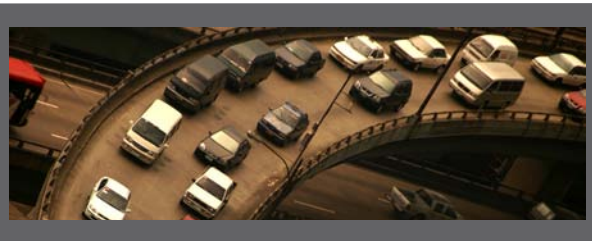


Ecodriving and Carbon Footprinting: Understanding How Public Education Can Reduce Greenhouse Gas Emissions and Fuel Use



MTI Report 11-11



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REPORT 11-11

ECODRIVING AND CARBON FOOTPRINTING: UNDERSTANDING HOW PUBLIC EDUCATION CAN REDUCE GREENHOUSE GAS EMISSIONS AND FUEL USE

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EXECUTIVE SUMMARY

Ecodriving is a collection of driving behaviors and maintenance practices that can improve the fuel efficiency of driving. As a practice, ecodriving has gained attention among automakers, policy makers, and researchers because it costs little or nothing to implement, and it can be applied to almost any vehicle. Common ecodriving practices such as accelerating slowly, braking gradually, and keeping tires properly inflated have been known for decades. However, only recently, with increases in gasoline prices, concerns about foreign oil dependence, and climate change, have these practices been viewed in a collective fashion to improve fuel economy.

Ecodriving has also gained attention due to newly emerging technologies that may be able to assist drivers in more efficient driving by delivering real-time information to them through navigational screens or audio messages. The emergence of these feedback technologies has produced a need for greater specificity in defining different types of ecodriving interventions. Prior to these feedback technologies, all ecodriving interventions were considered “static ecodriving” interventions in that they did not provide drivers with any new information while driving. A static ecodriving intervention is simply the provision of information, such as a website, a brochure, or classroom training program. With such interventions, drivers are taught about ecodriving beforehand, and they are not given any new information during or after their trips. Real-time feedback technologies, which generally draw data off of the onboard diagnostic (OBD) II port or use GPS-tracked movements to provide driver feedback, fall within the realm of “dynamic ecodriving.” Both types of interventions have their advantages. Static ecodriving, in the form of a website or brochure, is very low cost and can inform consumers on how to ecodrive. It is also more effective at describing maintenance practices that can maintain or improve fuel economy. Dynamic ecodriving costs more because it requires new technology that can process real-time driving situations and give the driver meaningful instruction. This more advanced feedback is given precisely when the driver needs it and is continuous over time.

This study explores the consumer response to ecodriving information as delivered through the implementation of static ecodriving. The study evaluates consumer response from a number of angles, including focus groups, expert interviews, a longitudinal survey, and a clipboard survey, all completed in the San Francisco Bay Area. Researchers also completed a survey of existing carbon footprinting websites, which provide relevant supplemental information related to personal transportation behavior and its impact on carbon emissions.

The longitudinal survey completed as part of this study divided a sample of roughly 100 respondents into two equal groups, defined as the “experimental” and “control” group. The sample was drawn from the population of UC Berkeley employees and students. Those participants that were in the experimental group were directed to a website, ecodrivingUSA.com,^A which provided general information about ecodriving practices and behaviors. The control group was not directed to any website. Both groups were given a pre-survey and a post-survey that asked questions about their current driving behavior. Participants within the experimental group were also given an additional intermediate survey that ascertained their response to the website itself, including the website’s effectiveness. This design was

^A The [ecodrivingUSA](http://ecodrivingUSA.com) website was removed from the Internet in Spring 2012. Please note that key information conveyed on this site is available in two fact sheets that appear in Appendix E of this report (pp. 150-151).

developed to evaluate whether shifts in reported driving behavior were different for the experimental group versus the control group.

The results of the longitudinal survey showed that the provision of ecodriving information to participants in the experimental group did cause a shift in driving behavior among some participants. The exhibited shift is not widespread or universal across all respondents in the experimental group, but it is large enough and different enough from the control group to exhibit a statistical significance within a relatively small sample size (~50). As an example, Figure E.1 shows the shift exhibited by respondents in both the experimental and control group for free flow highway speeds. Respondents were asked: “When you drive on the highway in free flow traffic (such as 101, 680, or 880), what cruising speed do you typically try to maintain?” The pre- and post-responses (dark to light) show the experimental group shifting to definitively lower speeds. The control group exhibits a shift that is not statistically significant.

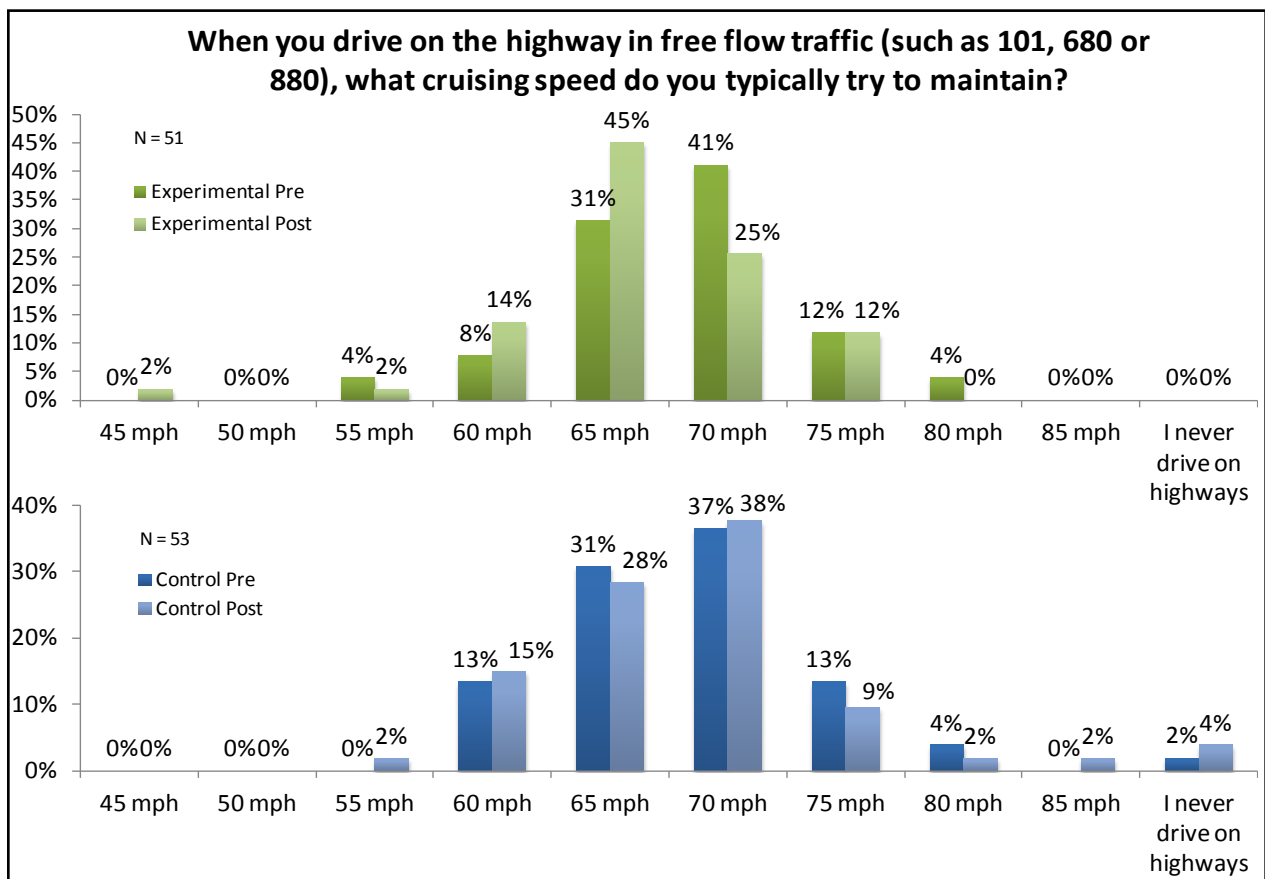


Figure E.1 Reported Shift in Highway Cruising Speed

Speed

The shift exhibited by the experimental group is statistically significant. A number of other questions revealed that the experimental group reported shifts in behavior that were statistically significant in contrast to the control group, which exhibited insignificant shifts or shifts that were in the opposite direction of ecodriving. A selection of these questions and their statistical significance is presented in Table E.1.

Table E.1 P-Values of Wilcoxon Signed Rank Test of Key Survey Questions

Question	Possible Responses	One-Tailed Test P-Value (shift direction)	
		Experimental	Control
When you drive on the highway in free flow traffic (such as 101, 680 or 880), what cruising speed do you typically try to maintain?	< 45 mph (downward-most response) 45 mph 50 mph 55 mph 60 mph 65 mph 70 mph 75 mph 80 mph 85 mph More than 85 mph I never drive on highways (upward-most response)	0.018+ (downward)	0.21 (downward)
Overall, how well do you think that your car is maintained?	Not well at all Not very well Okay, but could be better Rather well Very well	0.029+ (upward)	0.47 (downward)
How efficiently, in terms of fuel usage, do you think you drive your vehicle now?	Very inefficiently Somewhat inefficiently About average Somewhat efficiently Very efficiently	0.086* (upward)	0.27 (downward)
On cold mornings, how long do you typically warm up the car before starting your trip?	~0 seconds About 15 seconds About 30 seconds About 45 seconds About 1 minute About 1.5 minutes About 2 minutes More than 2 minutes	0.037+ (downward)	0.001+ (upward)
When driving your primary vehicle, how often do you adjust your driving behavior in ways to improve your fuel economy?	Never Rarely Sometimes Often Always	0.00076+ (upward)	0.34 (upward)
I regularly use the manufacturer recommended motor oil.	Strongly Disagree Disagree Agree Strongly Agree	0.51 (upward)	0.36 (upward)
I regularly check and properly inflate my tires at least once a month.	Strongly Disagree Disagree Agree Strongly Agree	0.0084+ (upward)	0.048+ (upward)
*statistically significant at the 10% level †statistically significant at the 5% level			

These results show that members of the experimental group did change their behavior in ways that improved their propensity to ecodrive. The control group, in contrast, did not shift their behavior. This result does not mean that all members of the experimental group shifted their behavior. In fact, some of these members appeared to worsen their propensity to ecodrive. The results state that some respondents did appear to shift reported behavior, and such shifts were large enough in magnitude to make the before-and-after differences in response distribution statistically significant. The policy conclusion emerging from this result is that static ecodriving information will shift the behavior of some people, and while such shifts are small, they may be cost effectively achieved given the low cost of information provisions, such as websites.

