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What Drives Car Attitudes: An Analysis of How Demographics and Environmental Views Relate to Car Attitudes

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Successfully marketing new, clean, car technologies to consumers requires an advertising strategy that fits consumers' priorities and attitudes towards cars. We created a survey to study how attitudes towards cars are associated with demographics and environmental views. Our study examined car preferences and environmental concerns of a sample of Gettysburg College students in comparison to a national sample obtained from Amazon's Mechanical Turk. Overall, we concluded that environmental beliefs are a significantly better prediction of car behaviors than demographics. We found that on average people would pay more for a car with a higher fuel economy, but not enough to cover the higher price of newer, cleaner technologies, such as hybrid cars. Gettysburg College students' environmental concern scores were significantly higher on average than that of the general American population. Survey respondents from both samples supported devoting more research and resources to hybrid, electric, and biofuel technologies. However, in regards to their personal purchases they ranked safety and other qualities of the car as higher priorities than greenhouse gas emissions or fuel economy. According to our results, marketing electric cars as safe and reliable is a better strategy than marketing their high fuel economy.

Keywords
Car, survey, environmental views, car attitudes, Gettysburg College, automobile, vehicle

Disciplines
Environmental Education | Environmental Indicators and Impact Assessment | Environmental Sciences | Natural Resources and Conservation | Oil, Gas, and Energy

Comments
Environmental Studies Thesis

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Abstract

Successfully marketing new, clean, car technologies to consumers requires an advertising strategy that fits consumers' priorities and attitudes towards cars. We created a survey to study how attitudes towards cars are associated with demographics and environmental views. Our study examined car preferences and environmental concerns of a sample of Gettysburg College students in comparison to a national sample obtained from Amazon's Mechanical Turk. Overall, we concluded that environmental beliefs are a significantly better prediction of car behaviors than demographics. We found that on average people would pay more for a car with a higher fuel economy, but not enough to cover the higher price of newer, cleaner technologies, such as hybrid cars. Gettysburg College students' environmental concern scores were significantly higher on average than that of the general American population. Survey respondents from both samples supported devoting more research and resources to hybrid, electric, and biofuel technologies. However, in regards to their personal purchases they ranked safety and other qualities of the car as higher priorities than greenhouse gas emissions or fuel economy. According to our results, marketing electric cars as safe and reliable is a better strategy than marketing their high fuel economy.

Introduction

The automobile has become a staple of the American lifestyle. For many people, it is now also a necessity of life. In 2005, the world light-duty vehicle fleet was comprised of 700 million vehicles (Schafer et al 2009). Throughout the history of the automobile, the number of cars on the road has increased immensely, with new technologies and gas prices increasing a supply of more affordable cars, while the changing American dream to a suburban lifestyle increased demand. However, the increase in car use has caused problems relating to climate change. The environmental impact of the car, specifically relating to gas mileage and emissions, has become a major concern with the continually increasing number of cars on the road worldwide. In the United States, 18 percent of total GHG emissions are due to passenger travel (Schafer et al 2009). As these issues have become known, technologies have been developed to mitigate the negative impacts utilizing ethanol, as well as hybrid and electric cars with higher fuel economy. However, none of the breakthroughs in technology will help the environment unless consumers will buy them. According to the United States Department of Transportation, only around 0.5% of all vehicles sold or leased in the U.S. in 2010 were hybrid cars (Bureau of Transportation Statistics 2014).

Studies have found that environmental quality is not the primary concern of the consumer when purchasing a car, and that quality, cost, brand name and safety are much higher priorities (UK Essays 2013, Nayum et al. 2012, Lane and Potter 2006, Mairesse et al. 2012). Not only is perception of cars key, but an individual's willingness to act on those perceptions is also important. Studies have shown that many people across the world understand the negative impact vehicle emissions have on the environment; however, they are not extremely likely to act on them (Lane and Potter 2006, Mairesse et al 2012, van Rijnsoever et al. 2009). This phenomenon is called an attitude-action gap and results in the prevalence of unsustainable implementations in vehicle regulations. The attitude-action gap is a disconnect in behavior in which a consumers attitudes are not reflected in their

purchasing and driving actions. This phenomenon has been witnessed across multiple topics; however it is extremely prevalent in relation to consumers' environmental concerns (European Commission 2008, Mairesse et al. 2012, van Rijnsoever et al. 2009, Lane and Potter 2007). This makes it incredibly difficult to predict how the public will act while purchasing a vehicle (Mairesse et al. 2012). A study of environmentally conscious car buying behavior in Europe showed that, while 75% of the continent supports the buying of environmentally friendly vehicles and products at high costs, the behavior is not reflected in their actions as only 17% will actually purchase these products for themselves (European Commission, 2008).

Environmental concern has increased throughout a great deal of the private and business sectors across the world (van Rijnsoever et al. 2009). Economic benefits for consumers, such as a tax break for cars with low carbon emissions, are successful strategies to promote some "cleaner options" for vehicles (Lane and Potter, 2007). Therefore, businesses have spent much more of their capital on perpetuating "green" technology (van Rijnsoever et al. 2009); however economic incentives alone are not enough to close the attitude-action gap. In addition to price breaks for using more environmentally friendly cars, Lane and Potter suggest education, shifting the target audience and improving the status of these cars are all important factors in closing this attitude action gap (2007). Each of these factors are important in gradually integrating low carbon emitting cars into the general public. Education is an overarching theme in order to facilitate change regarding the environment (van Rijnosoever et al. 2009). A large portion of the disconnect between consumer's attitudes and actions comes from an unwillingness to change. Therefore, we hope to examine attitudes of the public in regards to their environmental preferences in relation to cars.

While there have been studies about consumer preferences concerning environmental priorities, especially many in Europe, there is a lack of information concerning U.S. consumers, and more specifically, college age consumers who will be the next generation of car buyers (Caulfield, B. et al. 2010, Kruger, N., and Pareigis, J. 2009, Lane, B. and Potter, S. 2006, Mairesse, O. et al. 2012,

Nayum, A., Klöckner, C. A., & Prugsamatz, S. 2013, Nordlund, A.M. and Garvill, J. 2003, UK Essays 2013, van Rijnsoever, F., Farla, J., & Dijst, M. J. 2009). Through our study, we hope to learn about car preferences and environmental concerns from the students of Gettysburg College as our sample of a college population and compare that to a more general sample of the national population.

We created a survey to study how attitudes towards cars are associated with individual background and environmental views concerning Gettysburg College demographics. This survey will allow us a better understanding of the consumer's thought process when purchasing a car, especially in regards to environmental importance. By gathering information about individual's environmental preferences and their car-buying thought process, we will correlate the results and interpret trends in attitudes. Specifically analyzing Gettysburg College trends in comparison to a more general United States population, we can discern car attitudes and environmental views of a population that has not been studied. In order to focus our research, we formulated a general research question with three sub-questions that further delve into the topic. The question we aim to answer is, "how are attitudes towards cars associated with demographics and environmental views?" We then will analyze our response data through the three sub-questions. Will people sacrifice money or desired car attributes to lower emissions? Do people support shifting technologies towards more environmentally friendly cars? And what are people's priorities when buying cars? We hypothesize that Gettysburg College will have a more environmentally aware and concerned population relative to the population of Mechanical Turk. We believe this as the population is young, well-educated, and receiving an interdisciplinary education. We also hypothesize there will be a correlation between environmental views and car attitudes, with responses to car attitude questions reflecting their environmental beliefs. Finally, we believe we will find an attitude-action gap with relation to environmental beliefs of cars and transportation and actions taken to fulfill those beliefs.

Methods

In order to test our hypotheses, a survey was created and distributed to a random sample of Gettysburg College students, and a relatively random sample of the national American population through Amazon's Mechanical Turk website.

Survey Design

Questions concerning car attitudes, environmental beliefs, and demographic information were included in the questionnaire created (Figure 1). The first section of the survey pertained solely to vehicle owners and drivers. These questions look specifically at the specifications of their cars. The second section asks all respondents about their car preferences, even if they do not drive or own a car. These questions include car attribute priorities, thoughts concerning new technologies and transportation preferences to answer our research questions on what people's priorities are when buying cars, and if the public supports new, green technologies. The third section asked five questions pertaining to environmental attitudes, and the last section gathered demographic information. These last two sections were used to compare the two sample populations, and to answer our central research question of if environmental attitudes and demographics are associated with car attitudes.

Brace's book on survey design was used when considering the ordering of questions and sections of the survey. For example, the car behavior questions were asked before environmental attitude questions because behavioral questions should be put before attitudinal questions to avoid a bias (Brace 2008). A report to the USDOE was examined and the results were taken into consideration when wording questions about fuel economy and fuel efficiency as they found consumers have limited knowledge of their definitions. This report also influenced one of the subquestions, to see where people's priorities are when buying cars, as they believed consumers have limited economic rationality (Kurani and Turrentine 2004). Some questions about car attributes were modified from Belgian and English reports (Mairesse et al. 2012 and UK Essays 2013). Data on the

cost of a mechanical gasoline engine versus a hybrid engine were used to determine the cost difference is approximately $4,000, which shaped our question asking if consumers are willing to spend money to buy a car with lower emissions (Schafer et al. 2009). Questions were asked only about technologies that are already plausible and publicly known about to avoid finding useless data (Helman 2013). For example questions about hydrogen cars, which are less widely known about, or fantasies such as carbon capturing cars were not included.

