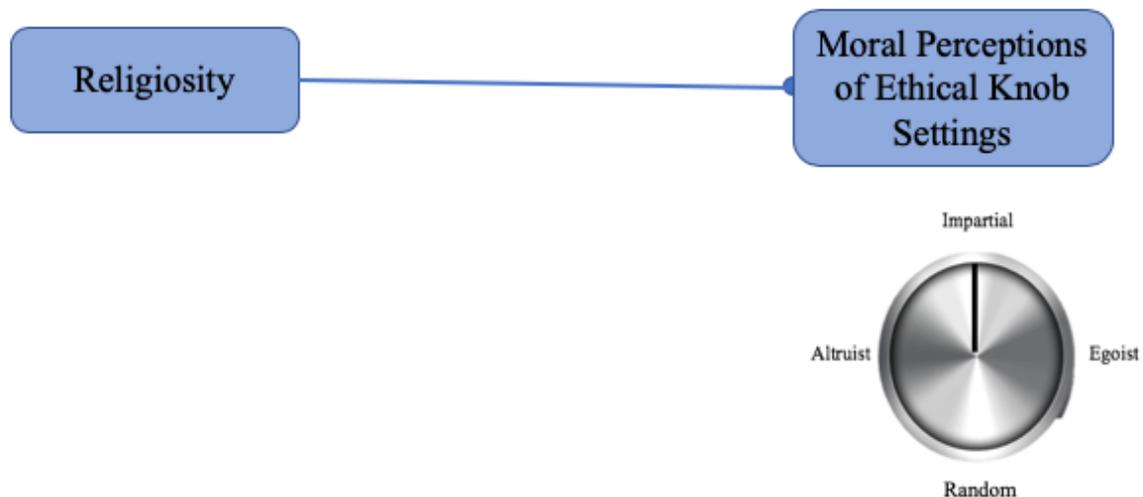


Figure 2: Research Model for Religiosity and the Ethical Knob

Research Hypotheses

The researcher formed multiple hypotheses in order to test the relationship between religiosity and the settings chosen on the ethical knob as well as perceived morality of the settings in self-driving cars.

H1: Higher levels of religiosity will lead consumers to believe the morality of the ethical knob in general is low.

As discussed by Zamir (2014), the *inaction principle* prohibits any action regardless of the potential outcome, and many religions incorporate this principle into their belief systems. People with high levels of religiosity will not want to choose any setting because they are taking

an action that may choose who lives and who dies. Also, some religions, such as Protestants, believe that the thought can be immoral without the action (Cohen et al., 2016). The ethical knob inherently causes the user to think about what to choose, and individuals with high levels of religiosity would not believe this thought to be moral.

H2: Higher levels of religiosity will lead consumers to believe the Impartial setting on the ethical knob is most moral.

As discussed above, since individuals with higher levels of religiosity believe that the action is immoral, they will not want to decide on who to sacrifice in the case of an accident (Zamir, 2014). The Impartial setting comes closest to inaction because the car will make the decision in the moment based on the situation; therefore, the user does not take the final “action” deciding who to spare.

H3: Higher levels of religiosity will lead consumers to believe the morality of choosing the Altruist setting on the ethical knob is higher than the morality of choosing the Egoist setting.

Many religions have definitive moral principles that one must abide by, and those with higher religiosity are more likely to believe in the deontological principle (Piazza & Landy, 2013). One of the most common laws is that one must never kill. Those with high levels of religiosity likely would find setting the ethical knob to Altruist as more moral than Egoist because Altruist would avoid harm to others. This way, you are not choosing to sacrifice someone’s life in a crash. The Egoist setting would be most similar to killing someone else, as the passenger is sacrificing another person to save his or her life.

H4: Higher levels of religiosity will make consumers least comfortable with self-driving cars with ethical knobs set to Egoist on the road than the other three settings.

Again, many religions prohibit killing. Those with high levels of religiosity will be more comfortable if no one on the road chooses to sacrifice others using the Egoist setting. Participants who fall higher on the religiosity scale will not be comfortable on the roads if others are going against the participants' morals.

H5: Higher levels of religiosity will make consumers most comfortable with self-driving cars with ethical knobs set to Impartial on the road over the other settings.

Those with high levels of religiosity are more likely to believe that taking any action is morally wrong, especially when it involves the lives and well-being of others. The Impartial setting allows the car to choose what action to take based on the scenario rather than the passenger, so individuals who have higher levels of religiosity will favor this option on their roads because it means that others are not completing an immoral action or decision. With the Impartial setting, no one is choosing the final action to take in regard to human life.

H6: Higher levels of religiosity will make consumers less willing to buy self-driving cars with an ethical knob.

Individuals with high levels of religiosity are more likely to believe that the action is in and of itself immoral (Zamir, 2014). The action of choosing a setting on the ethical knob would be immoral because the passenger is taking an action that involves someone's life. These individuals will not want to buy a car that forces them to take an action that makes them feel immoral.

H7: Lower levels of religiosity will make consumers more likely to believe that the Impartial setting is more moral than the Random setting.

Individuals with low levels of religiosity tend to believe in the utilitarian principle (Barak-Corren & Bazerman, 2017) . They believe it is most moral to save the most lives. The Random setting will choose any of the three options without taking situation, number of people, etc. into account; therefore, it will not be the most utilitarian option.

Methodology

This study surveyed adults through an online questionnaire/survey administered to students and faculty at Texas Christian University (TCU) as well as friends and peers of the researcher. The survey assessed the effect of religiosity on respondents' decisions regarding the "ethical knob" and its settings in self-driving cars. This survey was distributed via a URL included in emails to participants. To ensure that each respondent only completes the survey once, the survey software tracked IP addresses to block duplicates. The digital software used to conduct the survey was Qualtrics, and the survey questions and survey model appear in the Appendix. When the author distributed the survey, the email included a mandatory consent form, a description of the purpose of the survey, as well as the URL to the Qualtrics survey. Specifically, the survey consisted of 16 questions, and took approximately ten minutes to finish. The participants of the survey came from varying backgrounds, as participants come from different areas of the world, genders, classifications, and religions.