Those respondents in the experimental group reviewing the EcodrivingUSA website were asked to evaluate how effective they felt certain information and website features were in communicating the reasons for ecodriving and implementation methods. Table E.2 provides a summary of responses given by members of the experimental group.

Table E.2 Ecodriving USA Website Features Visited and Deemed Most Effective

<i>What sections of the website did you visit? (Please check all that apply)</i>			<i>Which section of the website did you find to be the most effective in informing you about the reasons and incentives for eco-driving? (choose one response)</i>		<i>Which section of the website did you find to be the most effective in informing you on how to eco-drive? (choose one response)</i>	
Website Feature	Count	%	Count	%	Count	%
The introductory video	37	74%	20	40%	15	30%
The list of maintenance tips	44	88%	6	12%	5	10%
The list of driving tips	47	94%	18	36%	25	50%
The quiz (Beginner)	14	28%	2	4%	1	2%
The quiz (Intermediate)	7	14%	3	6%	1	2%
The quiz (Pro)	3	6%	0	0%	0	0%
The endorsement of eco-driving by selected state governors	9	18%	0	0%	0	0%
The Eco-driving game	14	28%	0	0%	0	0%
Other, please specify:	0	0%	0	0%	0	0%
None	0	0%	1	2%	2	4%
Total	50	100%	50	0%	49	0%

The respondents that reviewed the website found that the video and the list of driving tips was among the most useful information that taught about ecodriving. Notably, the list of maintenance tips was considered among the least effective information. Nearly 90% of respondents reviewed the list of maintenance tips, but only 10 to 12% found the information useful. This, along with other study results, suggests that maintenance practices are harder to implement for drivers, and to achieve improvements in maintenance practices, better information is needed on improving vehicle maintenance. Improvements to this information may include more details about how to implement such maintenance practices and how to self-diagnose when such maintenance practices are needed.

The study also administered an intercept clipboard survey, which was administered during March and April 2011 at three main locations in the San Francisco Bay Area—UC Berkeley, San Francisco Union Square, and Golden Gate Park of San Francisco. Over the course of two months, 306 people completed the survey.

As part of the survey, participants were asked to review a fact sheet published by the EcoDriving USA™ campaign with information regarding ecodriving and maintenance practices (See Appendix E). This sheet was provided to evaluate which ecodriving practices they currently engage in and which practices they would be willing to try in the future. They were then given a short, one-page survey that asked about their current driving and maintenance habits, what ecodriving practices they were willing to try, and their overall perceptions about gasoline prices and climate change.

One of the highlights of the clipboard survey found that respondents were most willing to check tire pressure on a monthly basis and remove excess weight from the vehicle. Respondents were also privy to replacing the air filters and scheduling periodic tune-ups. Drivers were willing to consider avoiding rapid starts and stops, using cruise control, and maintaining a steady speed when possible.

A pair of focus groups were conducted in parallel to the survey to probe the response of consumers to the EcoDriving USA website and to gain more direct interactions with consumers that could use the ecodriving information. Two focus groups were conducted on February 17, 2010 and February 25, 2010. The focus groups were held in Berkeley, California, and all the participants were California licensed drivers from the San Francisco Bay Area. Participants were recruited via flyers handed out at local grocery stores, libraries, and other public locations. Participants received a \$50.00 gift certificate in appreciation of their time. Both focus groups were conducted with participants that had regular vehicle access. There were a total of 13 participants in the two focus groups, and their responses are summarized collectively here. The focus groups found that participants liked the use of a video to explain information on the benefits and effectiveness of ecodriving. They appreciated that the ecodriving information was applicable to everyone and put the concepts in simple terms that anyone could easily follow. Further, the website video contained graphics in dollars, which showed the effect ecodriving could have on each individual's savings in dollar values.

Researchers also completed a series of expert interviews to gain a greater understanding of expert opinions about social marketing and public education campaigns and the characteristics that make up a successful campaign. Experts were asked about their experiences with public education campaigns, strategies used to distribute the campaigns, and overall lessons learned. Researchers conducted interviews with seven experts from October 2009 to February 2010.

Among the highlights from the interviews were issues that the experts would have liked to know about prior to implementing a public education campaign. They noted that they would have liked to know more about some of the fears and misconceptions associated with their message beforehand. They would also like to have a better understanding of the funding available for the campaign in order to improve their resource allocation. They

noted that it was important to verify that there were no changes in policy or other efforts that could undermine the group's campaign. They also said that it was critical to assume that there may be opposition to their message. Finally, experts noted that it was very important that all people involved in a campaign agree on the campaign purpose and objectives they hoped to achieve.

This study evaluated ecodriving and ecodriving campaigns from a number of critical angles including a longitudinal survey, an intercept clipboard survey, focus groups, and expert interviews. Broadly, the study found that ecodriving information can influence driving behavior, but the overall shift in behavior from information alone is likely to be relatively small in magnitude. Static ecodriving information can provide people with basic pieces of information needed to adapt their driving behavior to improve the fuel efficiency of their driving. However, the results also show that static ecodriving will not produce widespread shifts universally among the population. More likely, a subset of those exposed to ecodriving information will shift behavior in positive ways, and the resulting reductions in fuel use will be achieved cost effectively given the low cost of information provision, particularly through websites. This study suggests that static ecodriving interventions can make contributions to reducing fuel consumption, and if incorporated into driver training, would provide the population with the knowledge necessary to save fuel and reduce emissions at relatively little public cost.

I. INTRODUCTION

Rising fuel prices and concerns about climate change are increasing. Transportation is a major contributor of carbon dioxide (CO₂) and other greenhouse gas (GHG) emissions from human activity, accounting for approximately 14% of total anthropogenic emissions globally and about 27% in the United States (U.S.). To date, the most dramatic policy measure at the U.S. state level has been the passage of California's Global Warming Solutions Act (AB 32), which seeks to limit GHG emissions from a wide range of industrial and commercial activities. AB 32 requires that California's GHG emissions be reduced to 1990 levels by 2020 (a 27% reduction) through an enforceable statewide cap that will be phased in starting in 2012 under rules developed by the California Air Resources Board (ARB). Furthermore, Governor Schwarzenegger's Executive Order S-3-05 includes an 80% reduction in GHG emissions by 2050.

On June 26, 2008, ARB released the *Climate Change Draft Scoping Plan: A Framework for Change*. In the draft plan, ARB emphasized the importance of public education in bringing about voluntary individual action. Public education through social marketing (marketing directed at promoting a social good through behavioral change) has the potential to change travel behavior to reduce GHG emissions. A greater understanding of the impact of social marketing and public education on travel behavior is necessary to gauge policy emphasis on this strategy and reliance on voluntary measures. This study seeks to understand how social marketing that relies on web-based information and fact sheets about ecodriving and carbon footprinting can impact transportation behavior and GHG emissions. Various techniques are used to accomplish this, including expert interviews, focus groups, online surveys, and intercept (in-person) surveys.

Ecodriving is the concept of changing driving behavior and vehicle maintenance to impact fuel consumption and emissions. Ecodriving can include both real-time driver feedback devices (for example, Toyota Prius in-vehicle navigation screen) and static information (websites and fact sheets) about driving habits and vehicle maintenance to reduce energy consumption and emissions. Carbon footprinting is the concept of an individual (or company) tracking their GHG emissions based on their energy consumption and travel behavior. A number of web-based carbon calculators have been developed that assist individuals with calculating their carbon footprint. These carbon calculators generally provide the user with a menu of things the user can do to reduce their carbon footprint.

The key study questions are:

- Whether or not travelers will adopt ecodriving practices in response to ecodriving and carbon footprinting information;
- The extent of GHG emission reductions if the new behaviors are adopted; and
- How long the modified behavior will persist.

To answer these questions, researchers:

1. Completed an extensive literature review on the state of ecodriving and carbon footprinting education worldwide;
2. Conducted expert interviews with persons involved with public education for environmental goals;
3. Convened two focus groups to discuss responses to Internet-based public education campaigns and specific ecodriving and carbon footprinting websites;
4. Completed a hundred-person “before” and “after” Internet survey with a control group that was not provided with ecodriving information, and an experimental group that was provided with a link to an ecodriving website;
5. Encouraged all of the survey participants to keep a fuel and mileage log during their participation in the study; and
6. Conducted a 300-person intercept (in-person) survey using a simple, easy-to-read ecodriving fact sheet.

Data collection was conducted from October 2009 through February 2011. During this timeframe, gas prices fluctuated from an average low of \$2.90 per gallon to a high of \$3.72 per gallon.