Survey Distribution

The two versions of the survey were created online using Google Forms and Amazon Mechanical Turk. The questionnaires were distributed to two different populations: Gettysburg College students and workers on the Mechanical Turk website that ideally would have represented a random sample of the American population.

To distribute the Google survey to Gettysburg College students, the college email directory and random letter and number generators were used to email students. Student names were not noted, but they were confirmed to be students and not faculty or staff of the college whom are also in the directory. On October 31st, 357 random students were emailed and asked to complete the survey. Between November 1st-November 15th, the survey was posted to the Student Email Digest for 9 days to receive responses.

The Mechanical Turk survey was published on the website, www.mturk.com, and required responders to live in the United States, have completed at least 1,000 HITs (Human Intelligence Tests), and have a 98% or higher approval rating on their work. All surveys submitted were approved within three days of their submission before the respondent was compensated.

In order to receive a better response rate, incentives were used in both forms of the questionnaire. Gettysburg College students who responded were put in a lottery to receive a $25 gift

card. On Mechanical Turk, each respondent was paid $0.65 to complete the survey. We received 200 responses from Mechanical Turk and 183 responses from Gettysburg College students (two other responses were omitted because they were international students, and our survey focuses strictly on the United States' population). On the Gettysburg College student survey, we made all questions mandatory except for demographic questions such as race and gender, so that people who preferred not to answer did not have to. Mechanical Turk did not allow for questions to be made mandatory. Surveys that had more than 2 missing responses were rejected, but approximately 20 surveys had one or two responses missing and they were accepted. For these reasons, both samples have some missing answers for workers and those survey responses were omitted when statistical analysis was completed for the question.

Analysis

We assigned each respondent an "environmental score" based on their answers to the five "environmental attitudes" questions. The maximum score a person could receive was 19, corresponding to the highest concern about the environment. The lowest score was 5, which responded to the lowest concern for the environment. The questions with five answers were assigned numbers with values from 1-4. "Yes, a lot" was 4, "yes, a little" was 3, "no" was 1, and "no opinion", and "do not know" were assigned a 2. The question that had only three answers, "yes", "no", and "do not know", differed only in that "yes" was assigned a 3; "no" and "do not know" were assigned the same values. After each respondent was assigned a numerical environmental score, they were sorted into environmentally view categories which ranged from 5-10 (1/Very low), 11-13 (2/Low), 14-16 (3/Moderate), and 17-19 (4/High).

Overall data analysis and categorization was completed in Excel, whereas statistical tests were completed in SPSS to determine significance of the data analysis completed in Excel. All responses to questions that were not reported as numbers were coded to perform the statistical analysis in SPSS. Cross tabulations were run to determine relationships between factors. Then statistical tests,

including chi-squared tests and correlations, were completed to ascertain the significance of these relationships.

Environmental scores were cross tabulated against car attitude question responses to determine the relationship between general environmental opinions and perspectives towards car buying and technology. Chi square tests and correlations were run on this data as well. Similar tests were completed comparing car attitude questions to demographic information, however no correlations were run. For the Mechanical Turk sample, age, race, gender, number of children, education level, living area, and political affiliation were compared to car questions. For our Gettysburg College sample, race, gender, living area, and political affiliation were compared. Age, number of children, and education level were omitted from the analysis for Gettysburg College because of the across the board homogenous responses by the nature of the sample. Cross tabulations were run comparing the demographic spread of the two samples against three select car attitude questions from the survey. Those questions were "how much more would you be willing to pay for transportation costs to lower your greenhouse gas emissions", "how much more would you be willing to pay for a more environmentally friendly car with high gas mileage (around 45 miles per gallon)", and asking if they think fuel efficiency standards should increase, remain the same, decrease, or be abolished. In addition, ArcGIS was used to create maps of the states where respondents live.

Results

Demographic Spread of Samples

The 200 Mechanical Turk respondents were from 33 different states (Figure 2). The age categories with the most respondents were 23-30 and 31-40 with 34% and 33% respectively. However, all age categories up to age 70 were represented (Figure 3). The workers from Mechanical Turk were 60% male, 49% female, and 1% genderqueer (Figure 4). Additionally, 64% of respondents had no children (Figure 5). The sample was mostly white, 77% (Figure 6). They were mostly Democrats, followed by 35% Independents, and 14% Republicans (Figure 7). Lastly, the

survey takers were mostly suburbanites, but 34% were from urban areas and 18% were from rural areas (Figure 8).

Our Gettysburg College sample included students from 14 states, but were mostly from Pennsylvania (Figure 2). The Gettysburg sample was comprised of individuals that were all between the ages of 18-22 except for one, and none of the respondents had children (Figures 3 and 5). The Gettysburg sample was 90% Caucasian (Figure 6). The sample was 77% female and 23% male (Figure 4). The students were also largely from the suburbs (Figure 7). Lastly the political affiliation spread of the sample was mostly Democrats, followed by independents (Figure 6).

While both of the samples were mostly caucasian, Gettysburg College's sample had a higher percent of caucasian respondents. Both samples had a gender bias, but Mechanical Turk had a higher number of males whereas the Gettysburg sample had a higher number of females. Both samples were largely from the suburbs, but the Gettysburg sample included less urbanites. Lastly, the political spreads were also similar with mostly Democrats, followed by Independents.

Demographic Associated with Car Attitudes

Mechanical Turk respondents' age, race, gender, number of children, education level, living area, or political affiliation were not found to be a significant predictor of whether they would pay to lower their car emissions or pay to have a higher fuel economy. In regards to their opinions on national fuel efficiency standards, only political affiliation was determined to be a significant predictor of the person's response ($p=0.004$, $df=20$). Regardless of party, the majority of each group said that fuel efficiency standards should increase. However, Independents and Republican were more likely to say that the standards should be abolished. Overall, of the 21 cross tabulations run on Mechanical Turk demographic data, only one was significant.

For the Gettysburg College sample, only one cross tabulation yielded a significant relationship as well. Gender had a significant influence of whether students would be willing to pay for a more environmentally friendly car with a high gas mileage ($p=0.036$, $df=6$). Women were more

likely to be willing to pay $1000-$2000, whereas the men were more likely to be willing to pay $5000. None of the demographic factors had a significant relationship with whether students would be willing to pay to lower their greenhouse gas emissions, or on their views of fuel efficiency standards.

Environmental Views Associated with Car Attitudes

Fuel Efficiency vs. Environmental Score

There is a significant relationship between opinions on fuel efficiency standards and environmental score for Gettysburg College (p=1.6387e^-7, df=9) (Table 1). Of the respondents in the moderate and high environmental concern categories, 78% believe the United States should increase fuel efficiency standards (Figure 9). There is a small positive correlation between fuel efficiency standards responses and environmental score (R2=0.339, P=0.000003, N=183) (Table 2). There is no significant relationship for the Mechanical Turk population (p=0.949, df=197) (Table 3) (Figure 10).

Environmental Technologies in Cars vs. Environmental Score

In general, the majority of the Gettysburg sample supports investing in researching and developing hybrid, electric and biofuel cars (Figure 11). There is a significant relationship between hybrid technology responses and environmental score (p= 0.000036, df=15) (Table 4). There is a significant relationship between electric technology responses and environmental score (p=0.001, df=15) (Table 4). However, there is not a significant relationship between biofuel technology responses and environmental score (Table 4). There is a relatively weak positive correlation of hybrid, electric, and biofuel technology responses to environmental scores, with R2 correlations of 0.272, 0.222, and 0.139 respectively (Table 5). There is a higher positive correlation of 0.485 between hybrid and electric technology responses (R2=0.485, P=3.5576e^-12,N=183) (Table 5). Across the three technologies, there is a relatively equal number of respondents with a 3 and 4 environmental score who responded that all hybrid, electric and biofuel technologies should be a high

priority to put more resources toward further research and development (Table 8, 9, 10). While only 4 respondents are unsure of hybrid and electric technologies, there are 16 respondents who are unsure of biofuels (Tables 8, 9, 10. It should be noted that an answer of "unsure" could mean the respondent is unsure of what a specific technology is, or that they are unsure whether to invest in furthering the technologies.

Mechanical Turk respondents' environmental scores showed a significant, positive correlation with opinions on advancing hybrid technologies (R^2=0.325, p= 0.006, N=200)(Table 8). The same correlation was shown for electric cars technologies (R2=0.421, p=5.1448E-10, N=200) and biofuels (R2= 0.207, p=0.003, N=200) (Table 8) (Figure 12).

Ideal Transport vs. Environmental Score

There is a significant relationship in the Gettysburg sample between ideal transport and environmental score (p=0.008, df=12) (Table 1). The only people who responded that their ideal transport would be walking had environmental concern scores in categories 3 or 4 (Table 6). In general, across the total Gettysburg College sample, the majority of students chose rail or bike as their ideal transportation (Figure 13). The majority of those respondents had environmental scores of 3 or 4 (Table 6). There is also a significant relationship between ideal transport and environmental score for the Mechanical Turk population (p=0.024, df=197) (Table 3). For the Mechanical Turk sample, 29% of respondents said they would prefer to ride a bicycle if all modes of transport were equally available and safe (Figure 14). Thirty-eight percent would ideally choose a form of public transportation, either bus (15%) or rail (23%).