Since religion can be a sensitive topic that some people feel uncomfortable answering questions about, the survey included other demographic questions, and the demographic questions section was placed at the end of the survey. This survey structure helped avoid skewed results due to participants noticing the correlation between religion and decision making.

Before officially launching the survey and collecting data, the researcher pilot tested the survey with three individuals to ensure all questions were correctly stated, questions could not be skipped, and invalid data could not be submitted. Once tested, the researcher administered the survey in the beginning of January 2019 and collected data until the beginning of February 2019.

The Qualtrics survey measured participants' religiosity, their preferences regarding self-driving cars' ethical knob settings: Altruistic, Impartial, Egoist, or Random, and their comfort level with having an ethical knob in the cars. The dependent variable in this study is what setting participants believe is the most moral on the ethical knob, and the independent variable is the participants' religiosity levels. In order to measure religiosity, the survey employs an existing religiosity framework used by Barak-Corren and Bazerman (2017). To test what people would choose on the ethical knob, the researcher used slightly modified scenarios and questions from Bonnefon et al. (2016). The survey consent statement, questions, and a figure mapping the survey appear in the Appendix.

DATA ANALYSIS AND RESULTS

The researcher cleaned the data collected from the survey by removing any unfinished survey responses, responses indicating lack of attention, and test responses. Removing these responses resulted in a sample size of 284 respondents. The following section summarizes the analysis and findings from the survey.

Demographic Data

This survey included several questions related to demographics. To identify general information about respondents, there were questions regarding respondents' gender, age, education level, and ethnicity/ethnic origin (one question each). The survey also contained seven questions related to level of religiosity. Using these seven questions, the researcher calculated

one, final measure of religiosity per respondent from one to seven. The final measure was calculated by averaging the responses from the seven questions. The researcher used this final measure, referred to as “full religiosity measure,” several times throughout the analysis. The measure can range from one to seven – one being the lowest level of religiosity and seven being the highest level of religiosity. With a Cronbach’s Alpha of .947, the seven-question scale has high reliability and internal consistency.

The table below (Table 1) illustrates the demographic data as percentages out of the 284 respondents.

D#/R#										
D12	Gender	Female	Male							
		44.7%	55.3%							
D13	Age	18-22	22-30	31-40	41-50	51-60	Over 60			
		75.7%	3.2%	1.1%	2.8%	7.7%	9.5%			
D14	Education Level	High-school	1 year college	2 years college	3 years college	4 years college	Bachelor	Master	Doctoral	
		9.5%	26.8%	34.9%	6.0%	2.8%	5.3%	7.4%	7.4%	
D16	Ethnicity/ Ethnic Origin	White	Hispanic/Latino	Black/AA	Native American	Asian/PI	Other			
		84.5%	8.1%	1.4%	0.0%	4.9%	1.1%			
R5-11	Full Religiosity Measure	Low 1-2.99	Neutral 3-4.99	High 5-7						
		15.8%	27.8%	56.3%						

*D# - Demographic variables' associated question number in the survey

*R# - Religiosity variable's associated question numbers in the survey

Table 1: Demographic Data

By examining the data in Table 1, one can note that the majority of respondents are 18-30 years of age and have completed two years of college or less (roughly 78.9% and 71.2%, respectively). Additionally, the vast majority of survey respondents are white (roughly 84.5%) with little representation of other ethnicities. Lastly, those with low levels of religiosity were under represented (roughly 15.8% of respondents) while those with high levels of religiosity contributed to over half the responses (roughly 56.3%). This over-representation of high levels of religiosity can likely be contributed to the fact Texas Christian University identifies as a religious school. Many of the respondents were students and professors.

In order to add to the discussion of perceived morality of self-driving cars and the ethical knob, the researcher analyzed the correlations between the demographic variables and perceived morality of the ethical knob in general. In order to detect any differences in perceived morality of the ethical knob (Q1) between the two genders (D12), the researcher conducted a Two Sample (with unequal variances) t-Test assuming a 95% confidence interval. The test found a significant difference in means between male and female respondents (p-value = 0.035). Males on average rated the morality of the ethical knob higher than females did (means = 49.44 and 43.24 respectively).

Since the majority of respondents were 18-22 years of age, the comparison between means for the other age groups was difficult; therefore, the researcher split the sample into two groups: Generation Z/Millennials (18-40) and Generation X through the Silent Generation (41-60+). The researcher conducted a Two Sample (with unequal variances) t-Test to analyze the difference between the mean ratings of perceived morality of the ethical knob of these two groups. The results indicate no significant difference in means between the two age groups (p-value = 0.425). Lastly, the researcher analyzed education level to observe if there was an effect on the perceived morality of the ethical knob in general. Again, since the individual education level groups have very different sample sizes, the sample was split into those that have had two years or less of college and those that have more than two years of college, and the researcher conducted a Two Sample (with unequal variances) t-Test. There was no significant difference between the mean ratings of perceived morality of the ethical knob in general (p-value = 0.15). Overall, the demographic variables collected did not seem to have an effect on the perceived morality of the ethical knob other than the gender variable. Some evidence suggests that males

perceive the ethical knob as more moral than females do, but more research would need to be conducted to confirm the hypothesis.

H1: Higher levels of religiosity will lead consumers to believe the morality of the ethical knob in general is low.

In order to address and analyze the first hypothesis, the researcher analyzed the seven questions related to religiosity (R5-R11), and one question about the perceived morality of the ethical knob in general was asked (Q1). The researcher used a simple linear correlation to analyze whether there is a relationship between level of religiosity and the perceived morality of the ethical knob. First, a scatter plot was created using the full religiosity measure for each respondent as the independent variable and the perceived morality of the ethical knob as the dependent variable (see Figure 3). The findings indicate no linear relationships between the two variables, as the data points are scattered. To confirm this conclusion, a trend line was added to the scatter plot using a linear regression, and it was evident there was no relationship, as the correlation coefficient was zero ($R^2 = -.0004$). Based on this analysis, Hypothesis 1 is not confirmed. There is no evidence that higher levels of religiosity lead consumers to believe the morality of the ethical knob in general is low.