II. CARBON FOOTPRINTING & ECODRIVING LITERATURE REVIEW

BACKGROUND

The threat of climate change has led many countries around the world to commit to the reduction of greenhouse gas emissions (GHGs). The Kyoto Protocol represents a global initiative of 191 states, including the European Union (E.U.), all dedicated to the goal of reducing emissions from five to eight percent under 1990 levels over the period from 2008 to 2012, or curtailing the rate of emission growth.¹ Consequently, a number of programs have been developed to help address this pressing issue, with efforts ranging from increased research on alternative fuels to campaigns aimed at promoting energy efficiency. Many countries are seeking ways to reduce GHG emissions from the transportation sector, which is responsible for 23% of worldwide CO₂ emissions from fossil fuel consumption.^{2,3}

In California, several initiatives have been passed in response to the threat of global warming. Executive Order S-3-05, which was signed on June 1, 2005, recognized California's vulnerability to climate change, calling for GHG reduction targets and efforts to reduce GHG emissions.⁴ Moreover, The Global Warming Solutions Act, or AB 32, was passed in 2006, which sets goals for carbon emissions to fall to 1990 levels by 2020. It is the first climate change bill that has been passed through a state legislature in the U.S.⁵

With this growing awareness and policy emphasis, individuals and businesses around the world have begun to look for ways to reduce GHG emissions. Social marketing has been suggested as a potential way to induce individuals to change their behavior to be more environmentally sustainable. "Social marketing" refers to the use of marketing and promotional strategies to influence behavior to benefit a larger social cause (as opposed to commercial marketing, which is undertaken to benefit the marketer).⁶

Raising awareness has been the starting point for many environmental social marketing campaigns. To reduce GHG emissions, it is important to first understand current emission levels and the impact of behavioral and activity changes on emissions. One method to help individuals and businesses track and understand their GHG emissions is through carbon footprinting. A carbon footprint measures the GHG emissions of various activities in terms of carbon dioxide equivalent (CO₂e). It includes the amount of GHG emissions produced through burning fossil fuels for electricity, heating, and transportation that are specific to the activities of an individual or business.⁷ A number of carbon calculators are now available on the Internet, providing individuals with the ability to assess their own carbon footprints and to monitor reductions in their GHG emissions corresponding to lifestyle changes.^{8,9,10} Furthermore, environmental impact trip planners are widely used to assess the carbon footprint of trips based upon different travel modes. Trip planners generally rely on public transportation schedules and routes to assess the impact of auto trips in comparison to public transit-based trips. However, this type of information may not be suitable for many populations, who may consider it impractical to switch to alternative modes. In the U.S., the personal automobile is the primary mode of transportation for a majority of American households. In 2008, transportation accounted for 27% of total U.S. GHG emissions.¹¹ According to the 2005-2007 American Community Survey 3-Year

Estimates, 91.2% of households owned at least one vehicle, and over 50% owned two or more vehicles.¹² Thus, it is necessary for U.S. households to have carbon emissions information specific to their primary transportation mode—driving.

Ecodriving, the concept of changing driving behavior to impact emissions and fuel consumption, is a form of public education that informs individuals of the changes in emissions they can realize by changing the way they drive.^{13,14,15} Studies conducted in the United Kingdom (U.K.), Western Europe, and Japan indicate that ecodriving has the potential to reduce fuel consumption by an average of 5 to 25% and showed significant reductions in fuel consumption and carbon dioxide emissions (10.9%) among participants who took part in ecodriving educational training classes.^{16,17,18,19} Ecodriving provides a no-cost, sustainable method for individuals to help achieve the global targets for emission reduction.

CARBON CALCULATORS

Carbon calculators can be found on the Internet and are often used to calculate individual, household, and business carbon footprints, as well as to estimate potential savings that may result from specific behavioral changes. Most calculators cover three general parameters: 1) household size, 2) energy use, and 3) transportation. The specificity of the information for each calculation varies from calculator to calculator; some require data specific to a household or business (for example, utility bills), while others use approximations. Some calculators factor in additional parameters, such as lifestyle (for example, shopping expenses) and food consumption. Others offer the opportunity to offset carbon footprints by providing the user with information about reducing GHG emissions or buying carbon offsets.

This diverse set of carbon calculators presents a problem, as the lack of consistency has led to carbon footprints that vary by calculator. Recognizing this, Padgett and his colleagues et al. (2008) analyzed ten carbon calculators and found that an individual's carbon footprint could vary by up to several metric tons of CO₂ depending on the calculator used. For example, Padgett et al. found that the calculated CO₂ emitted for 12,000 kilowatt hours of household electricity use mostly varied 15,600 to 18,000 lbs/year, but the high and low outliers presented emissions of 6,600 and 24,000 lbs/year. The study suggested that the variations could be the result of different conversion factors or calculation methods used by each calculator, and the lack of explanation behind calculation methods has made it difficult to identify the cause of variation. Therefore, Padgett et al. suggest that standardization and transparency are necessary in the design of future carbon calculators as usage of these online tools continues to grow.²⁰

Coulter et al. (2008) further explored questions relating to the design of carbon calculators in their study of both stakeholders (professionals seeking to communicate carbon emissions information) and users. Stakeholders emphasized the importance of targeting specific populations when designing the calculators—for example, study participants who had previously used carbon calculators and considered themselves aware of environmental issues did not feel that they benefited very much from the carbon calculators. In contrast, the calculators did increase understanding among non-users, and in some cases, impacted

their attitudes toward emissions. However, sometimes this impact was negated by the non-users' perception that their individual carbon emissions were actually quite insignificant compared to the emissions of national and international actors. Additionally, non-users were generally not willing to change their travel behavior to reduce their emissions, citing limited alternatives, time, and cost as reasons for not doing so. Through a comparison of a variety of carbon calculators, the non-users compiled a list of design criteria for effective calculators, including: simple and engaging graphics, everyday language, simple yet personalized information requirements, meaningful and understandable results, personal and realistic follow-up action, and available but discrete calculation information. Participants generally assumed that the sites were accurate, although they were more inclined to trust sites asking for detailed, personalized information over sites asking for averages or simplified information. Participants also noted the variability of results between different calculators and suggested that standardized data and methodology would increase the reliability of carbon calculators.²¹

In addition to the variable results of carbon calculators, other limitations have been identified that may prevent them from being an effective means of shifting individuals to more sustainable behaviors, especially in the realm of transportation. Chatterton et al. (2008) examined the effect of carbon calculators as an educational tool, by conducting a before-and-after study of people who had never previously used carbon calculators. The individuals generally had a greater understanding and interest in reducing their carbon emissions after using the carbon calculators, and while many participants were willing to make changes in their household behavior, very few people felt that they could change their travel behavior, especially with regard to switching modes from driving to an alternative mode such as public transit, walking, or biking. Participants perceived changing their travel behavior as a significant lifestyle shift, an idea that the carbon calculators themselves often reinforced, by recommending strategies that would require a large-scale change, such as buying a smaller car or avoiding certain trips. Even when smaller-scale changes were suggested (such as ecodriving or planning to avoid congestion), individuals overlooked these and instead focused on the large-scale changes. Chatterton et al. found that individuals generally would not change their travel behavior to mitigate health and environmental impacts because these issues cannot outweigh what they identified as the 'three Cs'—cost (in terms of time and money), comfort, and convenience. There are significant economic and social barriers that must be overcome before individuals will be willing to switch from driving to alternative modes—for instance, the variable cost of using an alternative mode can often be more costly than driving for individuals who already own a car, and there are also positive social signals that individuals associate with driving (for instance, wealth and status). Chatterton et al. concluded that although carbon calculators can play a role in helping individuals understand their impact on the environment, this role is very limited for a number of reasons. First, they only represent one aspect of environmental damage (climate change), neglecting to account for other health and environmental consequences. And second, the choices that carbon calculators offer for reducing emissions are often not perceived as realistic (for instance, buying a smaller car), which may cause individuals to feel guilty or powerless, and thereby reduce their inclination to adopt other, more readily achievable behavioral changes, such as ecodriving.²² Table 1 lists and describes some of the carbon calculators that have been available online.

Table 1. Online Carbon Calculators

Name	Organization	URL	Description
Climate Change Calculator	American Forests	http://www.americanforests.org/resources/ccc/	Calculates carbon footprint using either exact figures or national averages of home and transportation energy use; provides option of planting trees to offset emissions.
Carbon Savings Calculator	American Public Transportation Association	http://www.publictransportation.org/tools/carbonsavings/Pages/default.aspx	Calculates the potential reduction in emissions from switching all or part of travel to public transit.
Carbon Calculator	Bonneville Environmental Foundation	http://www.b-e-f.org/carbon/calc/?gclid=CN6t6frdhqkCFUkZQgod60hgqg	Calculates home, transportation, and flight emissions using either exact figures, national averages, or averages for a given type of housing and travel behavior.
Carbon Calculator	Be Green	http://www.greenmountainenergy.com/green-mountain-energy-company-store/carbon-calculator	Calculates emissions from vehicles, electricity, travel, and heating using either exact figures or national averages.
Carbon Footprint Calculator	Carbon Footprint	http://www.carbonfootprint.com/calculator.aspx	Calculates emissions from house, flights, car, motorbike, and bus and rail for a user-defined time period; requires exact information.
Custom Carbon Calculator	Carbonfund.org	http://www.carbonfund.org/Calculators	Calculates emissions from home, car, flight, and train/bus activities; provides option to purchase offsets.
Atmospheric Carbon – What’s your share?	Chuck Wright	http://www.chuck-wright.com/calculators/carbon.html	Calculates emissions from auto and air transportation and home electricity, natural gas, and fuel oil usage.
GoZero SM Calculator	The Conservation Fund	https://gozero.conservationfund.org	Calculates emissions from household energy use, auto and air travel; provides option to plant trees to mitigate climate change.
Carbon Calculator	Conservation International	http://www.conservation.org/act/live_green/carboncalc/Pages/default.aspx	Calculates emissions from household, auto, and travel activities; provides option to purchase offsets.
Calculator	Cool California	http://www.coolcalifornia.org/calculator	Calculates emissions from household, travel, and shopping behavior.
Carbon Calculator	eco HATCHERY	http://www.ecohatchery.com/calculator	Calculates emissions from home, vehicles, diet, and travel.
Household Emissions Calculator	United States Environmental Protection Agency	http://www.epa.gov/climatechange/emissions/ind_calculator.html	Calculates emissions based on household vehicles, home energy, and waste information; provides suggested actions and estimated savings (in both money and emissions).
Calculate Your Personal Impact	Fight Global Warming	http://www.fightglobalwarming.com/carboncalculator.cfm	Calculates emissions based on housing, driving, and flying information.