Car Attributes vs. Environmental Score

For the Gettysburg college sample and Mechanical Turk sample, there is a significant relationship between priorities of fuel economy in car attributes and environmental score (p=0.002, df=12) (Table 1)(Table 3). The relationship between greenhouse gas emissions as a priority when evaluating car attributes and environmental score is significant (p=1.0713e^-8, df=12) (Table 1)

(Figure 15). There is a statistically significant positive correlation between environmental score and car attribute priorities concerning greenhouse gas emissions for both Gettysburg College and Mechanical Turk (R2=0.366, p=3.5039e^-7, N=183) (Table 1) (Table 3). There is a statistically significant weak negative correlation between environmental score and electronics as a car attribute priority for Gettysburg college and no relationship for Mechanical Turk (R2=-0.197, p=0.007, N=183) (Table 7) (Figure 16). No other car attribute demonstrated a significant relationship with environmental score.

Overall, safety and reliability are ranked as the top priorities when ranking car attributes (Table 7). There are weak negative correlations between environmental score and safety, comfort, image, brand, top speed, size and electronics (Table 7). There are also relatively weak positive correlations between environmental score and reliability, purchase price, fuel economy, and maintenance costs. However, these correlations are not statistically significant (Table 7).

Mechanical Turk vs. Gettysburg Results

The sample populations of Gettysburg College and the Mechanical Turk respondents show significantly different environmental ranks (p=0.0016, df= 363). Responses regarding the importance of hybrid car technologies (p=0.00095, df=381) and biofuels (p=0.021, df=380) were also significantly different between the two populations. There was also a significant difference between the populations in regards to ideal transport (p=0.00053, df=378) . Answers for electric car technologies were not significantly different between the samples (p=0.8724, df=380) .

Are People Willing to Sacrifice Enough Money to Lower Emissions?

There was a significant correlation between Mechanical Turk respondent's answers to how much they would pay to lower their greenhouse gas emissions, and how much they would pay for a car with higher gas mileage (p=1.12e^-30, df=42). The Gettysburg sample had a significant correlation as well (p=4.9e^-5, df=28). Opinions on fuel efficiency standards and how much one

would be willing to pay for higher gas mileage were also significantly correlated for Mechanical Turk data (p=4.89e^-28, df=28), and Gettysburg data (p=7.41e^-32, df=28).

Seventy percent of Mechanical Turk workers said fuel efficiency standards should increase, followed by 24% that believed they should remain the same. In regards to how much they would pay for a car that has a high gas mileage, 8% would pay $5,000. Seventy five percent of Gettysburg respondents said that fuel efficiency standards should increase, followed by 21% that believed they should remain the same. The majority said they would pay $3,000 for a car with 45 mph gas mileage at 23% .

Discussion

Demographics vs. Car Attitudes

Overall, demographic background was not found to have a significant influence on car attitudes. The only significant results found for the Gettysburg data involved gender, and since females outnumbered males with a 3:1 ratio, this data could be skewed and may not be an accurate representation of the Gettysburg male population's view on paying for cars with high gas mileage. The Mechanical Turk's sample of political affiliation was also largely different from the actual U.S. population. It is difficult to say that the results compared to fuel efficiency opinions are not skewed even though a statistical significance was found. For example, a higher percentage of Republicans (75%), versus Democrats (68%) said that fuel efficiency standards should increase, which is surprising.

There were biases in our samples that could have caused our inconclusive results for demographics. Mechanical Turk's sample was not a random sample of the American population because of its age bias alone. The sample was mostly young, which was unsurprising since the survey was conducted on the internet. Republicans were also underrepresented in the survey, and

Democrats were overrepresented. In 2013, 46% of Americans identified as independent with only 29% Democrats and 22% Republicans (Jones 2014). In contrast both of our samples were mostly democratic. This could be due to a self-selection bias on Mechanical Turk, and through our email system. On Mechanical Turk workers choose what surveys to take, and it's possible political affiliations that are less environmentally minded, such as Republicans, choose not to take an environmental survey. The same goes for the Gettysburg College sample because while the emails were random, it was the recipient's' choice whether or not to respond.

Environmental Views of Gettysburg College and Mechanical Turk Samples

It is not surprising that the majority of students are environmentally conscious on campus, as multiple studies have found that education is a large factor in determining one's environmental attitude (Lane and Potter, van Rijnsoever et al. 2009). This supports our hypothesis that a sample of young, well-educated individuals, such as Gettysburg College, will have a large number of people concerned about the environment. The high percentage of environmentally friendly responses at this higher education level is consistent among studies from around the world (European Conference 2008. Rijnsoever et al. 2009, Lane and Stephens 2012).

A large proportion of the Mechanical Turk respondents were also ranked as having the highest environmental score. This is consistent with our hypothesis, as they identify themselves as environmentally friendly, but not as frequently as Gettysburg College students. The very low number of respondents in the "very low" environmental score category further supports our hypothesis. These results reflect the findings from the Gettysburg survey and multiple other studies (European Conference 2008. Rijnsoever et al. 2009, Lane and Stephens 2012).

Willingness to sacrifice money to lower emissions

We found that the answer to our subquestion, would people sacrifice money to lower emissions, is yes, but that they are not willing to pay enough. Our results show that the samples believe that environmental standards are important and should in fact increase, but at the same time

are not willing to spend the extra money that is required to lower emissions by upgrading to more fuel-efficient technologies. For example, 70% of Mechanical Turk and 75% of Gettysburg College respondents believe that fuel efficiency standards should increase, however only 24% and 33% respectively would be willing to pay $4,000 or more for a more fuel efficient car, which represents a baseline figure of how much more a hybrid or electric car would cost (Schafer at al. 2009). This demonstrates a disconnect between beliefs about national issues and personal willingness, and could also show that individuals are simply misinformed about how much these technologies cost when they said they support increasing standards.

Support for environmentally friendly technology

As environmental issues become more prevalent in society, people are beginning to better understand and research ways in which they can be mitigated. Electric cars are an old technology which has recently gained a great deal of traction in the public sector. These low carbon emitting vehicles have been growing in popularity across the country, which is evident in the survey results. Through our survey, we found many people to respond favorably when asked if there should be more resources and time put into these technologies. A study by Kurani and Turrentine examines the fact that, since these hybrid electric vehicles are relatively new to the public sector, consumers today are the first age of people to have the opportunity to increase their fuel efficiency by paying more (2004). Even though we found a majority of respondents who said they would be willing to pay more for these services, this study found a large portion of respondents who were more interested in saving money than higher fuel economy (Kurani and Turrentine).

In another study, Caulfield, Farrell and McMahon found in Ireland that many of their respondents declared hybrid cars to be better for the environment and believed they would be the car of choice in ten years, further demonstrating the increased popularity of hybrid technologies (2010). While their study did not address interest in electric vehicles, our study shows that within our sample, 79% of respondents felt that investment in further research of electric cars is important. This could be

due to the fact that general knowledge of electric cars has increased immensely within the past four years.

Global warming and climate change is perhaps the most prevalent issue in the field of environmental studies. Since the transportation sector uses approximately 49% of the world's oil resources, cars are a major factor in the earth's changing climate (Amjad et al. 2010). In order to decrease this dependence on oil, a switch to sustainable energy sources, such as electric and hybrid cars, and biofuels, are the next logical step. It is, therefore, promising to see a sample of the American public showing strong support for the implementation of these technologies in our society. The two forms of public transportation, buses and rail systems, ranked very high for respondents' ideal transport attitudes in both samples. These findings help demonstrate that environmental attitudes translate into more environmentally friendly transportation decisions. However, this question is based on an idealistic world, demonstrating environmental attitudes, not necessarily behaviors.

Switching to public transportation is another key strategy in reducing greenhouse gas emissions (Amjad et al. 2010). Buses and rail systems allow for the movement of large amounts of people in a much smaller space, which also limits congestion and therefore reduces commuting time. In an ideal world, bicycles and public transportation would be the most prevalent forms of transportation in the world; however the convenience of the automobile reduces the popularity of these options.

Another key way to reduce greenhouse gas emissions is to impose fuel efficiency standards. The United States currently has fuel efficiency regulations in place, the CAFE standards, and the majority of the Gettysburg College sample shows interest and support for the advancement of fuel efficiency standards. These responses show a positive reaction to regulations, but without regulations, it is unclear whether these students would make environmental changes in car purchases on their own.

Priorities when buying cars

Twenty-seven percent of respondents still chose the car as their ideal form of transport, above all other more sustainable options. A study conducted by Beirao and Cabral found convenience to be one of the most favorable qualities of a car (2007). This study related the convenience of cars with comfort and independence, with safety ranked much lower and any opinion on environmental impacts did not factor in (Beirao and Cabral 2007). In a study in the UK, it was found that people are more concerned about the investment value of their car than its environmental impacts. The top priorities for consumers were practicality, reliability, cost, safety, and sales packaging (UK Essays 2013). Our study also found that safety and reliability were top priorities for both samples, though we did not analyze overall practicality, general cost or sales packaging.

Greenhouse gas emissions were found to be of lower importance in our study, which is consistent with other studies suggesting flashier or more convenient attributes outweigh environmental concern (Lane and Potter 2007, Beirao and Cabral 2007, Mairesse et. al 2012). However, since there is a positive correlation between environmental score and greenhouse gas emissions as a car attribute, our results show more environmentally conscious individuals are more likely to take their emissions into account when buying a car. This relationship would be strengthened with increased efforts to educate the public on how much vehicle emissions affect the environment, and inform people on the emissions of the cars they are buying (UK Essays 2013). The attitude-action gap could be decreased by increasing public education on how an individual car can impact the environment and contribute to climate change.