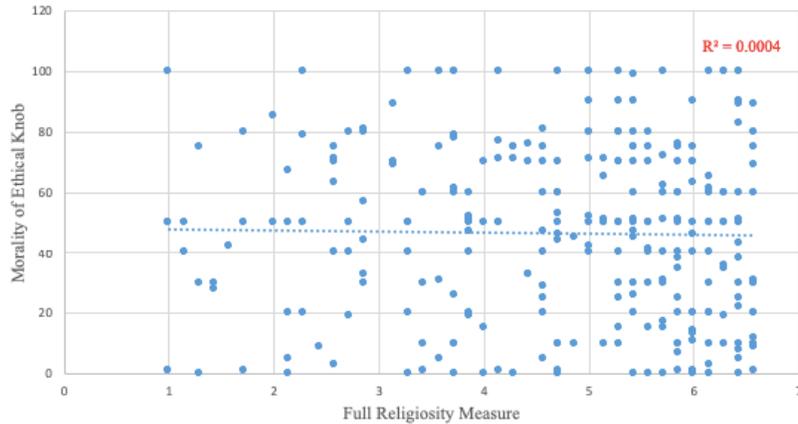


Figure 3: Correlation Between Religiosity Level and Perceived Morality of the Ethical Knob

H2: Higher levels of religiosity will lead consumers to believe the Impartial setting on the ethical knob is most moral.

To test the validity of Hypothesis 2, the researcher used one question (with four sub-questions) regarding the morality of each setting on the ethical knob (Q2), and seven questions regarding the religiosity of the respondent were analyzed to create one full religiosity measure per respondent (R5-R11). First, the sample was broken into two groups: those that rated the Impartial setting (II) higher than the other three settings (most moral) and those that did not. From these groups, the full religiosity measures were extrapolated for each respondent and averaged to get the mean religiosity level for each of the two group. These means were compared using a Two Sample (with unequal variances) t-Test with a 95% confidence level. Table 2 summarizes the output of this analysis.

t-Test: Two-Sample Assuming Unequal Variances		
	Impartial Rated Highest	Impartial NOT Rated Highest
Mean Religiosity Level	4.7903	4.6883
Variance	1.9956	3.1648
Observations	217	67
Hypothesized Mean Difference	0	
df	91	
t Stat	0.4267	
P(T<=t) One-Tail	0.3353	
t Critical One-Tail	1.6618	
P(T<=t) Two-Tail	0.6706	
t Critical Two-Tail	1.9864	

Table 2: Hypothesis 2 Output – Impartial vs. Other Settings

As Table 2 indicates, the means of the religiosity levels of the two groups are very similar. When the t-Test was completed, it was confirmed that the slight difference in means is not significant, as the p-value is greater than 0.05 (p-value = 0.34). By observing the differences between the average religiosity level in the two groups, one can gain insight into whether religiosity level affects respondents' views on the morality of the ethical knob settings. For example, if the means were significantly different, one could conclude that religiosity levels may have an impact on the respondents' moral perceptions. Since there is no significant difference in the two groups' means, one can conclude that higher levels of religiosity do not lead consumers to believe that the Impartial setting is most moral. Hypothesis 2 is not confirmed.

H3: Higher levels of religiosity will lead consumers to believe the morality of choosing the Altruist setting on the ethical knob is higher than the morality of choosing the Egoist setting.

In order to analyze Hypothesis 3, the researcher analyzed the seven questions related to religiosity (R5-R11) to calculate a full religiosity measure for each participant. Once a full

religiosity measure was calculated for each participant, the sample was split into three groups based on religiosity level. The three groups were those with low levels of religiosity (1-2.99 full religiosity measure), those with neutral levels of religiosity (3-4.99 full religiosity measure), and those with high levels of religiosity (5-7 full religiosity measure). One question (with four sub-questions) related to the perceived morality of the four settings was also used (Q2). Specifically, the sub-questions related to the Egoist setting (Q2, setting I) and the Altruist setting (Q2, setting III) were analyzed. The points given to these two settings (1-100, 100 being perceived as most moral) were identified for each person in the three groups. Then, for each group, the mean ratings were calculated for each of the two settings: Altruist and Egoist. These means were compared using a Paired Two-Sample t-Test for each group. Finally, the corresponding P-values were analyzed (see Table 3).

	Mean Egoist	Mean Altruist	Difference in Means (Absolute Value)	p-value
Low Religiosity	14.40	12.24	2.16	0.305
Neutral	10.234	14.16	3.92	0.029
High Religiosity	10.91	18.95	8.04	2.35E-05

Table 3: Hypothesis 3 Output

Table 3 reveals differences in the perceived morality/rating of the Egoist setting and the Altruist setting in all three groups. The Paired Two-Sample t-Tests confirms that the differences in means are significant for the Neutral and High Religiosity groups (p-value = 0.029 and p-value = 2.35E-05, respectively); however, for the Low Religiosity group, the difference in means is not significant (p-value = 0.305). A column chart was created to visualize the mean differences. The religiosity groups are the independent variables and the average perceived morality ratings of the two settings is the dependent variable (see Figure 4).