Carbon Footprint Calculator	The Nature Conservancy	http://www.nature.org/green-living/carboncalculator/	Calculates emissions based on self-reported behaviors related to home energy, driving and flying, food and diet, and recycling and waste.
Carbon Footprint Calculator	PG&E	http://www.pge.com/about/environment/calculator/	Calculates emissions based on electricity and natural gas used per month and miles driven per year.
Calculator	SafeClimate	http://www.safeclimate.net/calculator/	Calculates emissions based on home energy use and distance traveled by car and by air.
Carbon Calculator	Sustainable Travel International	https://sustainabletravelinternational.org/documents/op_carboncalcs.html	Calculates emissions from flying, driving, home energy use, hotel stays, and events; provides option of purchasing offsets.
Carbon Footprint Calculator	TerraPass	http://www.terrapass.com/carbon-footprint-calculator/	Calculates emissions from driving, air travel, and home energy use; provides option to purchase offsets.

PRINCIPLES OF ECODRIVING

Ecodriving employs a series of simple rules to maximize the fuel economy of existing cars while minimizing carbon emissions. It is a modified way of driving that is best suited for modern engine technology.²³ The basic principles of ecodriving include anticipating changes in traffic, maintaining the vehicle properly, and minimizing brake use. Drivers can improve fuel economy by:

- Driving at the speed limit,
- Keeping tires properly inflated,
- Avoiding air conditioner use at lower speeds by opening windows instead,
- Using the lowest weight oil to improve kinematic viscosity,
- Changing air filters as recommended by the manufacturer,
- Accelerating smoothly and coasting to stops and parking spots,
- Idling for no more than 30 seconds,
- Avoiding unnecessary weight, and
- Removing bike racks and roof racks.²⁴

Ecodriving offers numerous benefits, including fuel cost savings, fuel consumption and GHG reductions, greater safety and comfort, and less noise pollution.²⁵

ECODRIVING RESEARCH

Europe

Ecodriving research conducted in the U.K. and Western Europe has been predominantly based on before-and-after and longitudinal driving trials. In 2004, ecodriving trials conducted in the U.K. compared the fuel consumption of drivers before and after taking

part in a two-hour ecodriving course, with results yielding average fuel savings of 8.5% after training.²⁶ In 2002, before-and-after driving trials in Sweden measured the effects of ecodriving on vehicle emissions, and results showed average fuel savings of 10.9% after training.²⁷ A Dutch research team studied the effects of following Dutch ecodriving tips on fuel consumption and emissions in 2002. The study indicates that ecodriving techniques can reduce fuel consumption by 7% to 10%, depending on vehicle type (diesel or petrol). The study also reviewed nitrous oxide (NO_x) emissions and found that diesel cars driving under urban conditions resulted in significantly higher NO_x emissions than under rural conditions. Researchers attributed this to the timing of the gear shift and the reduced ability to anticipate traffic in urban conditions.²⁸ Furthermore, a Belgian study showed that savings of 5% to 25% could be achieved by following Dutch ecodriving rules. They also examined the phrasing of the Dutch ecodriving rules and drivers' interpretation of the rules and found that some drivers might have higher fuel consumption as a result of misinterpreting certain rules.²⁹ One of the rules that confused drivers was: "Press the throttle quickly and vigorously as much as it takes to keep up with traffic." The findings in this study suggest a need to ensure that ecodriving message instructions are clear to each driver.

While less significant than short-term effects, long-term savings have also been documented.³⁰ In a number of trials conducted across Europe, Ford has shown that there are 10% savings in long-term fuel consumption after drivers undergo ecodriving training.³¹ Although the details of these studies are not available to the public, the German Traffic Safety Board (DVR) has verified the findings. SenterNovem the Netherland's agency for energy and environment produced similar results in an evaluation of company and professional drivers. They found that within one year of training, drivers reduced fuel consumption by 15% to 25%, but after one year, fuel savings became less significant ranging from 4.7% to 8%.³² These studies suggest the potential need for refresher courses as drivers revert to old driving habits over time.

Asia-Pacific

Japanese ecodriving research has involved the use of simulation modeling, driving trials, and on-board monitoring devices. Based on simulation models, in 2007, researchers concluded that ecodriving techniques were a more efficient method of driving, except in heavy traffic.³³ This finding is reinforced by the Dutch study mentioned earlier, in which NO_x emissions were found to increase as a result of applying ecodriving principles under urban driving conditions for diesel cars.³⁴

Ford Motor Company also began launching its ecodriving initiative in several Asian countries by training driving instructors in 2008. Since then, over 5,000 drivers have been trained in the Philippines, Vietnam, Thailand, and Indonesia.³⁵

In Australia, Syme et al. (1987) conducted a study evaluating the effects of a television campaign encouraging viewers to conserve petrol by implementing practices such as driving more slowly, driving more smoothly, checking tire pressure and getting engine tune-ups—in essence, by adopting the tenets of ecodriving. The researchers evaluated the effect of two different campaigns: the first placed an emphasis on saving money and

the second on good citizenship. Syme et al. found that regardless of the theme, both campaigns had a small but statistically significant effect on attitudes and beliefs, intention to save petrol in the future, and self-reported conservation behaviors.³⁶

North America

In the U.S., more limited research has been conducted on ecodriving. In 2008, Ford Motor Company and Pro Formance drivers conducted tests on ecodriving with 48 Arizona residents before launching a pilot targeted towards fleet customers. Results showed that fuel economy improvements ranged from 6% to as much as 50%, with an average of 24% improved fuel economy as a result of ecodriving. With these data, Ford and Pro Formance are planning on beginning a pilot program for Ford fleet customers.³⁷

In another study, University of California, Riverside researchers Matt Barth and Kanok Boriboonsomsin explored the effects of “dynamic ecodriving”—ecodriving with real-time feedback—on emissions and fuel consumption using freeway simulations and real-world trials. When drivers were given recommended speeds in real-time, researchers found 10% to 20% increases in fuel economy. In addition, reduced CO₂ emissions were possible without much travel time impact. The simulation results were better than the real-world trials because the simulation could assume higher adoption rates of ecodriving technology. In the real-world trial, only the researchers received information about speeds. An interesting finding they noted was that more savings were achieved in conditions with greater congestion.³⁸

The same researchers conducted a subsequent study evaluating how real-time fuel economy feedback affects driving behavior. They found that city-driving fuel economy improves by 6%, while freeway fuel economy improves by only 1%.³⁹ Not surprisingly, congested freeway conditions hindered the latter’s fuel economy improvements.

MISCONCEPTIONS

There have been some concerns about the travel time impacts, passenger comfort, and safety as a result of ecodriving. Studies have generally shown that rather than leading to longer travel times, ecodriving actually often results in improved travel times, without encouraging excessive speeds.^{40,41} This is because ecodrivers tend to maintain a more consistent speed, which allows them to avoid sudden braking and results in slightly faster speeds on average. An ecodriving challenge held by Ford and the Energy Saving Trust (EST) of the U.K. with 494 participants showed that ecodriving resulted in slightly higher speeds than normal driving.⁴² The Eco-Drive campaign of Switzerland also found that participants had a 2.5% increase in speed when practicing ecodriving compared to normal driving.⁴³ This study also showed a 34.1% increase in the comfort level of those in cars with drivers practicing ecodriving.⁴⁴ Ecodriving is also generally a safer way to drive because it discourages excessive speeding and sudden accelerations and encourages greater driver anticipation of road conditions.⁴⁵ A number of studies in Europe report lower percentages of insurance claims and accident rates among drivers and companies that had undergone ecodriving training.⁴⁶

ECODRIVING PROGRAMS

Many countries have launched national ecodriving campaigns to educate and train existing and new drivers to drive more economically and efficiently as a means to reduce GHG emissions and meet emission reduction targets. The methods used for education vary among countries. Generally, all programs include training, outreach, and education components. Many also employ competitions and incentives to encourage the use of ecodriving techniques. The vast majority of existing programs are located in Europe, with fewer programs in Asia and the U.S.