Attitude-Action Gap

It can be inferred that our sample populations understand the relationship between greenhouse gas emissions and fuel economy since the relationship between the responses for paying to decrease emissions and increase fuel economy related for both samples. However, the respondents' opinions on how fuel efficiency standards should change, versus what they are willing

to pay do not align.While many respondents believe that fuel efficiency standards should increase, a much smaller proportion would be willing to spend enough money to pay for, a hybrid or electric engine that would meet higher standards would cost (Schafer et al. 2009). This represents an attitude-action bias, meaning our population believes that environmental standards are important, but at the same time is not willing to spend the extra money that is necessary. Other studies have also found that college students tend to be environmentally minded, but that there is no correlation between an individual's responses to and their actions when purchasing a car (European Conference 2008. Rijnsoever et al. 2009, Lane and Stephens 2012).

Another study by van Rijnsoever, Farla and Dijst also found that there is a gap between environmentally friendly attitudes and behaviors concerning car purchases. They speculated the gap may be due to the still widely held belief that environmental choices require financial, comfort or performance sacrifices (van Rijnsoever et al. 2009). Lane and Potter believe that this is to an extent still the reality, and that in addition to the higher upfront price of environmentally minded choices, the extra time and effort new technologies require contribute to the attitude-action gap. For example, the new refueling system for electric cars can take hours versus a few minutes to fill a tank at the gas station (Lane and Potter 2006).

The attitude-action gap is also demonstrated in this study because there is no significant correlation between environmental score and annual miles driven. Some individuals with high environmental scores were also the ones to drive the most annual miles. This could be because commuting long distances to and from work are vital aspects of many occupations. Also, many students have to travel hundreds of miles in order to get to and from school every year. However, the car is also a tool of convenience abused by many with little regard to environmental impact. Overall, people will not sacrifice enough money to lower emissions, and their car uses do not correspond to their environmental beliefs, demonstrating the attitude-action gap in car purchases.

Limitations

The main limitation of this study stems from the relatively small size of our two sample populations. In order to distribute Mechanical Turk surveys, a set fee must be charged per response. Since our funding came from the Environmental Studies department at Gettysburg College, we were restricted to only two hundred responses. In collecting our Gettysburg College data, we were limited by the amount of time it took to send and receive responses from the student body. If we had more time and money to collect survey responses, we believe our demographic results would have shown more statistical significance.

Future Studies

More surveys that expand on specific questions from our survey with a larger sample size should be completed. A study elaborating on the hybrid, electric, and biofuel technologies would be beneficial to clarify questions raised from our survey, as well as determine how to make them more successful in the marketplace. Also, while the majority of all respondents in our survey said that they think fuel efficiency standards should increase, we did not ask if they knew what the standards for 2050 were, or even ask if they knew what fuel efficiency standards means. It would be important to clarify these points in a future study to see if expanding their knowledge of what CAFE standards are would change their answer on if they should increase, decrease, stay the same, or be abolished. Lastly, our survey included environmental attitude questions but not environmental behavior questions, which would add another important factor in the attitude-action gap analysis.

Conclusion

Overall, our results suggest that environmental beliefs are a significantly better prediction of car behaviors than demographics. We found that on average people will sacrifice money to lower

emissions from their cars, but they are not willing to sacrifice the expense that is needed for newer, cleaner technologies. Our survey respondents supported devoting more resources to environmentally friendly technologies, but they ranked safety and other qualities of the car as higher priorities than greenhouse gas emissions regarding their personal purchases. In order to successfully market new, clean, technologies to consumers, the strategy needs to fit consumers' wants. According to our results, marketing electric cars as safe and reliable is a better strategy than marketing their high fuel economy. However, as our results suggested both samples demonstrate a gap between their attitudes and their actions, it is inconclusive from this data alone if consumers would respond to such a marketing strategy. Ideally, there should have been a larger sample size surveyed of both populations in order to have more representative samples. A future study should be completed with more funds to incentivize a larger number of respondents. A long-term analysis of individuals would enable a better grasp on driving habitats over time to flesh out their personal attitude-action gap. More surveys that expand on and clarify key parts of our survey, such as willingness to buy hybrid cars and CAFE standard opinions, should be completed to understand the effects of car attitudes on car purchases to make greener cars more successful in the market.

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Tables

Table 1: Chi-Square Test of Fuel Efficiency, Ideal Transport, Fuel Economy, and GHG Emissions vs Environmental Score (Gettysburg College)

Chi-Square Tests (Gettysburg College)		
	p-value (95% C.I.)	df
Fuel Efficiency	1.6387e^-7	9
Ideal Transport	0.008	12
Fuel Economy	0.002	12
GHG Emissions	1.0713e^-8	12

Table 2: Correlations of Fuel Efficiency vs Environmental Score (Gettysburg College)

Fuel Efficiency Correlations (Gettysburg College)			
p-value (95% CI)		Correlation Coefficient (R2)	N
Fuel Efficiency	0	0.339	183

Table 3. Correlation of Fuel efficiency vs. Environmental Score for MechanicalTurk

	p-value (95% C.I)	Correlation Coefficent (R2)	N
Ideal Transport	0.024	0.160	199
Fuel Efficiency	0.949	0.005	199
Greenhouse Gas	0.002	0.143	199

Correlations

Table 4: Chi-Square Hybrids, Electric, Biofuel Technologies vs Environmental Score (Gettysburg College)

Chi-Square Tests (Gettysburg College)		
	p-value (95% C.I.)	df
Hybrid	0.000036	15
Electric	0.001	15
Biofuels	0.334	15

Table 5: Correlations Hybrid, Electric, Biofuels, Environmental Score (Gettysburg College)

Correlations of Technologies (Gettysburg College)				
	Environmental Score	Hybrid	Electric	Biofuels
Environmental Score	1	0.272	0.222	0.139
P-value		0	0.003	0.06
Hybrid	0.272	1	0.485	0.267
P-value	0		0	0
Electric	0.222	0.485	2	0.124
P-value	0.003	0		0.096
Biofuels	0.139	0.267	0.124	1
P-value	0.06	0	0.096	

Table 6: Ideal Transport vs Environmental Score (Gettysburg College)

		EnvScore				
		1	2	3	4	Total
IdealTransport	Car	2	4	5	7	18
	Bus	1	1	9	18	29
	Rail	2	1	21	34	58
	Bike	0	1	21	41	63
	Walk	0	0	6	8	14
Total		5	7	62	108	182

Table 7: Correlations Car Attributes, Environmental Scores (Gettysburg College)

Correlations

		EnvScore	Safety	Reliability	Comfort	PurchasePrice	FuelEconomy	Maintenance Costs	GHG	Image	Brand	TopSpeed	Size	Electronics
EnvScore	Pearson Correlation	1	-.018	.053	-.136	.016	.115	.002	.366**	-.145	-.034	-.086	-.082	-.197**
	Sig. (2-tailed)		.814	.473	.066	.830	.121	.974	.000	.050	.646	.246	.272	.007
	N	183	183	183	183	183	183	183	183	183	183	183	183	183

Table 8: Hybrid vs Environmental Score (Gettysburg College)

		EnvScore				
		1	2	3	4	Total
Hybrid	Unsure	0	1	1	2	4
	Very Low	0	0	1	1	2
	Low	0	2	1	3	6
	Neutral	3	2	6	7	18
	Moderate	2	2	34	36	74
	High	0	1	19	59	79
Total		5	8	62	108	183

Table 9: Electric vs Environmental Score (Gettysburg College)

		EnvScore				
		1	2	3	4	Total
Electric	Unsure	0	1	0	3	4
	Very Low	0	0	0	1	1
	Low	0	2	5	1	8
	Neutral	3	2	11	10	26
	Moderate	0	1	28	37	66
	High	2	2	18	56	78
Total		5	8	62	108	183

Table 10: Biofuels vs Environmental Score (Gettysburg College)

		EnvScore				
		1	2	3	4	Total
Biofuels	Unsure	1	0	7	8	16
	Very Low	0	0	0	2	2
	Low	0	1	4	3	8
	Neutral	2	3	11	17	33
	Moderate	2	1	22	28	53
	High	0	3	18	50	71
Total		5	8	62	108	183

Figures

Figure 1. Survey distributed to Gettysburg College sample and national sample (Mechanical Turk).

1) Do you own a vehicle or drive a vehicle on a regular basis?
   Circle One: Yes No

If you answered "no", skip parts a-f and go to question 2.

   a) What are the make, model and year of your car?
   Make: _____ Model: _____ Year: _____
   b) Did you purchase your car yourself? Yes No
   c) Do gas prices impact how much you drive?
   Yes, a lot. Yes, a little. No. No opinion. Do not know.
   d) How many miles per gallon does your car get? (If you are unsure, write "unsure").
   _____
   e) How many miles do you drive annually? (If you are unsure, write "unsure").
   _____
   f) How much more would you be willing to pay for transportation costs to lower your greenhouse gas emissions?

   A lot. A little. None. No opinion.

2) Rate the importance of each of the following car attributes on a scale of 1-5.
   1: low importance- 5: high importance

___Safety
___Reliability
___Comfort
___Purchase price
___Fuel economy
___Maintenance costs
___Greenhouse gas emissions
___Image
___Brand
___Top Speed
___Size
___Electronics (AUX/USB, DVD player, navigation system, rearview camera)

3) How much more would you be willing to pay for a more environmentally friendly car with high gas mileage (around 45 miles per gallon)?
   a) Less than $1,000
   b) $1,000
   c) $2,000
   d) $3,000
   e) $4,000
   f) $5,000
   g) Over $5,000

4) Imagine you live in a city with extensive, safe bike lanes and sidewalks. Public transportation, including bus and rail systems, is efficient and clean, and roads for automobile traffic are well maintained. Which form of transportation would you prefer to use in this ideal transportation world for daily short distance trips of about 5 miles?
   Bike Bus Car Rail Taxi Walk
5) I think fuel efficiency standards (require vehicle manufacturers to comply to minimum gas mileage set by the government) should:
   Increase Remain the same Decrease Be abolished
   Comments: _____

6) Rate the importance of devoting resources and research to each of the following technologies in your opinion.