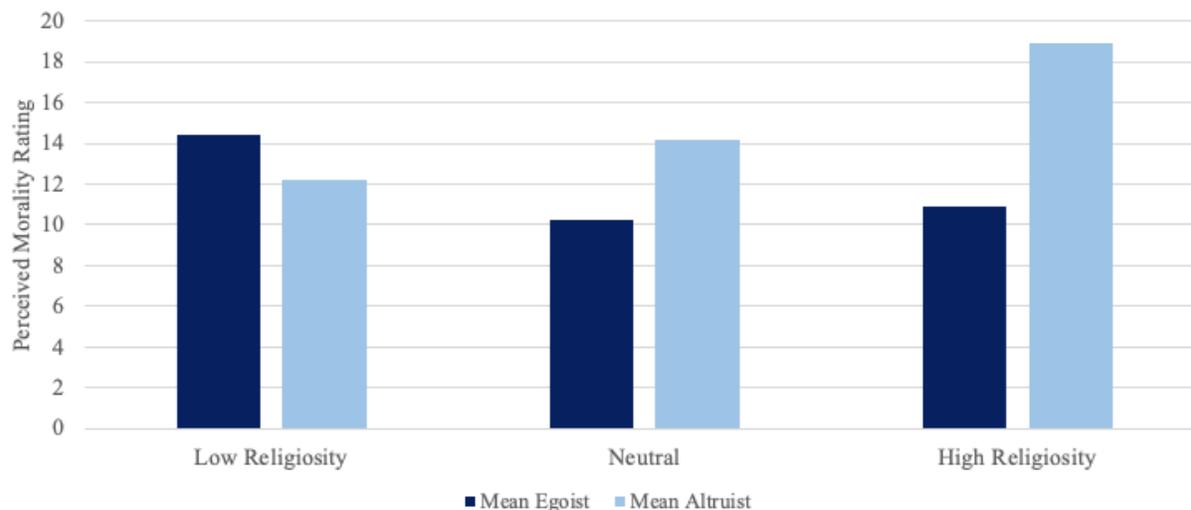


Figure 4: Egoist and Altruist Setting Rating Means for Three Different Groups Based on Religiosity Levels

Figure 4 reveals differences in the morality ratings for the Egoist and Altruist settings; however, the size of the difference varies according to the religiosity group. For the low religiosity group's means, the mean of the Egoist setting is higher than the mean of the Altruist setting. For the Neutral and High Religiosity Groups, the means for the perceived morality of the Altruist setting is higher than the means for the Egoist setting. Also, the difference between the means is greater for the High Religiosity group than the Neutral group (8.04 and 3.92, respectively). This information may partially support Hypothesis 3. Since the difference between the means grows as the level of religiosity grows, the evidence may support the idea that higher levels of religiosity will lead consumers to believe the morality of choosing the Altruist setting on the ethical knob is higher than the morality of choosing the Egoist setting. However, the difference in means for the Low Religiosity group were not statistically significant, so it is necessary to conduct more research.

H4: Higher levels of religiosity will make consumers least comfortable with self-driving cars with ethical knobs set to Egoist on the road than the other three settings.

To analyze Hypothesis 4, the researcher used seven questions on religiosity (R5-R11) to calculate one, full religiosity measure for each respondent, and one question (with four sub-questions, Q3) regarding the participants' comfortability of each ethical knob setting. Similar to the H2 analysis, the sample was broken into two groups: those least comfortable with the ethical knob set to Egoist (setting I) and those least comfortable with one of the other settings. For each group, the full religiosity measures for each respondent were extrapolated and averaged to get the mean religiosity level for the group. To analyze the difference in the means of the two groups, the researcher used a Two-Sample (assuming unequal variances) t-Test with a 95% confidence interval. Table 4 presents the output of the test.

t-Test: Two-Sample Assuming Unequal Variances		
	Least Comfortable with Egoist Setting	Least Comfortable with Another Setting
Mean Religiosity Level	4.8866	4.7474
Variance	2.0368	2.2859
Observations	34	250
Hypothesized Mean Difference	0	
df	44	
t Stat	0.5294	
P(T<=t) One-Tail	0.2996	
t Critical One-Tail	1.6802	
P(T<=t) Two-Tail	0.5992	
t Critical Two-Tail	2.0154	

Table 4: Hypothesis 4 Output – Egoist vs. Other Setting

Table 4 shows that the religiosity level means for the two groups are similar. The slight difference in means is not significant and is due to random chance (p-value = 0.29). There is no significant difference in the groups' mean religiosity level; therefore, one cannot conclude that

higher levels of religiosity will make consumers least comfortable with self-driving cars with ethical knobs set to Egoist on the road than the other three settings. The findings do not support Hypothesis 4.

H5: Higher levels of religiosity will make consumers most comfortable with self-driving cars with ethical knobs set to Impartial on the road over the other settings.

To analyze Hypothesis 5, the researcher used seven questions related to religiosity (R5-R11) as well as one question (with four sub-questions) related to respondents' comfort with the ethical knob settings (Q3). From the seven religiosity questions, one measure of religiosity was calculated for each participant ("full religiosity measure"). First, the sample was separated into two independent groups: individuals most comfortable with the Impartial setting and individuals most comfortable with one of the other three settings. Then the researcher extrapolated each individual's full religiosity measure and calculated the average religiosity measure for both groups. With this information, a Two-Sample (with unequal variances) t-Test using a 95% confidence interval was conducted. Table 5 summarizes the results of this test.

t-Test: Two-Sample Assuming Unequal Variances		
	Most Comfortable with Impartial Setting	Most Comfortable with Another Setting
Mean Religiosity Level	4.7349	4.8551
Variance	2.1513	2.5861
Observations	215	69
Hypothesized Mean Difference	0	
df	107	
t Stat	-0.5515	
P(T<=t) One-Tail	0.2912	
t Critical One-Tail	1.6592	
P(T<=t) Two-Tail	0.5824	
t Critical Two-Tail	1.9824	

Table 5: Hypothesis 5 Output – Impartial vs. Other Setting

Similar to the results of Hypotheses 2 and 4, the religiosity level means are similar across the two groups. The Two-Sample t-Test indicates that the slight difference in means is not significant. The p-value is not less than 0.05 (p-value = 0.29), so the difference is due to random chance. Significant differences in the mean religiosity levels would likely indicate that level of religiosity plays a role in the respondents' level of comfort with the ethical knob settings. Since there is not a significant difference between the means, Hypothesis 5 cannot be confirmed. Higher levels of religiosity do not make consumers most comfortable with self-driving cars with ethical knobs set to Impartial on the road over the other settings.

H6: Higher levels of religiosity will make consumers less willing to buy self-driving cars with an ethical knob.