Europe

Several pan-European ecodriving efforts have been launched since 2005. Intelligent Energy Europe (IEE), which was founded to improve market conditions for energy-saving initiatives throughout Europe, has been a significant source of funding for many of these projects. One of the more extensive IEE-supported projects is the ECODRIVEN project,⁴⁷ which operated from January 2006 to December 2008 in nine countries in the European Union. The program was based on a “bottom-up” approach, relying on participating countries to promote ecodriving to their citizens in a country- and culture-specific manner. The program reached more than 20 million licensed drivers in the participating countries and resulted in 1 million metric tons (Mt) CO₂ emission avoidance between 2006 and 2010.⁴⁸ Another pan-European project supported by IEE was the TREATISE project, which ran from January 2005 to June 2007. The purpose of this project was to provide free training on a number of sustainability topics for energy and transport professionals. During this project, 1,722 people were trained in the topics of cleaner fuels and vehicles, ecodriving, and mobility management; and 41 local transport projects were initiated, resulting in 95 kilotons (kton) CO₂ savings.⁴⁹

The Rewarding and Recognition Schemes for Energy Conserving Driving, Vehicle procurement and maintenance (RECODRIVE) campaign merges many of these existing ecodriving initiatives with good fleet management and logistics practice to improve fleet management and fuel efficiency. Since October 2007, RECODRIVE’s multilingual website (www.recodrive.eu) has built a knowledge hub for ecodriving projects all over the world. The project includes the sharing of information and successful ecodriving practices among fleet owners and interest groups through demonstrations. Overall, there were 21 demonstrators in nine countries, achieving an estimated average of 7.5% fuel savings.⁵⁰

Fleet Environmental Action and Assessment (FLEAT) is another large E.U. project specifically targeting fleet vehicles. It focuses on practical measures and policies to create more energy efficient fleet management systems and reductions in energy consumption and CO₂ emissions.⁵¹ One of the key components of FLEAT is ecodriving education for drivers and driver trainers. Numerous pilot actions under this project began in 2008 and concluded between 2009 to 2010, including campaigns in Greece, Romania, Belgium, Austria, Germany, the Netherlands, and Italy.⁵² It found an average fuel consumption savings of 6.4% across the fleets.⁵³

Ecodriving campaigns in several European countries have been supported under the umbrella of TREATISE and ECODRIVEN. In the Netherlands, the concept of ecodriving has been active since the late-1980s. The national program, Het Nieuwe Rijden, began in 1999 following the Kyoto Protocol targets and was scheduled to run until 2010, but it has since been extended. The goals of the program are to reduce CO₂ emissions by 0.8 kton annually by 2010 (2.4% emission reduction due to road transport), with 0.5 kton achieved through the use of in-car devices and driving behavior change, and 0.3 kton through better tire pressure.⁵⁴ To achieve these goals, the campaign has targeted five areas: driving school curricula, re-education of licensed drivers, fuel saving in-car devices, tire pressure, and consumer behavior. The program owes much of its success to its extensive partnerships with public and private institutions, as well as its advertising campaign, which focused on immediate individual benefits such as cost savings and comfort, rather than the environment. In its 2007 annual evaluation, results showed that 80% of drivers were familiar with the campaign, 90% of driving instructors were trained in ecodriving, one third of drivers applied ecodriving techniques, and at least 0.3 Mt CO₂ emissions were avoided as a result of the program.

The Austrian campaign Sprintspar Initiative is part of “klima:aktiv mobil,” an ongoing effort to fight climate change in the transport sector. This ecodriving effort includes an annual ecodriving competition; extensive media promotion; trainer certification; and training for car, truck, and bus drivers. In 2008, 435 participants were chosen at random from a pool of 3,000 to participate in the annual competition, and the winner achieved a fuel economy of 2.98 liters/100 km (78.9 miles per gallon). Furthermore, by 2008, 200 trainers had been certified as ecodriving trainers, and over 6,000 drivers had been trained in ecodriving.

In countries that have had a long exposure to ecodriving, it has been incorporated into new driver education, the theory test for obtaining a license, and driver instructor training.^{55,56} Generally, students are first taught the theoretical principles of ecodriving, which are then reinforced a second time during actual driving lessons. In Finland, students are even evaluated for economical driving as part of the practical examination. Poor performance does not result in failure; rather, it gives the opportunity for feedback.⁵⁷ The Netherlands also began including ecodriving in practical examinations for new drivers in 2008. The ECOWILL campaign, launched in May 2010, aims to further this integration of ecodriving into driver education by providing short-duration ecodriving training programs for licensed drivers in 13 countries that do not yet require ecodriving training for new drivers. It was endorsed by Austria, Croatia, the Czech Republic, Finland, Germany, Greece, Hungary, Italy, Lithuania, Poland, Spain, the Netherlands, and the United Kingdom. ECOWILL is projected to achieve a total of 8 Mtons CO₂ avoidances by 2015.

Asia-Pacific

In Japan, ecodriving is largely promoted through regional workshops and ecodriving websites.⁵⁸ Nine workshops held from July to December 2006 trained 225 participants, who achieved an average of 25.7% fuel economy reduction.⁵⁹ Japan's ReCoo (www.recoo.jp) website allows members to log their mileage and track their performance over time. The website also functions as a ranking system, allowing users to compare their fuel economy to other members on the website. Another website, www.ecodrive.jp, provides ecodriving

tips to viewers and serves as a portal to other informational websites. Individual citywide campaigns have also begun in Japan. In 2004, the city of Kyotango began an ecodriving program that required installation of in-vehicle intelligent transport systems (ITS) in vehicles of businesses and individuals. These in-vehicle ecodriving navigation systems log the driving statistics of the driver and provide tips on how to drive more economically. After the six-month trial, the city continued lending the devices to drivers to continue encouraging ecodriving techniques.⁶⁰

In May 2009, Bridgestone Corporation launched the “Make Cars Green Eco-Drive Camp” in China.⁶¹ In Australia, the Australian Automobile Association has produced ecodriving informational brochures. In addition, several training programs exist, including one that focuses on goods movement and truck drivers. This training program was evaluated by researchers at Monash University and was found to reduce gear changes and brake applications by 27% and 41%, respectively.^{62,63}

North America

In the U.S. in September 2008, the Alliance of Automobile Manufacturers launched EcoDriving™ (www.EcoDrivingUSA.com),^B a nationwide effort to increase fuel savings while reducing fuel consumption and emissions.⁶⁴ The campaign began with the support of the governors of California and Colorado, but it later expanded to include 16 more states and territories: Alabama, Georgia, Idaho, Kentucky, Maryland, Michigan, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Utah, Virginia, West Virginia, Puerto Rico, and the U.S. Virgin Islands.⁶⁵ Additionally, May 2009 was declared “National EcoDriving Month” to highlight the campaign and to encourage millions of U.S. drivers to practice driving more economically.⁶⁶ This campaign was integrated into this study’s research design, with support from the Auto Alliance.

In 2009, a pilot program started in Milwaukee, Wisconsin. Sixteen students have completed the Fleet Training on Ecodriving project run with a Federal Congestion Mitigation and Air Quality (CMAQ) grant. Two fleets, one from the City of Milwaukee Department of Public Works and one from Veolia Water Milwaukee, are participating in the pilot program. The first group has already completed the program and has seen a 10.42% increase in fuel economy.⁶⁷ Combined, the two groups achieved a 13% increase in fuel economy.⁶⁸ Other campaigns have sprung up around principles of ecodriving, including New York City’s anti-idling campaign “GreenNYC – Turn it Off” and Colorado’s “Driving Change” program. The latter program employs onboard monitoring devices to record driving data for analysis and already helped the city of Denver increase fuel efficiency by 15%.⁶⁹

Canada also has a very comprehensive nationwide ecodriving initiative, titled “ecoENERGY.” ecoENERGY is part of Canada’s ecoTRANSPORT, which was created to promote economic and environmental objectives in transportation. The program is composed of two components—ecoENERGY for Personal Vehicles and ecoENERGY for Fleets. ecoENERGY for Personal Vehicles provides a variety of teaching tools, online resources, publications and driver tips, including the Auto\$mart Video Series and the Auto\$mart Driver Education Kit, which is provided as part of the driver education program at Auto\$mart-

^B The ecodrivingUSA website was removed from the Internet in Spring 2012. Please note that key information conveyed on this site is available in two fact sheets that appear in Appendix E of this report (pp. 150-151).

registered driving schools. ecoENERGY for Fleets primarily focuses on ecodriving for trucks and buses. Table 2 lists and describes some of the ecodriving programs in the E.U., and Table 3 shows programs in Asia and the U.S.

Table 2. Ecodriving Programs in Europe

Name of Campaign	Area Covered	Campaign Date	Description/Goals
Easy, Rider!	Finland	2005 - present	Campaign to educate the public about ecodriving. Offers free training to companies and provides public demonstrations and presentations.
Eco-challenge for the bus drivers of RATP Paris bus network	France	Sep 2007 - Jun 2008	A competition between different bus companies to encourage more fuel-efficient driving.
ECODRIVEN	Austria, Belgium, Czech Republic, Finland, France, Greece, Poland, Netherlands, United Kingdom	Jan 2006 - Dec 2008	To establish a European market for ecodriving training and to have ecodriving incorporated into the driver licensing process in Europe.
Ecodriving Campaign	Greece	Sep 2007 - Nov 2008	Education campaign to inform government and people of ecodriving benefits.
Ecodriving for Learner Drivers & Ecodriving Charter for Driving schools	Belgium	Jan - Aug 2008	To educate driving instructors and new drivers about the benefits and practice of ecodriving.
FLEAT	pan-Europe	Ongoing	To reduce CO ₂ emissions and energy consumption via energy-efficient use of vehicles and fleets and policy measures.
Het Nieuwe Rijden	Netherlands	1999 - 2010	Driving school curricula to encourage new and experienced drivers and fleet owners to drive vehicles more efficiently, use in-car devices, and monitor tire pressure. Also encourages consumers to purchase more fuel-efficient vehicles.
Looking for A-Class Haulier	Czech Republic	Jun 2008 - Oct 2008	Certification program for hauliers to help improve fuel economy and minimize environmental impacts.
RECODRIVE	pan-Europe	Oct 2007 - Mar 2010	A website of information about current ecodriving initiatives, pilot programs, and demonstrations for fleet owners to help improve management and logistics.
Spritspar-Initiative	Austria	Ongoing	Part of "klima:aktiv," the Austrian initiative for active climate protection. Includes an ecodriving competition; certification of ecodriving instructors; and certified ecodriving training for car, truck, and bus drivers.

START - Short-Term Actions to Reorganize Transport of Goods	Bristol, UK; Gothenburg, Sweden; Ljubljana, Slovenia; Ravenna, Italy; Riga, Latvia	2006 - 2009	Part of greater project targeting freight to make goods movement more energy efficient and reduce harmful emissions.
TREATISE	pan-Europe	Jan 2005 - Jun 2007	To provide free training on sustainable transport subjects.