1- very negative, 2- negative, 3-neutral, 4-positive, 5- very positive
(If you do not know what one of these technologies is, write "unsure").

   a) Hybrid cars: _____
   b) Electric cars: _____
   c) Biofuels (ethanol): _____

Environmental Attitudes

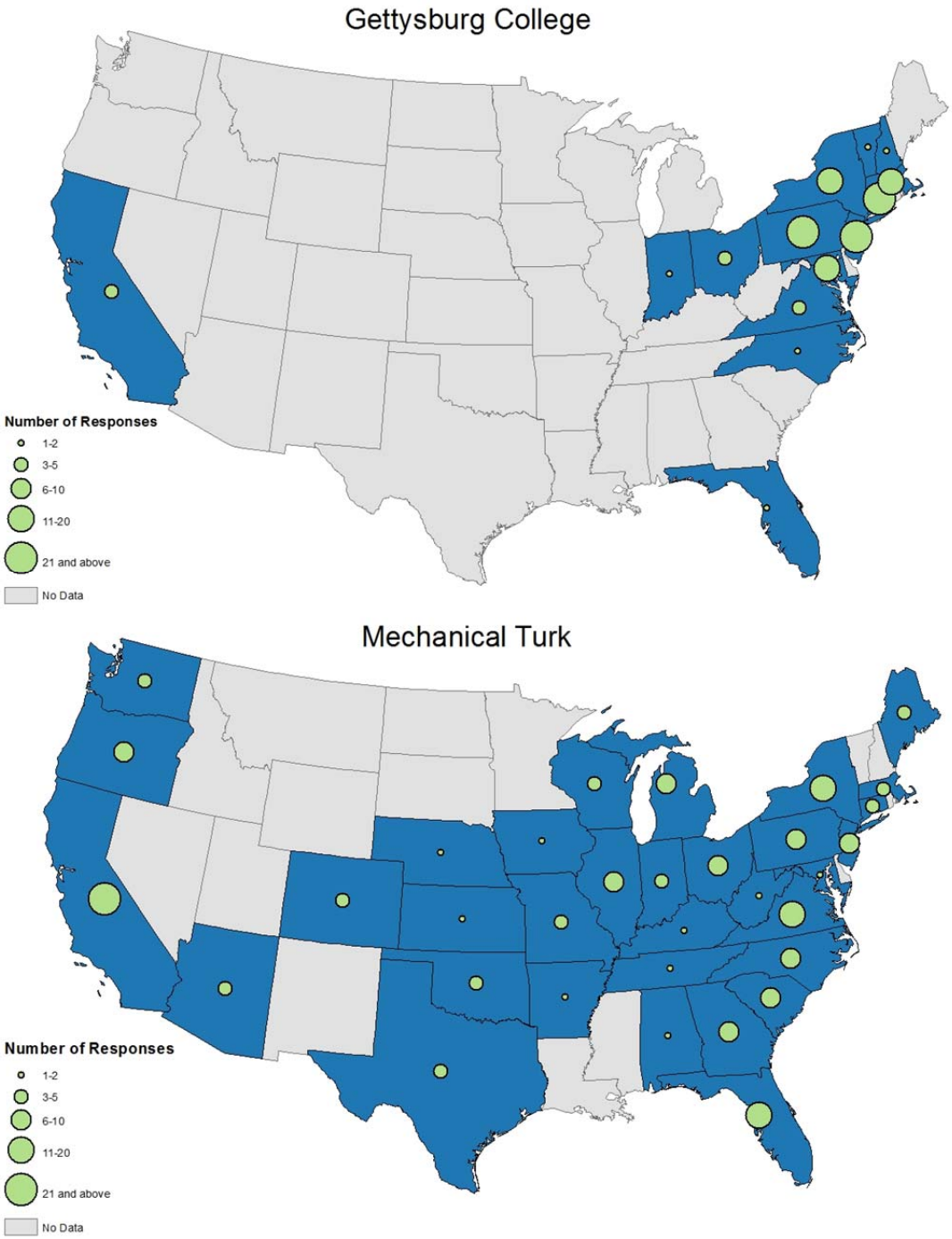
1) Do you believe climate change is a threat?
   Yes, a lot. Yes, a little. No. No opinion. Do not know.
2) Do you think human action is a contributor to climate change?
   Yes, a lot. Yes, a little. No. No opinion. Do not know.
3) Do you think humans are responsible for taking care of the environment?
   Yes, a lot. Yes, a little. No. No opinion. Do not know.
4) Do you believe we can achieve environmental protection and economic growth at the same time?
   Yes No Do not know.
5) Do you consider yourself environmentally friendly?
   Yes, a lot. Yes, a little. No. No opinion. Do not know.

Demographic and personal information background:

1) Where are you from? Country: _____ State: _____ City: _____
2) Age: 18-22, 23-30, 31-40, 41-50, 51-60, 61-70, Over 70
3) What is your race? _____
4) What is your gender? _____
5) What is your highest education level? Some High School, High School Diploma, GED, Some College, Associate's Degree, Bachelor's Degree, Master's/PhD Degree,
   Other: _____
6) What was your major in college, if you attended? _____
7) How many children do you have? _____
8) What is your occupation? _____
9) Do you live in an urban, suburban, or rural area?
   Urban Suburban Rural
10) What is your political affiliation?
   Republican Democrat Independent Other: _____

Any additional comments

Figure 2. Home State of Survey Respondants



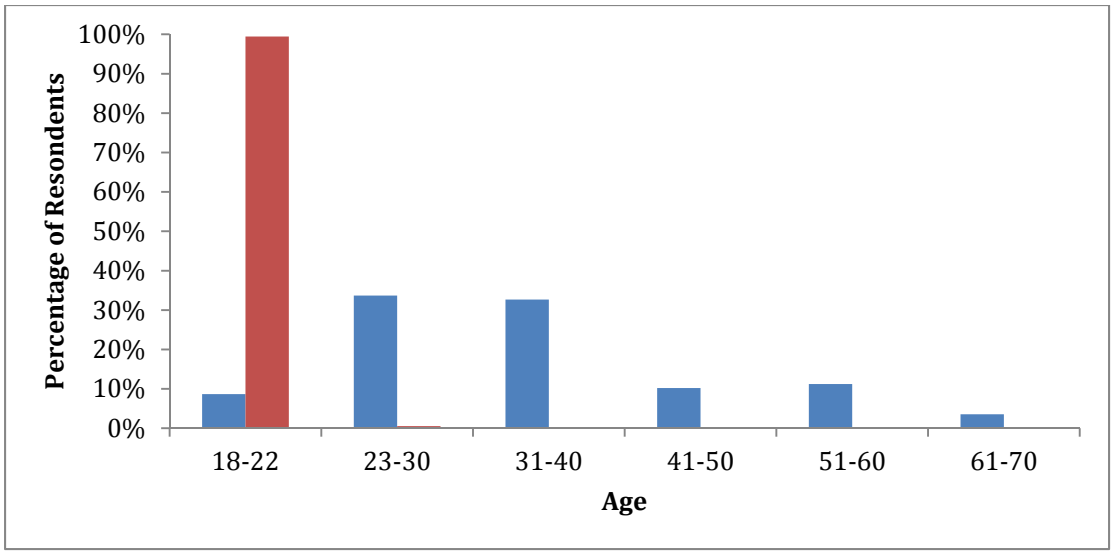


Figure 3. The age distribution of the Mechanical Turk (blue) and Gettysburg College (red) samples.

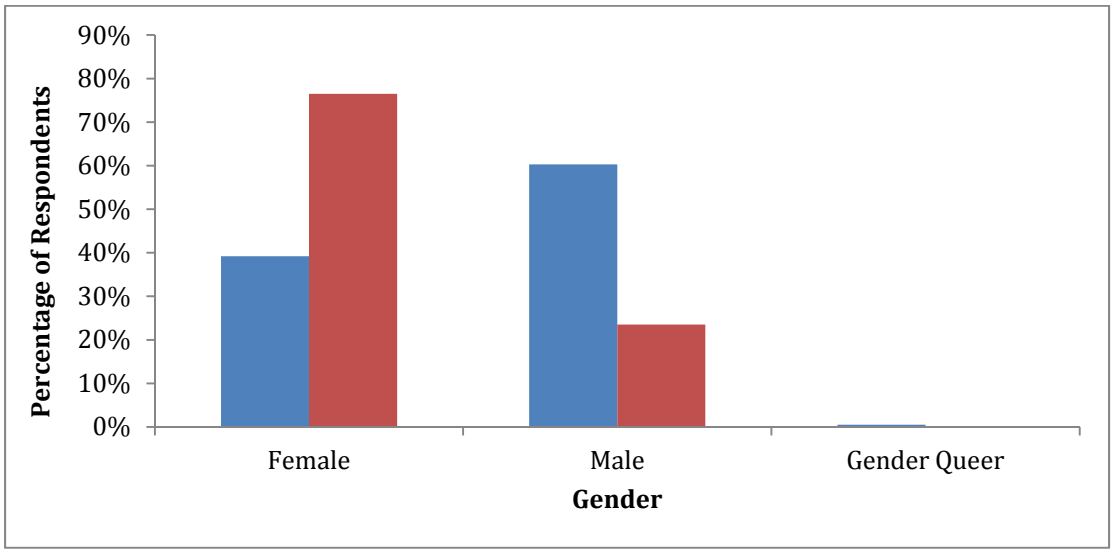


Figure 4. The gender distribution of the Mechanical Turk (blue) and Gettysburg College (red) samples.