In order to test Hypothesis 6, the researcher used seven questions relating to religiosity levels (R5-R11) along with one question regarding respondents' willingness to buy a self-driving car with an ethical knob installed (Q4). From the seven religiosity questions, one measure of religiosity from one to seven was calculated for each survey respondent ("full religiosity measure"). First, a scatter plot was created using the full religiosity measure as the independent variable and the level of willingness to buy a self-driving car with an ethical knob (1-100) as the dependent variable. The scatterplot helps viewers visualize the relationship between the two variables; however, the results indicate there is no relationship because a pattern is not apparent (see Figure 5). To confirm this observation, a linear regression was completed. The correlation coefficient was almost zero ($R^2 = 3e-5$), so there was no relationship. Because there is no correlation between religiosity levels and willingness to buy a self-driving car with an ethical knob, Hypothesis 6 is not supported.

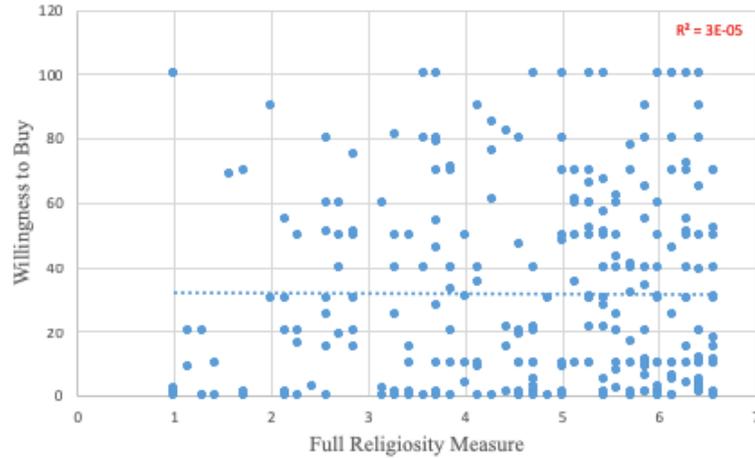


Figure 5: Correlation Between Religiosity Level and Willingness to Buy a Self-Driving Car with an Ethical Knob

H7: Lower levels of religiosity will make consumers more likely to believe that the Impartial setting is more moral than the Random setting.

To analyze Hypothesis 7, the researcher used seven religiosity questions (R5-R11) to calculate one religiosity measure for each individual (1-7). After calculating these measures, the sample was split into three independent groups: those with low levels of religiosity (1-2.99), those with neutral levels of religiosity (3-4.99), and those with high levels of religiosity (5-7). For all groups, each individual's ratings from 1-100 were analyzed for the Impartial setting (Q2, setting II) and the Random setting (Q2, setting IV). The mean ratings for the Impartial setting and the Random setting were calculated for all three groups separately. Then, the researcher compared these means using Paired Two-Sample t-Tests for each group, and the corresponding p-values were analyzed (see Table 7).

	Mean Impartial	Mean Random	p-value
Low Religiosity	59.56	13.80	8.03E-10
Neutral	64	11.61	1.08E-24
High Religiosity	57.58	12.56	7.25E-38

Table 7: Hypothesis 7 Output

As Table 7 indicates, the researcher found no significant differences in the perceived morality of the Impartial setting means and the perceived morality of the Random setting means across the three groups. The Paired Two-Sample t-Tests confirmed that the differences in the means were significant. For the Low Religiosity group, the difference in means was significant, as the p-value was less than 0.05 (p-value = 8.03e-10). This finding is the same for the Neutral group (p-value = 1.08e-24) and the High Religiosity group (p-value = 7.25e-38). To visualize the mean differences, the researcher created a column chart with the religiosity groups on the x-axis and the average perceived morality ratings on the y-axis (see Figure 6).

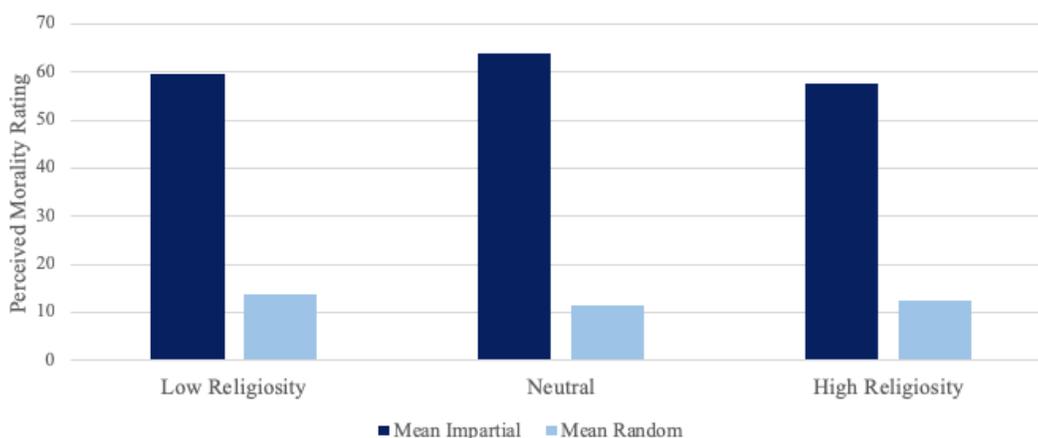


Figure 6: Impartial and Random Setting Rating Means for Three Different Groups Based on Religiosity Levels

As Figure 6 illustrates, there are large differences between the average perceived morality ratings for the Impartial setting and the Random setting for all three groups; however, it also

illustrates that religiosity levels do not cause these differences. Since all three groups show a much lower perceived morality rating for the Random setting, Hypothesis 7 is not supported. Lower levels of religiosity do not affect consumers' beliefs that the Impartial setting is more moral than the Random setting. An interesting observation is that the large majority of people believed the Impartial setting was more moral than the Random setting across all three religiosity groups.