Table 3. Ecodriving Programs in Asia and the United States

Name of Campaign	Area Covered	Campaign Date	Description/Goals
ASIA			
Make Cars Green	China	2009	To teach drivers the principles of ecodriving.
Numerous Online Ecodriving Campaigns	Japan	Ongoing	To encourage drivers to drive more efficiently by practicing ecodriving and with the help of on-board devices.
UNITED STATES			
Driving Change	Denver, CO	2008	To stop idling and promote more environmentally friendly transportation practices.
EcoDriving USA	U.S.	2008	To introduce drivers to the principles of ecodriving.
Fleet Training on Ecodriving	Milwaukee, WI	2009	To improve fuel economy of city fleets through ecodriving practices.
GreeNYC—Turn It Off	New York, NY	2009	To stop idling.

ECODRIVING TECHNOLOGIES

Monitoring and feedback technologies (for example, GPS navigation and traffic monitoring systems) can be used to provide drivers with real-time information on congestion, construction, weather, and alternative routes to increase fuel efficiency.⁷⁰ Several automakers (for example, Fiat, Ford, Nissan, and Toyota) have developed ecodriving technologies, marketed primarily in the U.K. and Japan. Table 4 provides a list of current in-vehicle technologies from automakers. Several aftermarket devices are also available with similar features, shown in Table 5. These systems use in-vehicle sensors to monitor accelerator use, engine and transmission efficiency, and speed to provide real-time information to drivers on average fuel economy and allow the driver to adjust driving behavior based on this feedback. Some of these systems go beyond individual monitoring and rank individual performance with those of others on the same system, providing an incentive to compete with other motorists to engage in fuel-saving driving behavior.

Table 4. Ecodriving In-Vehicle Technologies by Automakers

Automaker	Name	Year Launched	Available In/ On	Description
Fiat	Eco:Drive™	2008	Europe: Grande Punto, Punto Evo, Bravo, Croma, Qubo, Doblò, and 500 models	System collects vehicle efficiency data on a USB flash drive. Drivers take the flash drive to a computer to view statistics and tips for improving fuel efficiency, set goals, and compare with friends. Partnered with Microsoft for software platform Blue&Me™. ⁷¹
Ford	SmartGauge™ with EcoGuide	2009	North America: 2010 Fusion and Milan hybrid models	Device uses two LCD screens on either side of the speedometer that can be configured to show different types of information, including fuel and battery power levels and average and instant mileage data. An interactive display consisting of growing leaves and vines reflects the driver's efficiency. Four configurations that can be chosen include: Inform, Enlighten, Engage, and Empower. Regardless of configuration, all are capable of displaying information regarding instantaneous fuel economy, fuel economy history, odometer, engine coolant temperature, gear, and trip data. Developed in collaboration with IDEO and Smart Design. ⁷²
Honda	Eco Assist™	2009	2010 Insight model	Gives real-time feedback to driver through guidance functions (for instance, speedometer displays varying colors, acceleration/braking gauges) and scoring functions (for instance, ranks for current trip and long-term driving) in dashboard. ECON™ button automatically improves vehicle's fuel efficiency. iPhone® app also available. ⁷³
Kia	Ecodriving System (also known as EcoMinder®)	2008	Models with automatic transmission	Displays in real-time an "ECO" light on the dashboard. Displays green when the vehicle reaches high fuel-efficient driving and white for normal driving or for inefficient driving. ⁷⁴
Nissan	ECO Pedal	2009	Japan: Fuga model	System that calculates most efficient acceleration rate. If driver exerts too much pressure, pedal pushes back. System also includes a dashboard ecodriving indicator. Can be turned on and off. Includes a dashboard instrument panel that provides drivers with real-time feedback about fuel consumption. In November 2010, licensed to Mikuni Corporation. ⁷⁵

Toyota	Eco Drive Indicator	2006	Select models	Located on the instrument panel, this indicator lights up when the vehicle is operated in a fuel-efficient manner. Fuel efficiency takes into consideration accelerator use, engine and transmission efficiency, and speed and rate of acceleration. ⁷⁶
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Table 5. Aftermarket Ecodriving In-Vehicle Technologies

Manufacturer	Name	Year Launched	Available In	Description
Digitalcube	I-station U7	2008	South Korea	Touch-screen, tilt-sensitive GPS device that uses built-in knowledge of economical driving to help drivers determine the most economical roads to drive on. It also features an LED that indicates whether or not the driver has chosen the best road through a blue or red light. ⁷⁷
Earthrise Technologies	Eco-Way	2010	North America	Ecodriving navigation system that reads on-board vehicle statistics and provides real-time fuel economy and CO ₂ emissions (lbs. CO ₂ /mi) statistics. ⁷⁸
HKS USA	CAMP/ CAMP2	1996	Worldwide	Engine monitoring system. Has an ECO Drive feature to calculate fuel costs, average fuel consumption, and fuel efficiency in real-time. ⁷⁹
Hunter Research and Technology	GreenMeter	2009	U.S.	An iPhone® app that employs the built-in accelerometer to calculate horsepower, fuel economy, annual fuel cost, crude oil consumption, and carbon footprint in real time with instantaneous feedback. Most updated version includes ecodriving light indicator. ⁸⁰
Linear Logic LLC	ScanGauge/ ScanGaugell	2005		Device plugged into the vehicle, which displays instantaneous and average fuel economy and engine statistics. ⁸¹
PLX Devices Inc.	Kiwi™	2008	Worldwide	Device plugged into vehicle, designed to train driver how to drive more efficiently. Uses 4 measures: smoothness, drag, acceleration, and deceleration to create a "Kiwi score." Also keeps track of fuel economy and engine health. ⁸²

LESSONS LEARNED

Public Campaigns and Education

Public education and outreach campaigns have been integral to ecodriving efforts in the U.K. and Western Europe for over a decade.⁸³ The success of these campaigns has been due to tailoring programs to the specific ecodriving knowledge of each country.⁸⁴

Countries experienced in ecodriving might pursue successful campaigns focused on driving school curriculum. On the other hand, countries new to ecodriving may focus on distributing pamphlets and flyers to the general population to create a knowledge base on which to build future efforts. In addition to country-specific efforts, messages tailored to target audiences have also been a key strategy in ecodriving campaigns.⁸⁵ In Finland, this strategy led to the introduction of ecodriving to new drivers as “economical driving” in an effort to highlight the significance of driving economically. The campaign in Germany focused on creating a positive image around ecodriving and introduced the concept to new drivers as “cool driving” or “smart driving.”⁸⁶

Another similarity among all ecodriving campaigns thus far is the emphasis on benefits for the individual driver rather than environmental benefits. This was a crucial point emphasized by the ECODRIVEN campaign and the Het Nieuwe Rijden program. Rather than appealing to an individual’s desire to reduce greenhouse gas emissions and improve air quality, all campaigns found it more effective to advertise the fuel cost savings that an individual could gain from adopting ecodriving behaviors. The “ancillary” benefits of helping to prevent climate change were promoted as additional gains.⁸⁷

Partnerships between the public and private sectors have also been crucial to the success of all campaigns.⁸⁸ These partnerships have lent credibility to some of the campaigns, particularly those partners that have a big presence in the transportation industry. Many European campaigns have also found it invaluable to have connections with commercial entities for their wealth of resources and marketing experience, as well as governmental departments for their ability to greatly influence the campaign exposure.

Simulation vs. Driving Course Testing

Ecodriving research has generally been conducted via simulated driving courses or real-world, on-road testing. The Eco-Drive campaign of Switzerland conducted evaluations of both methods and found each resulted in the same amount of fuel consumption.⁸⁹ However, drivers trained on the simulator experienced more discomfort during accelerations and tended to drive at higher speeds than those trained on road courses.⁹⁰ This is likely due to the fact that simulators are incapable of completely replicating real-life experiences. Despite this, simulators provide an efficient and faster way of training greater numbers of students without the need for a physical track, car, or actual fuel use.^{91,92}

Retention Requires Incentives

As shown in existing research on long-term effects of ecodriving training, fuel economy tends to decrease over time as drivers turn to old driving habits. This suggests that extra measures may be necessary to encourage drivers to practice ecodriving long after training. At a 2007 International Energy Agency (IEA) conference, a representative from a U.K.-based consulting company who worked closely with freight companies and a spokesperson from Isuzu stated that more than just ecodriving training was needed to maintain efficient driving habits. One ecodriving incentive that was provided as an example was a reward scheme centered on bonuses for every mile per gallon (mpg) in increased fuel economy. Another suggested method of motivating drivers to continue using ecodriving principles is

through on-board monitoring. On-board monitoring systems are able to record real-time information about brake usage, gear shifting, and fuel consumption, and to remind drivers of ecodriving tips.⁹³ As more individuals and businesses adopt ecodriving as a means of reducing fuel costs and CO₂ emissions, other methods of ensuring long-run efficient driving behavior will have to be determined to maintain ecodriving benefits.

Next Steps

Researchers have systematically measured fuel consumption reductions for drivers who take ecodriving courses through before-and-after and longitudinal studies of up to two years.^{94,95,96,97,98} Whether on-road or in a simulator, drivers who take part in ecodriving training generally experience fuel consumption reductions between 10% to 15%. Even two or more years after the course, participants achieve better fuel economy than conventional drivers.^{99,100} However, other outreach efforts, such as public service announcements, websites, and brochures from Europe—for example, Dutch Ecodriving Campaign, and European Climate Change Program (ECCP)—have not included research evaluations, which measure and document the effectiveness of these initiatives on CO₂ and fuel consumption. Thus, a study of the impact of ecodriving media outreach efforts on CO₂ emissions and fuel consumption would add to the understanding of this ecodriving strategy.