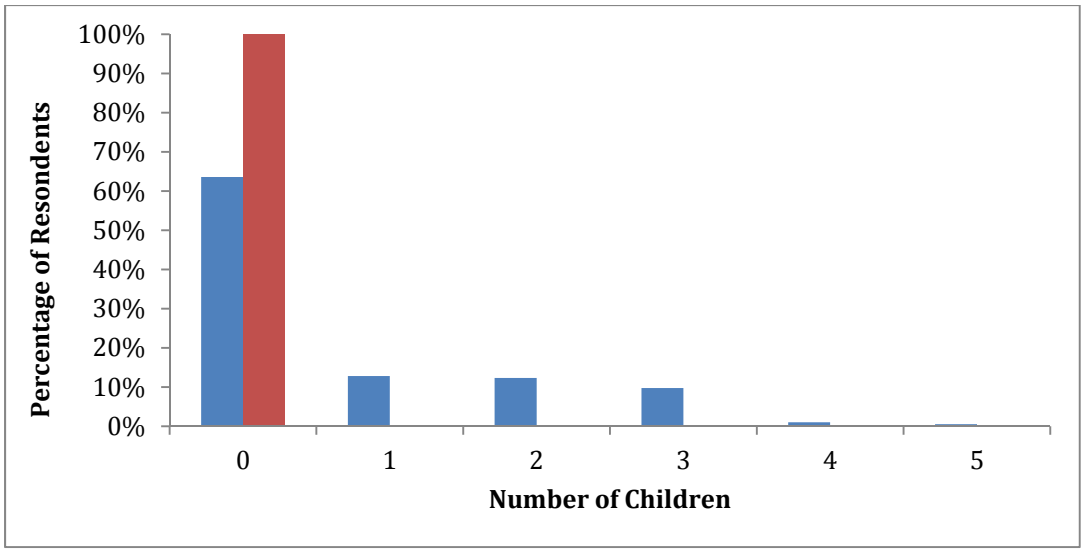


Figure 5. The number of children respondents had for the Mechanical Turk (blue) and Gettysburg College (red) samples.

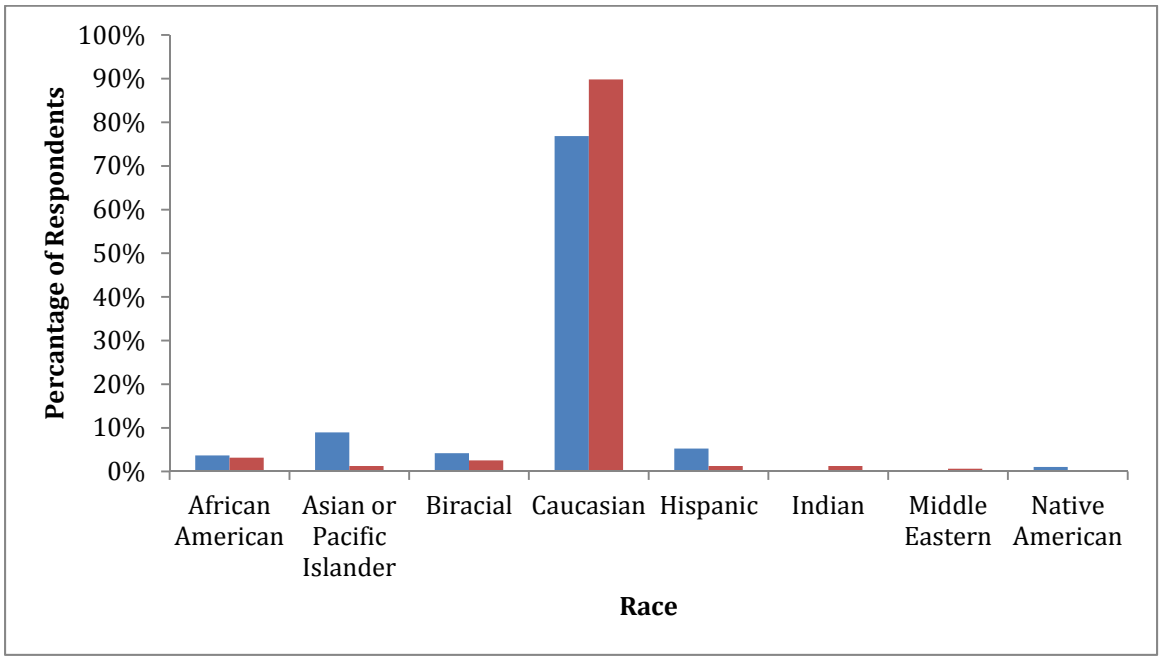


Figure 6. The racial distribution of the Mechanical Turk (blue) and Gettysburg College (red) samples.

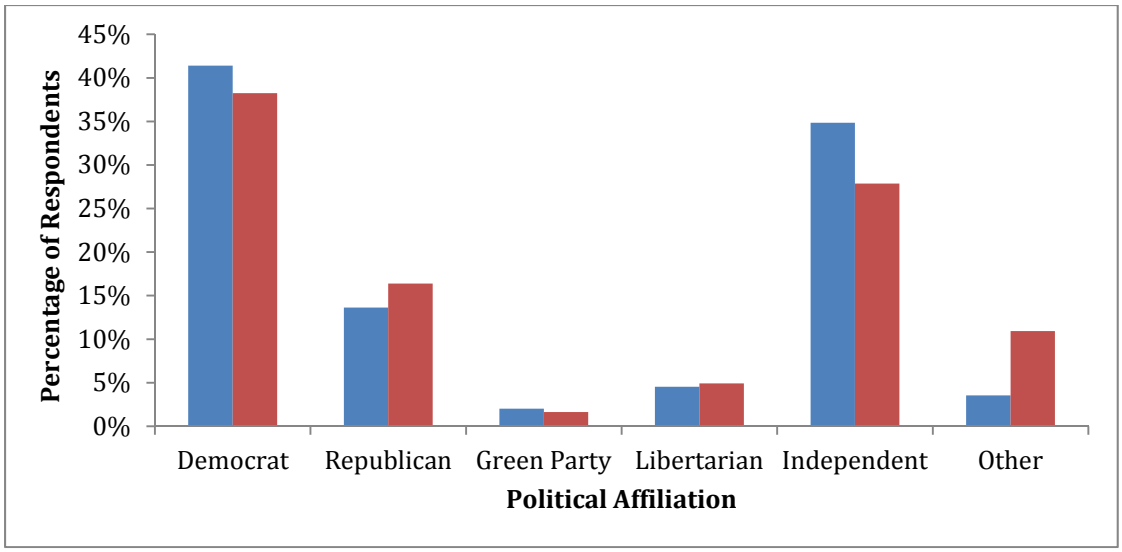


Figure 7. The political affiliation distribution of the Mechanical Turk (blue) and Gettysburg College (red) samples.

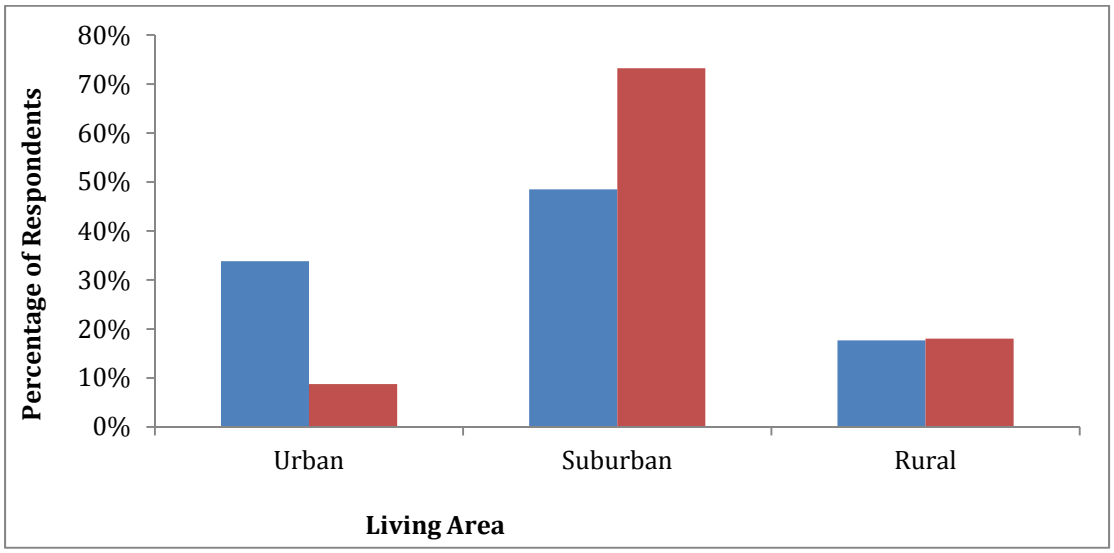


Figure 8. The distribution of where respondents live for the Mechanical Turk (blue) and Gettysburg College samples.