DISCUSSION

Out of the seven hypotheses presented, six were not supported (H1-2 & H4-7), and one may be supported with further research (H3); however, there were some other interesting findings from the survey results and analysis. An analysis of the survey results made it apparent that while religiosity levels may not have affected individuals' answers, there were trends across a majority of individuals. First, for Hypothesis 2, it was evident that the majority of respondents (regardless of religiosity level) believed that the Impartial setting is most moral. Roughly 76.6% of respondents identified the Impartial setting as the most moral out of the four settings. Along with this finding for Hypothesis 3, the mean ratings for the two settings (Altruist and Egoist) were low for all three religiosity groups. Every mean was below 20 (out of 100), suggesting that respondents perceived the morality of the Egoist and Altruist setting as relatively low. This finding likely again emphasizes that the majority of individuals believe the Impartial setting is most moral. Along with the perceived morality of the Impartial setting, a majority of individuals were also most comfortable with the Impartial setting. About 76% of respondents rated the Impartial setting the highest when asked how comfortable they were with each setting. Lastly, when asked about their willingness to buy a self-driving car with an ethical knob, roughly 75%

of respondents rated their willingness to buy as less than 50 out of 100. Clearly, then, the majority of people would not want to buy an autonomous car with an ethical knob.

Although religiosity levels did not seem to affect the perceived morality and comfort of the four ethical knob settings, other factors may have influenced participants' choices. In this study, evidence shows males may perceive the morality of the ethical knob in general as higher than females do. Although there may be a correlation based on gender, it does not imply causation, so more research should be conducted on this relationship. Specifically, is the difference in perceived morality solely due to gender, or do other underlying factors correlate with gender as well? This study did not see any relationship between the other demographic variables such as age and education level, but a broader force may be at work – underlying moral principles. These moral principles are not universal, and it is important for future studies to identify what affects individuals' morality. A survey published in *Nature* concluded that many moral principles that guide people's behavior vary by country of residence (Maxmen, 2018). For example, those from prosperous countries with strong institutions were less likely to spare pedestrians who illegally stepped into the road (Awad et al., 2018).

The Moral Machine Experiment studied the many moral decisions that self-driving cars must make (young vs. old, animals vs. humans, etc.) over 40 million people and across 233 countries. After thorough analysis, the researcher found the only thing the majority of individuals agreed on was sparing humans over pets and groups of people over individuals. Other than that, they shared no universal moral code. So, the researcher divided the responses into three groups that answered relatively similarly on the moral conundrums. The three groups were as follows: North American and European nations; Japan, Indonesia, and Pakistan; and Central and South American nations along with France. The biggest conclusion for this study is that so many

cultural factors go into our moral perceptions. For example, the level of economic inequality in individuals' culture may affect their decision to save a homeless person, and the different religions present in other countries also may have had an effect on their decisions (Awad et al., 2018). This is an interesting finding because in the present study, the researcher looked at the effect of the overall religiosity levels of respondents regardless of the specific religion people follow. In the future, researcher may find it useful to study the different religions' affect as well as the many other aspects that go into shaping culture, such as power distance, forms of government, economic systems, history, and daily life.

LIMITATIONS

There are several limitations to this study that are worthy of noting. First, the sample used in the survey analysis was not diverse. The majority of respondents were white and had an education level of less than three years of college (84.5% and 71.2% respectively). Also, the majority of respondents were 18-22 years of age (75.7%). All of the respondents were located in and around Fort Worth, TX, but some respondents are from other regions originally; however, this data was not collected. Although these demographic variables did not appear to have an effect on the results of the study, it is important to have solid representation from all groups in order to take into account all variables that could affect the results, and therefore, ensure more accurate conclusions.

Another limitation of this study would be a respondent's social desirability bias, particularly given that religiosity is tied to an individual's identity. Many participants likely have a perception of what the "right" answer is even if their first instinct would be to choose a different answer. When respondents feel like answering a question a certain way may define their character, they are probably less likely to choose the answer they really believe over the

“right” answer. Also, respondents’ understanding of self-driving cars, what decisions they must make, etc. is an important factor in the analysis of their decisions that the researcher did not take into account in this study. Those who more thoroughly understand self-driving cars and the underlying algorithms and decision making involved, may have different answers than those who do not understand anything about self-driving cars. Those who understand the many nuances and underlying dilemmas autonomous cars are tied to, may believe the morality of the ethical knob is higher. This concept is another area of research that would prove important because if education on self-driving cars would make consumers understand the ethical implications, it may be worth investing in for the future.

Lastly, the trolley problem and the ethical implications of self-driving cars may not belong together. Some ethicists argue that the trolley problem is a flawed and oversimplified way to think about a complicated problem. For example, one article stated that the trolley problems are “unrealistic and unrepresentative of the moral situations people encounter in the real world” and “they do not elicit the same psychological processes as other moral situations” (Bauman, McGraw, Bartels, & Warren, 2014, p. 536). The trolley problem gives limited options, but in real life there are many other options available. Some people believe that rather than focusing on the concept of intentionality of self-driving cars, we should spend that time focusing on teaching the cars to avoid harm in the first place (Baram, 2019). For future studies, it may be helpful to use other ethical problems that take more complexities into account to more closely resemble the real world.

IMPLICATIONS

This research results in several implications for individual consumers. First, it is important for consumers to understand their moral preferences and how their morality relates to

the ethical conundrums of self-driving cars. Although many believe that God or a higher being is responsible for what happens in their lives, this belief may be challenged by the adoption of self-driving cars because someone must program the decisions a self-driving car makes. This study taught us that religiosity may not play a role in consumers' ethical decisions in relation to the ethical knob because there was not an option for consumers to not choose anything on the knob, which would be the equivalent to surrendering the outcome to God or a higher being. In many of the proposed solutions to the ethical dilemmas posed from autonomous cars, there is not an option that would be similar to how accidents are dealt with now. Currently, the driver often makes the decision in milliseconds, but with self-driving cars, someone with little understanding of the specific situation must make the decision far in advance in order to program the car. In the future, consumers will need to think about their preferences and how the introduction of self-driving cars will affect them.