III. PUBLIC EDUCATION, ECODRIVING, AND CARBON FOOTPRINTING EXPERT INTERVIEWS SUMMARY

OVERVIEW

The purpose of the expert interviews was for researchers to gain a greater understanding of expert opinions about social marketing and public education campaigns, and the characteristics that comprise a successful campaign. Experts were asked about their own experiences with public education campaigns, strategies used to distribute the campaign messages, and overall lessons learned. Interviews with seven experts were conducted from October 2009 to February 2010 by study team researchers.

Preliminary Information

The experts worked on the following public information campaigns and had been employed at their respective organizations for time periods ranging from three months to 20 years:

- Spare the Air, Bay Area Air Quality Management District (BAAQMD),
- Water Saving Hero, San Francisco Public Utilities Commission (SFPUC),
- United States Fire Association,
- Climate Protection Campaign,
- Save Our H₂O, Association of California Water Agencies (ACWA),
- American Lung Association (ALA) California, and
- Drug Abuse Resistance Education (D.A.R.E.) America.

The experts interviewed included an executive director, a Public Information Officer, a program director, two program managers, and two regional directors.

Expert Information

The experts' current positions and past experience included:

- Promoting alternative transportation modes including carpooling and public transit to improve air quality and reduce congestion;
- Reducing particulate air pollution from wood burning stoves, through methods such as supporting local regulations;
- Educating the San Francisco community about the need to diversify the fresh water supply;
- Statewide water issues, with a particular focus on the Sacramento and San Joaquin Delta and the drought and water supply shortages in recent years, in conjunction with a State agency;
- Fire safety and preparation;
- Climate change and environmental issues; and
- Air quality issues including climate change, diesel, and wood smoke pollution.

The experts' responsibilities for the public campaigns were as follows:

- Two were project managers for several campaigns in their respective organizations, and one had the additional role of handling contracts for campaigns.
- One expert's primary role is to speak with and conduct outreach to the media, including television and news interviews, speaking at events, and working with contractors to create effective advertisements for placement in magazines and other media.
- Another expert works on public education and outreach throughout the San Francisco Bay Area.
- One is responsible for "a little bit of everything," including achieving the mission statement of the campaign, changing behavior, inspiring other communities to address the same issues, and attending meetings with various community leaders.
- One expert conducts trainings and quarterly meetings to raise awareness.
- Another expert's role is to work with public safety and school officials to make them aware of the program, provide assistance with implementation, and offer training to professionals in the field.

Public Messages

The experts discussed how their organizations determined the best message for the public and how the specific language used to convey the message was developed. A variety of methods were used to determine the message and to refine the language, including:

- Focus groups were noted the most frequently as a means to determine messages and to gauge public attitudes towards the topic;
- Telephone surveys were also noted frequently, as a means to gain a better understanding of attitudes and willingness to change behaviors;
- Most experts also used feedback from the public and partner organizations to help refine their messages;
- Meetings with community leaders were used to decide whether or not to adjust the messaging or outreach methods of the campaign and to determine the best way to interact with their constituents or people they represented;
- Two experts also relied on scientific research to assist with their message development;
- One campaign used a study about cognitive linguistics and messages that are effective for compelling people to change behavior;
- One expert also sought feedback and worked in cooperation with a scientific advisory board, an educational advisory board, and a law enforcement advisory board; and
- One expert used research conducted by academic institutions, noting that the general public believes that academic studies have more credibility and the appearance of greater objectivity than studies by market research companies.

Experts were then asked a series of questions about the success of the messages, including whether or not they considered the message successful, how it could be improved if it was not considered successful, and how message success was measured. All experts felt that the messages of their respective campaigns were at least slightly successful. They used a number of different methods to measure this success, including:

- Surveys were noted a number of times, to collect feedback about changes in opinion and behavior that matched their message;
- Several experts also noted the number of calls to hotlines, signups for phone and email alerts, visits to their websites, and the quality and number of received emails/feedback;
- Two experts also tracked the number of campaign appearances and media attention;
- One expert judged the success of the campaign by the number of specific goals that were achieved;
- Evidence, such as reduction in the number of deaths or reductions in drug abuse over the period of their public campaign;
- The successful adoption of regulations and resolutions; and
- Evaluation through the use of pre- and post-tests.

Other methods the experts noted include the number of people who attended presentations, the number of visitors to booths at state fairs, and independent studies of their program by other institutions.

One expert also commented that it would probably take years of campaigning before people would start changing their behavior, and another noted that a regulation supporting the same “action” as their campaign would cause more people to pay attention to their message.

Experts were also asked about the type of methods they used to deliver the campaign messages, which methods were most successful, and how success was measured. The methods mentioned most often include:

- TV and radio (for example, public service announcements);
- Print media;
- Emails;
- Campaign websites;
- Electronic newsletters and bulletins;
- Online social networking and popular websites, such as Facebook, Twitter, and YouTube;
- Meetings (large and small with stakeholders and community members); and
- Brochures and pamphlets.

Other methods that experts named included: grassroots and nontraditional outreach methods; presentations, speakers’ bureaus, briefings, and open houses for the general

public; the blogosphere; workshops for the general public in several languages when necessary; and billboards.

Overall, experts agreed that there was never one successful method for distributing public messages, and the most successful strategies involved using a combination of different approaches to reach the public.

The experts gauged the success of their distribution methods, using criteria similar to those used for measuring evaluating success, including:

- Surveys;
- Number of signups for email and phone alerts;
- Number of calls to hotlines;
- Metrics for specific campaigns (for example, reduced emissions in tons of CO₂, lower number of fires); and
- Quality of public feedback.

Some experts noted that it was difficult to measure campaign success, as there were often other factors that could affect the same metrics they would use to measure success.

Experts were asked if they used the Internet to distribute their message, whether this was a large or small part of their effort, and which aspects of the websites they considered most successful. All experts used the Internet in some capacity, and each campaign had a specific website. Most considered the Internet to be a rather large part of their campaign, as it was available and accessible anywhere in the world at all times of the day for people who wanted more information on the respective campaigns. Several experts also reiterated that the Internet would only reach a certain demographic of the general public and that traditional media was still necessary for outreach. Common Internet sites that were used include Facebook, Twitter, YouTube, Yelp, and SF Gate.

Experts were asked what outreach materials were developed, if they developed material to target specific groups, and which methods of publicity the public was most receptive to. All campaigns employed a targeted approach, and all experts agreed that targeting was the most effective way to reach the diverse public. However, several experts also said that targeting is difficult to do in campaigns targeted at a broad audience, especially if resources are limited. Outreach materials included:

- Factsheets;
- Language-specific materials (for instance, TV ads, newspaper articles in Spanish and Chinese);
- TV and radio ads;
- Print media;
- Email newsletters;
- Pamphlets and brochures for targeted audiences (for example, one for media, a different one for health events);

- Educational videos;
- Toolkits;
- Posters; and
- Hot chocolate mix with campaign messages printed on the packages.

The development of outreach materials was largely centered on identifying target groups and then determining the most effective ways of reaching these groups. Experts employed a number of methods, including:

- Conducting research about populations that would be most receptive to changing behavior;
- Improving campaigns based on past experiences and lessons learned (for instance, have good visuals and few words in ads);
- Recruiting help from stakeholders, staff members, and interns and community members who have a better understanding of the targeted communities;
- Identifying different target groups and categorizing them to better focus campaign efforts (for example, mothers and caregivers, businesses, youth, government, and media); and
- Cooperating with special scientific, educational, and law enforcement advisory boards.

Experts agreed that a mixture of outreach materials was most effective for reaching a broad and diverse group of people. One expert felt that the Internet was the best way to reach people, while others again noted that the Internet would only reach certain demographics.

One expert did not believe that public education campaigns alone would result in change, stating that economic and environmental signals had to align with their message before any major change would be accomplished.

Project Specifics

Experts were asked about the implementation of their projects, including partnerships, challenges, and logistical issues they had not anticipated. Regarding implementation and partners:

- All experts had worked with different levels of government and different governmental entities throughout their campaigns;
- Most campaigns also reached out to and relied on help from local businesses to help spread their messages, as well as give them feedback; and
- Only one expert mentioned having to obtain specific licensing agreements (with a technology vendor).

The major problem that some experts had not anticipated was a lack of funding and limited resources. Other problems included:

- Two experts mentioned having a short timeframe before the launch of their campaign;
- Another found it difficult to develop the message because of the conceptual nature of the issue and the major implications associated with it; and
- One expert did not anticipate the benefits of working locally, as well as some unexpected barriers.

Experts were then asked about the issues they would have liked to know about the process of implementing a public education campaign before launching one. The experts noted the following information and advice for launching a public information campaign:

- Have more information about some of the fears and misconceptions associated with the message beforehand;
- Have a clear understanding of the funding available for the campaign to improve resource allocation;
- Understand the process of working with the Federal government;
- Verify there are no changes in policy or other efforts that undermine the group's campaign;
- Do not assume that *not* hearing opposition is equivalent to no opposition; and
- Make sure that all people involved in a campaign agree on the campaign purpose and objectives they hope to achieve.

Experts were then asked about how much of an impact they expected to make going into the campaign. A few experts felt their campaign had made a larger impact than they had anticipated, while others noted that they still had much more work ahead of them.

- Several experts, particularly those with limited resources, were amazed at how much feedback they were getting from the general public and how many people recognized their campaigns;
- One expert was happy with the success of and many responses to a provocative ad campaign; and
- Two experts agreed that their work was not yet over, and their campaigns would continue to operate for a long time.