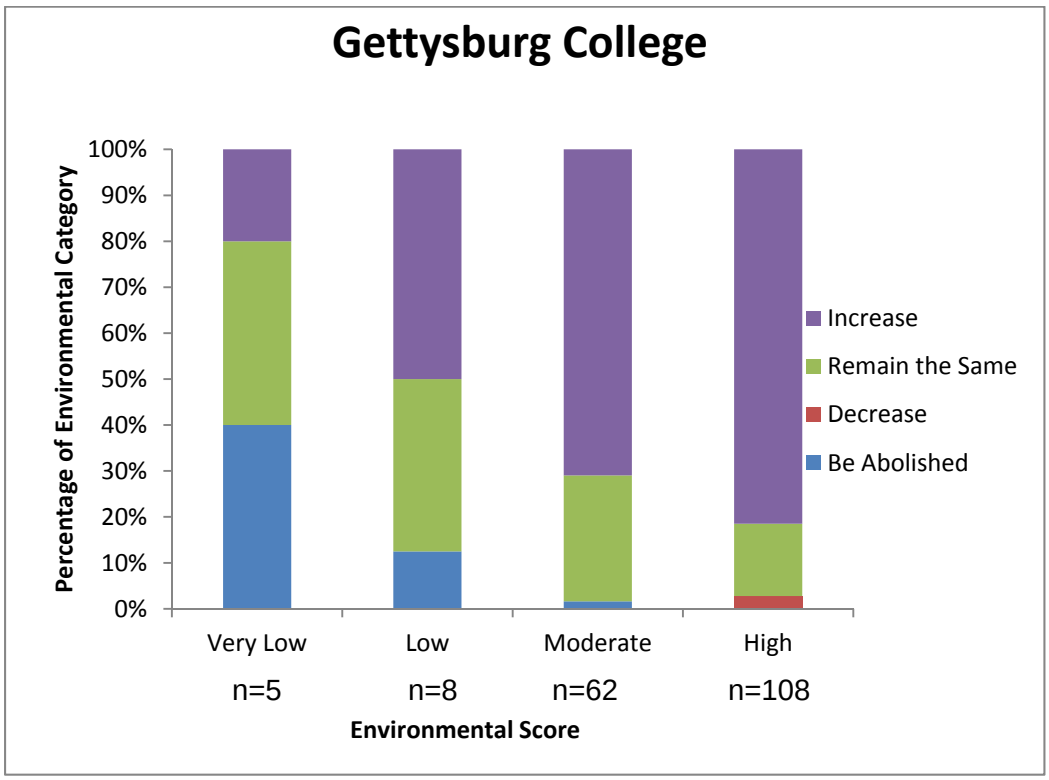


Figure 9. Opinions on fuel efficiency standards vs. Environmental Score, Gettysburg College.

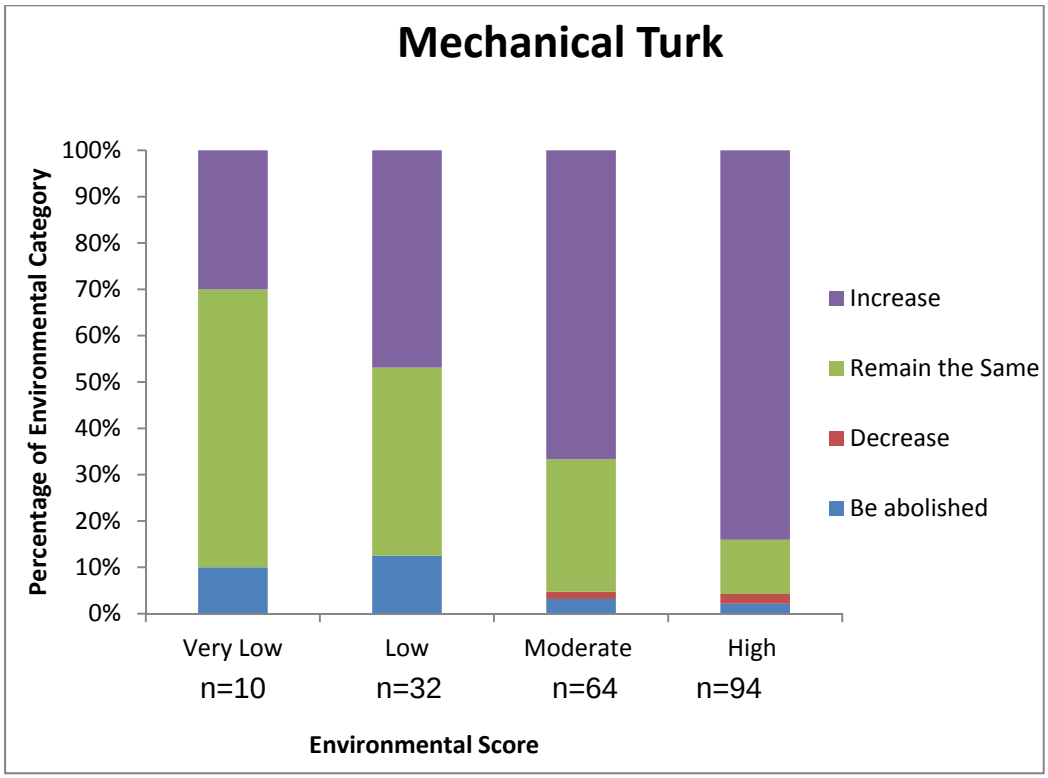


Figure 10. Opinions on fuel efficiency standards vs. Environmental Score, Mechanical Turk.

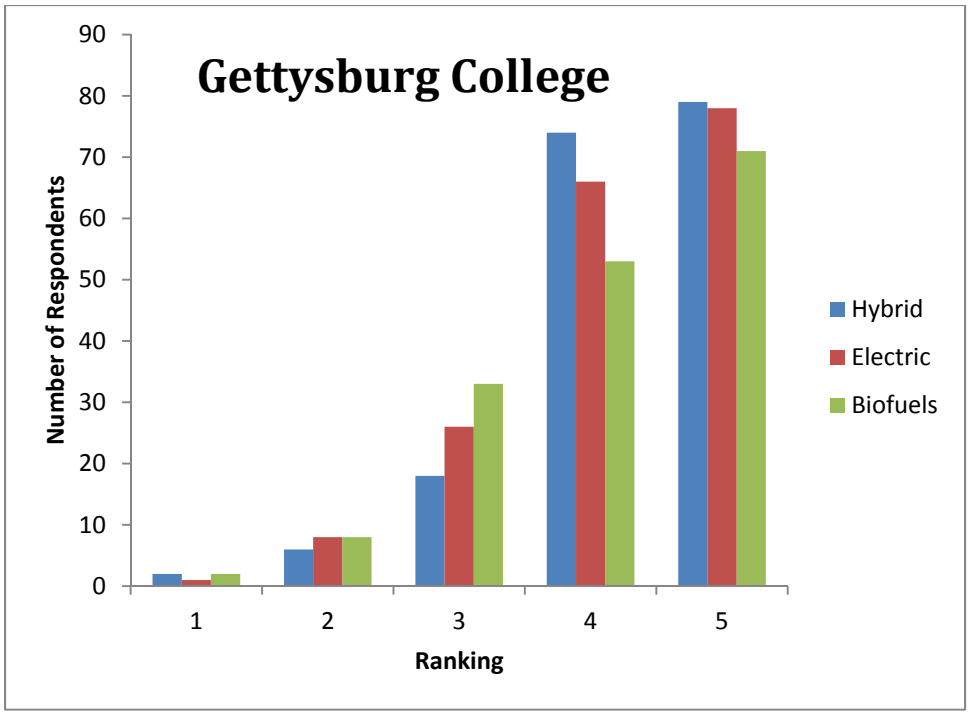


Figure 11. Ranked importance of increasing research and resources for hybrid, electric and biofuel technologies, Gettysburg College.

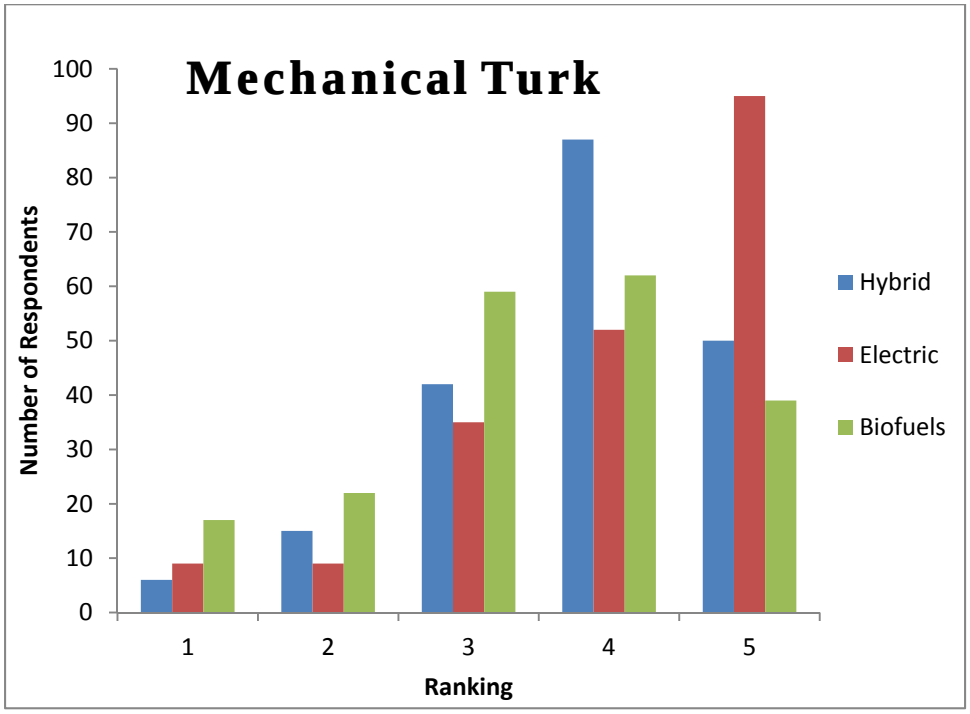


Figure 12. Ranked importance of increasing research and resources for hybrid, electric and biofuel technologies, Mechanical Turk.