This research also has implications for manufacturers of self-driving cars (currently and in the future). Until all cultures embrace a universal law or understanding on how to program cars to deal with unavoidable accidents, manufacturers need to understand user preferences, and what they are willing to buy. This study shows that the level of religiosity may not affect consumer preferences when it comes to the ethical knob, but it may be worth understanding consumers' religions when it comes to other proposed solutions. Overall, manufacturers cannot begin selling self-driving cars until there is a large enough population that is willing to buy what they are selling. This realization means that the consumers must believe how the car makes decisions is morally right. Manufacturers should focus on providing detailed information to consumers on how their cars make decisions and what that means for ethical dilemmas. They

should also focus on how the cars get information from their surroundings to make the best decisions.

Lastly, this study has implications for governments around the world. Eventually, governments must regulate self-driving cars and the car manufacturers. Likely, this regulation will mean one universal ethical solution for each country in order to avoid prisoners' dilemmas between cars. This study showed that levels of religiosity may not have an effect on consumers' ethical choices; however, other studies suggest that specific religions and cultures may have different moral perceptions. This finding may suggest that governments of each country should be in charge of selecting the best moral solution for their citizens. In order to do so, governments should invest in researching their population and their preferences. From this research, governments can more thoroughly understand what factors affect the citizens' moral perceptions, and how they should take those perceptions into account when identifying a universal solution for self-driving cars. Overall, governments need to understand that one factor does not shape an individual's morality. Hundreds of factors shape morality, and we must study them all to fully understand how the factors interact and to facilitate making a decision for what is "best" for a given country. Countries that are diverse, like the United States, are going to have a tougher time identifying the "best" solution for the ethical dilemmas, as one culture does not dominate to base the solution off of.

CONCLUSION

Self-driving cars pose significant opportunities to societies if adopted successfully; however, there are currently too many ethical dilemmas in the mix to fully implement the technology. Humans are complex creatures and so is our morality/moral attitudes. It is difficult to pin-point where our moral attitudes and perceptions come from. Is it our family, our

environment, our religion, our education? This research has proven that humans' morality is not one-size-fits-all, and we are far from understanding what shapes our individual perceptions regarding self-driving cars. Specifically, the level of religiosity does not influence humans' moral perceptions regarding self-driving cars and ethical-knob.

Although religiosity alone does not shape individuals' moral perceptions, other studies have shown that culture, as a whole, does. For future studies, it is important that we study our culture more thoroughly. For example, it may be necessary to have individuals identify their specific religion. This study showed that religiosity level does not affect the moral perceptions, but certain religions may have more of an effect than others. Additionally, it is important to research the many different aspects that shape our culture. With consistent research, it may become apparent that there are a few aspects that drastically affect our views; however, we may never fully understand our culture and how it shapes our moral values because it is so convoluted. In this case, it is important for governments and manufacturers to create solutions that individuals will be comfortable with. At this point, there are too many moral dilemmas to create one solution, but if we want to realize the benefits of self-driving cars, something must transpire to solve their ethical dilemmas.

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APPENDIX A

Consent Statement (In the Qualtrics Survey)

This research project is being conducted by Kiana Stephen (Undergraduate Honors Student; Business Information Systems; Texas Christian University; Study Investigator) and Beata M. Jones, Ph.D (Honors Faculty Fellow and Professor of Business Information Systems; Neeley School of Business; Texas Christian University; Principal Investigator) You are invited to participate in this research project concerning the ethics of self-driving cars.

Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time. Should you decide not to participate in this study, or if you withdraw from participating at any time, you will not be penalized.

This procedure involves filling out an online 16-question survey that will take no more than 10 minutes to complete. Your responses will be confidential, and we do not collect identifying information such as your name or IP address. Beyond some fundamental demographic questions, the survey asks questions about your opinion on the ethics of self-driving cars. Specifically, it will ask you questions about the morality of settings on the “ethical knob” which allows passengers to determine how the car should react in an unavoidable accident.

We will keep all information confidential. All data will be stored in a password protected electronic format. The results of this study will be used for scholarly and research purposes.

If you have any questions about the research study, please contact:

1. Kiana Stephen by phone at 303-525-5315 or via email at kiana.stephen@tcu.edu
2. Beata M. Jones by phone at 817-257-6948 or via email at b.jones@tcu.edu

Please select your age. If you are under 18, exit the survey now.

- I am over 18 years of age.
- I am under 18 years of age.

By agreeing to participate in this study, you agree to the following:

- You are free to withdraw from the study at any time without penalty.
- You have read and understand all the above material.
- Yes, I agree and consent to participate
- No, I disagree and do not consent to participate

Survey

Section 1:

Background Information: The “ethical knob” is a proposed solution to the ethical dilemma of self-driving cars. The “ethical knob” allows the passenger to choose one of four settings to determine how the self-driving car will react in an unavoidable accident. The settings range from saving the passenger at all costs to saving bystanders at all costs. Passengers must choose the “ethical knob” setting long before the accident occurs and before the details of the accident are known.

Instructions: Read the following questions fully and answer truthfully after reading the background information above. First, read the information in the scenario provided below, and answer the following, related questions (1 – 4).

Scenario: You are the sole passenger riding in an autonomous, self-driving car that is traveling at high speed down a main road. Suddenly, one pedestrian appears ahead, in the direct path of the car. In preparing the car for such an eventuality, you have chosen how the car will react on the knob in your car. You had three options on the knob:

- I. The car would continue on its path, kill the pedestrian on the main road, but you as the passenger would be unharmed.
 - II. The car would be programmed to choose the most utilitarian option: the option that will result in the least harm to all, i.e., save the most people.
 - III. The car would swerve quickly, diverting the car onto the side road where it will kill you as the passenger, but the pedestrian on the main road will be unharmed.
 - IV. The car will randomly choose an action (swerve, continue straight) etc.
1. (Q1) How would you rate the morality of the “ethical knob” being installed in self-driving cars? Please rate the morality from zero (not moral) to 100 (completely moral).
 - I. Given a sliding scale from 0 – 100.
 2. (Q2) How would you rate the relative morality of these four options? More points given to an option means the morality is higher. Please allocate 100 points across all four options. The points given to all four options must add up to 100.
 - I. The car would continue on its path, kill the pedestrian on the main road, but you as the passenger would be unharmed.
 - i. Given a sliding scale from 0-100.
 - II. The car would be programmed to choose the most utilitarian option: the option that will result in the least harm to all, i.e., save the most people.
 - i. Given a sliding scale from 0-100.
 - III. The car would swerve quickly, diverting the car onto the side road where it will kill you as the passenger, but the pedestrian on the main road will be unharmed.
 - i. Given a sliding scale from 0-100.
 - IV. The car will randomly choose an action (swerve, continue straight) etc.

- i. Given a sliding scale from 0 – 100.
3. (Q3) How would you rate the relative comfort with having autonomous vehicles with one of these four knob settings on the roads in your part of the world? More points given to an option equates to high levels of comfort. Please allocate 100 points across all four options. The points given to all four options must add up to 100.
- I. *The car would continue on its path, kill the pedestrian on the main road, but you as the passenger would be unharmed.*
 - i. Given a sliding scale from 0-100.
 - II. *The car would be programmed to choose the most utilitarian option: the option that will result in the least harm to all, i.e., save the most people.*
 - i. Given a sliding scale from 0-100.
 - III. *The car would swerve quickly, diverting the car onto the side road where it will kill you as the passenger, but the pedestrian on the main road will be unharmed.*
 - i. Given a sliding scale from 0-100.
 - IV. *The car will randomly choose an action (swerve, continue straight) etc.*
 - i. Given a sliding scale from 0 – 100.
4. (Q4) How would you rate your relative willingness to buy an autonomous vehicle with an ethical knob (100 being completely willing, 0 being not willing at all)?
- I. Given a sliding scale from 0-100.

Section 2:

Instructions: Read the following questions fully and answer truthfully. Please rate your agreement with the following statements from 1 (not at all) to 7 (very much) (questions 5 – 9):

- 5. (R5) How strongly do you believe in God or gods?
- 6. (R6) To what extent do you consider yourself religious?
- 7. (R7) To what extent is religion or faith an important part of your life?
- 8. (R8) To what extent do you identify with your religion?
- 9. (R9) How often do you think about religion or being religious?

Instructions: Read the following questions fully and answer truthfully. Please select the one option that you most identify/agree with.

- 10. (R10) How often do you attend religious services?
 - I. Never
 - II. A few times a year
 - III. Once or twice a month
 - IV. Almost every week
 - V. 2-3 times a week
 - VI. Daily

11. (R11) How often do you pray outside of religious services?
- I. Daily
 - II. 2-3 times a week
 - III. Once a week or less
 - IV. Once a month or so
 - V. Only in times of need or emergency
 - VI. Never

Section 3:

Instructions: Read the following questions fully and answer truthfully. Select the one option that you most identify with.

12. (D12) What is your gender?
- I. Male
 - II. Female
13. (D13) How old are you?
- I. 18 – 22
 - II. 23 – 30
 - III. 31 – 40
 - IV. 41 – 50
 - V. 51 – 60
 - VI. Over 60
14. (D14) What is your highest earned education level?
- I. High-school diploma
 - II. One year of college
 - III. Two years of college
 - IV. Three years of college
 - V. Four years of college
 - VI. Bachelor Degree
 - VII. Master Degree
 - VIII. Doctoral Degree
15. (D15) What is your role at Texas Christian University?
- I. Student
 - II. Faculty
 - III. Staff
 - IV. Other
16. (D16) Please specify your ethnic origin/ethnicity:
- I. White
 - II. Hispanic or Latino
 - III. Black or African American
 - IV. Native American or American Indian
 - V. Asian / Pacific Islander
 - VI. Other

Thank you for completing the survey!

APPENDIX B

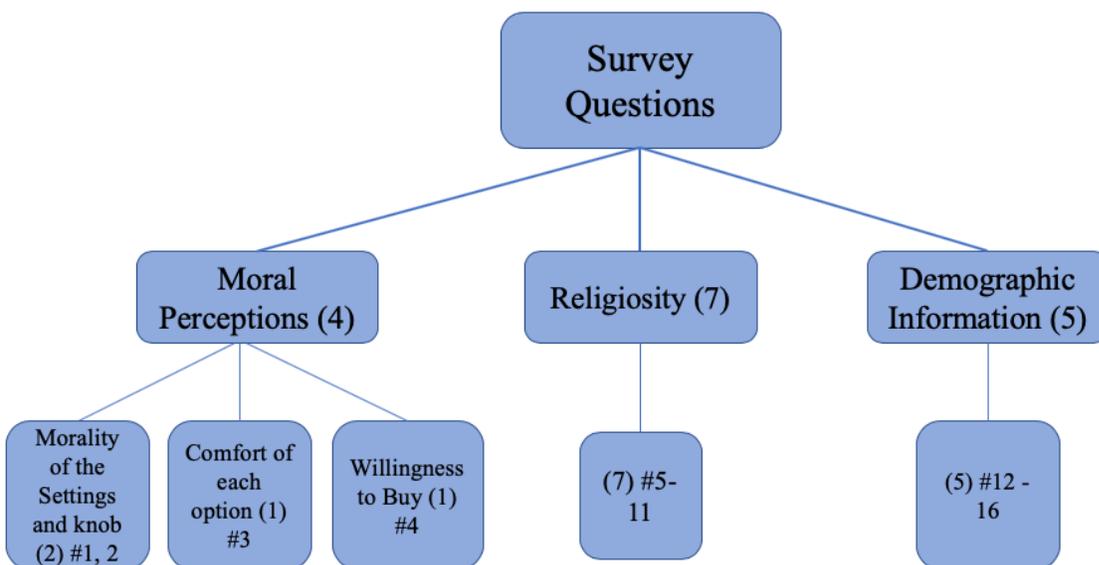


Figure 7: Survey Model