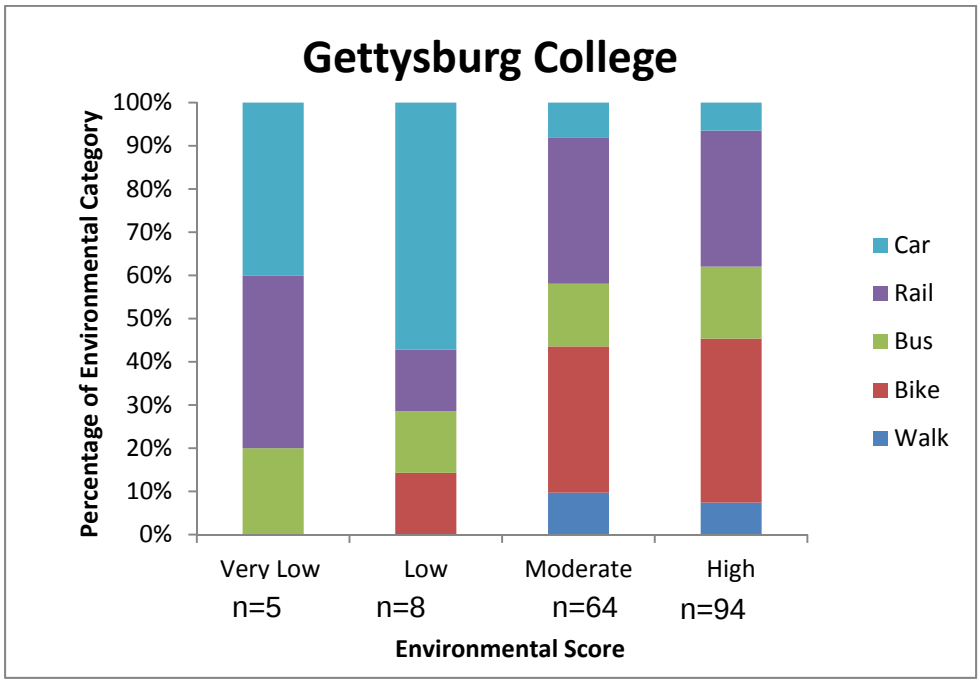


Figure 13. Ideal Transport vs. Environmental Score, Gettysburg College

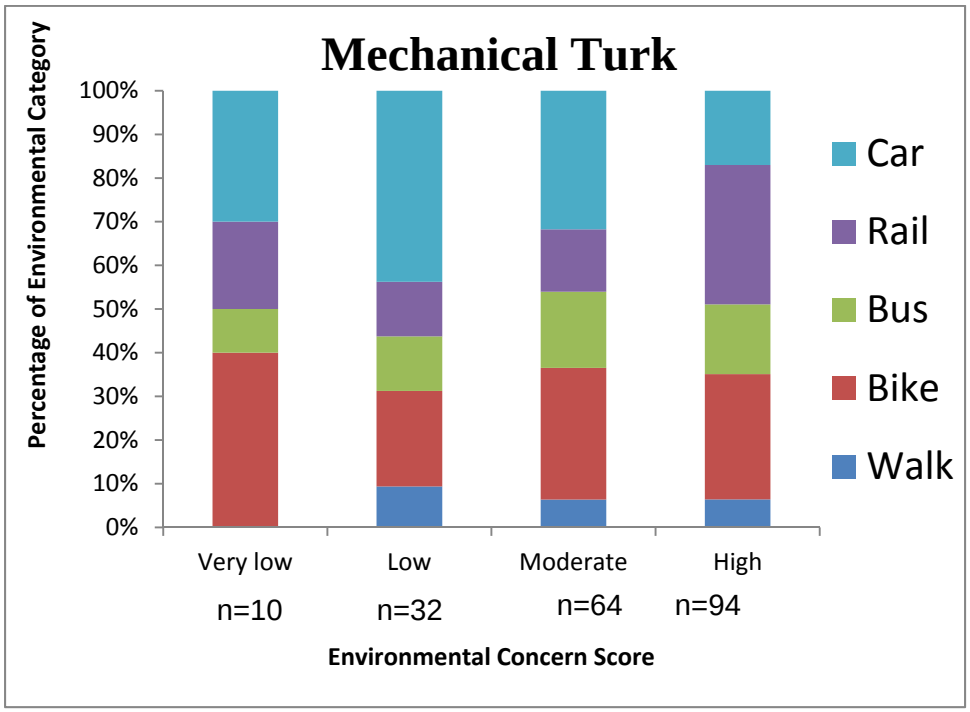


Figure 14. Ideal Transport vs. Environmental Score, Mechanical Turk

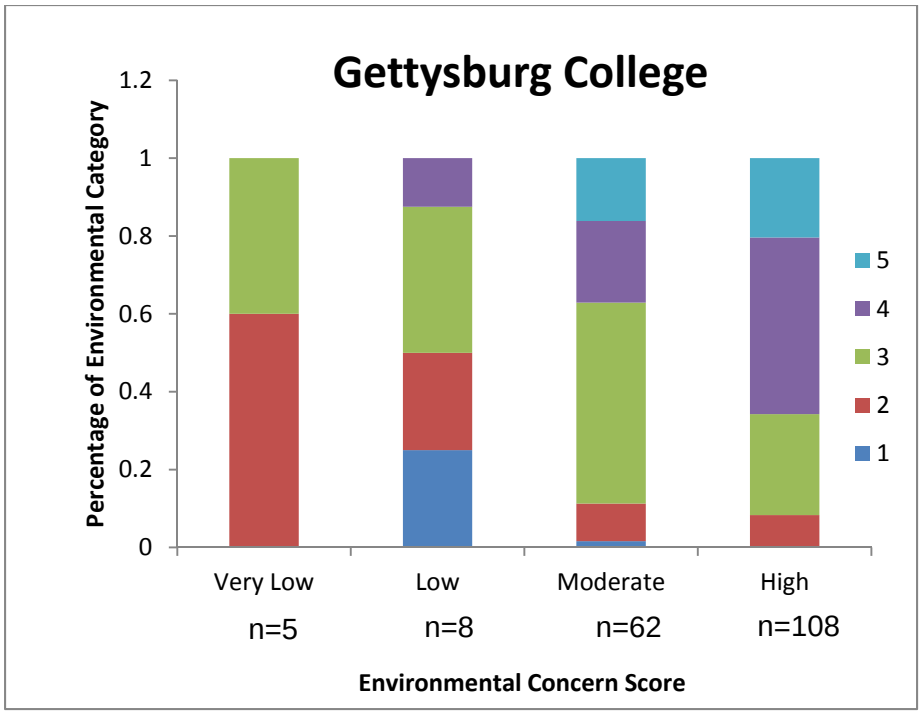


Figure 15. Importance of greenhouse gas emissions vs. Environmental Score, Gettysburg College.

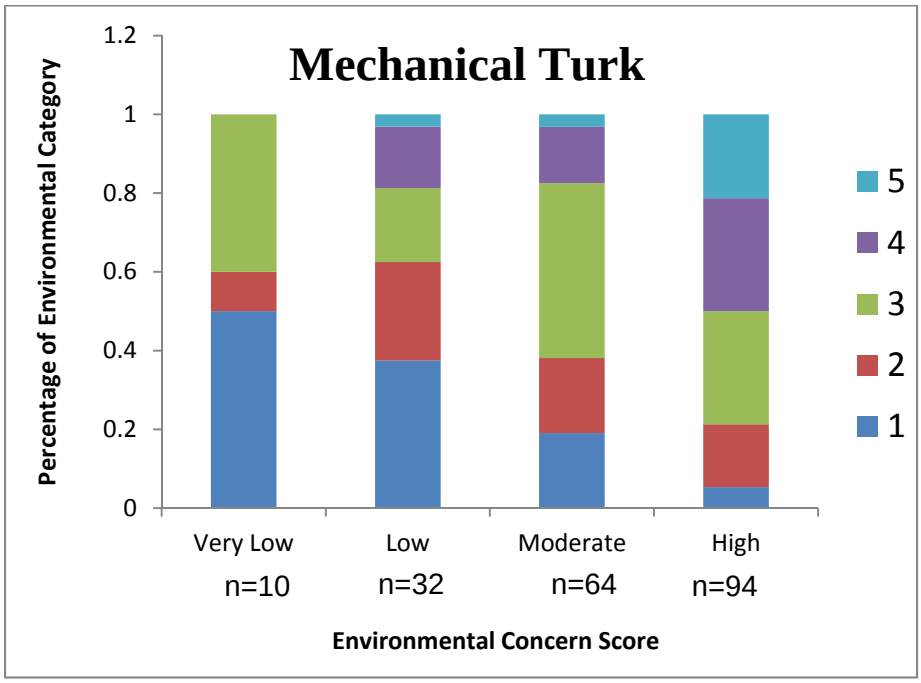


Figure 16. Importance of greenhouse gas emissions vs. Environmental Score, Mechanical Turk.