The measurements used to evaluate the success of a campaign were similar to those used to evaluate the effectiveness of different outreach methods and materials, including:

- Surveys;
- Focus groups;
- Number of persons signing up for email and phone alerts;
- Quality of comments provided or questions asked by the public (good, informed responses reflect well on the success of the education);

-
- Hits/visits to website;
 - Placement in traditional media (print articles, radio, mention in media);
 - Orders of campaign publications; and
 - Air quality improvements.

Other measurements included the number of cities that adopted similar programs and targets and evaluation by other institutions. Several experts mentioned that some campaigns were harder to measure because of a lack of a good metric to evaluate success.

Experts were then asked about the most difficult and easiest parts of the campaigns. Overall, the experts noted more difficult aspects of their campaigns.

- Two experts noted that limited funding and resources were the most difficult parts of their campaigns;
- Two other experts mentioned problems with misinformation and distributing their messages;
- One expert stated that internal issues were often the most difficult challenge of organizing all the aspects needed for a successful campaign;
- One expert had difficulty with the campaign's bad reputation from previous efforts; and
- One expert found working with a state partner to be both the most difficult and smoothest part of the campaign.

Only two experts discussed the easier aspects of their campaigns. These included implementing a strategy and building political support, and creating an information or advertisement piece with a creative hook that was clear, compelling, and prompted responses from the public.

Finally, experts were asked about any other information or lessons learned that they would like to share.

- One expert commented that public education campaigns take time;
- One advised that campaigns need flexible plans so that they can constantly readjust and be open to opportunity (for instance, reaching out to other community businesses or groups for help with running ads or funding); and
- Another reiterated that some of the most successful campaigns involve targeting specific audiences, and the more campaigns can tailor their messages, the greater success they will have with their audience.

IV. ECODRIVING AND CARBON FOOTPRINTING FOCUS GROUPS

INTRODUCTION

Two focus groups were conducted on February 17 and 25, 2010. The focus groups were held in Berkeley, California, and all of the participants were California licensed drivers from the San Francisco Bay Area. Participants were recruited via flyers distributed at local grocery stores, libraries, and other public locations. Participants received a \$50.00 gift certificate in appreciation for their time. Both focus groups were conducted with participants that had regular vehicle access. There were a total of 13 participants in the two focus groups, and their responses are summarized collectively here. Prior to each focus group, a brief questionnaire was administered to gather demographic information about the participants, as well as attitudes towards the environment and energy. The focus group discussion was centered on transportation mode choice and public education campaigns, as well as the carbon footprinting website designs and efficient driving techniques. See Appendix B for the focus group questionnaire and protocol. Appendix C contains individual summaries of each of the two focus groups.

QUESTIONNAIRE RESULTS

The demographic attributes of the participants were as follows:

Thirteen participants: four male and nine female.

- One was between the ages of 26 to 30, three were between 36 to 40, four were between 41 to 55, four were 56 or older, and one declined to state.
- Three participants were married, seven were single, one was married with children, one had children, and one declined to state.
- Eight participants lived in households with one vehicle, one lived in a household with two vehicles, one lived in a household with three vehicles, one lived in a household with four vehicles, one did not own a vehicle, but uses Zipcar (a shared-use vehicle service), and one declined to state.

Figure 1 and Figure 2 show the highest education level achieved by the focus group participants and their household income.

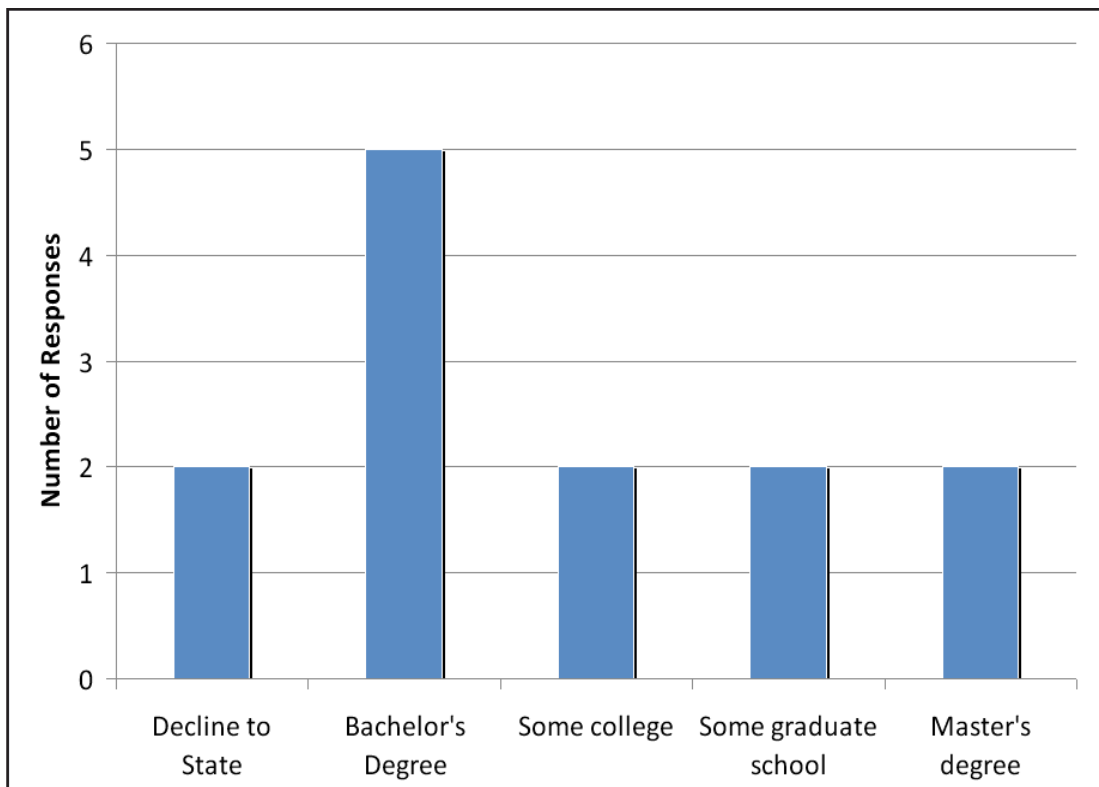


Figure 1. Highest Education Level Achieved by Focus Group Participants

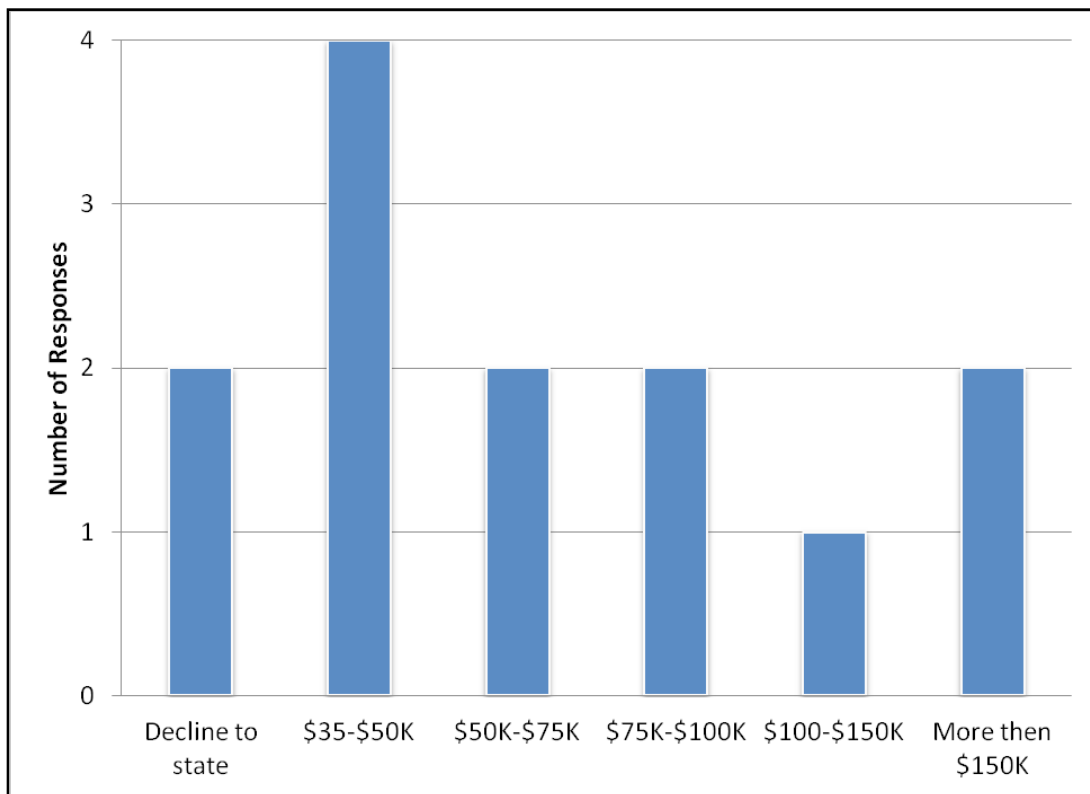


Figure 2. Household Income of Focus Group Participants

Participants provided the following information about the number of miles they drive each year:

- Seven participants drove 5,000 miles or less per year;
- Three participants drove between 5,000 and 10,000 miles per year;
- One participant drove more than 10,000 miles per year; and
- Two participants declined to respond.

Participants were asked to what degree they agreed or disagreed with a series of statements. The answer distribution is displayed in Table 6.

Table 6. Participant Responses to Climate Change and Fuel Cost Statements

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The Earth is currently experiencing climate change.	0	0	0	6	7
Human activity contributes to climate change.	0	1	0	6	6
Dependence on foreign oil is a serious problem facing the United States.	0	0	0	4	9
The cost of fuel is currently too high.	1	3	0	4	5

The participants reported in the questionnaire the make, model, and year of the vehicles they own. Based on this information, Figure 3 shows the Environmental Protection Agency (EPA) rated miles per gallon (mpg) of the vehicles of the participants.

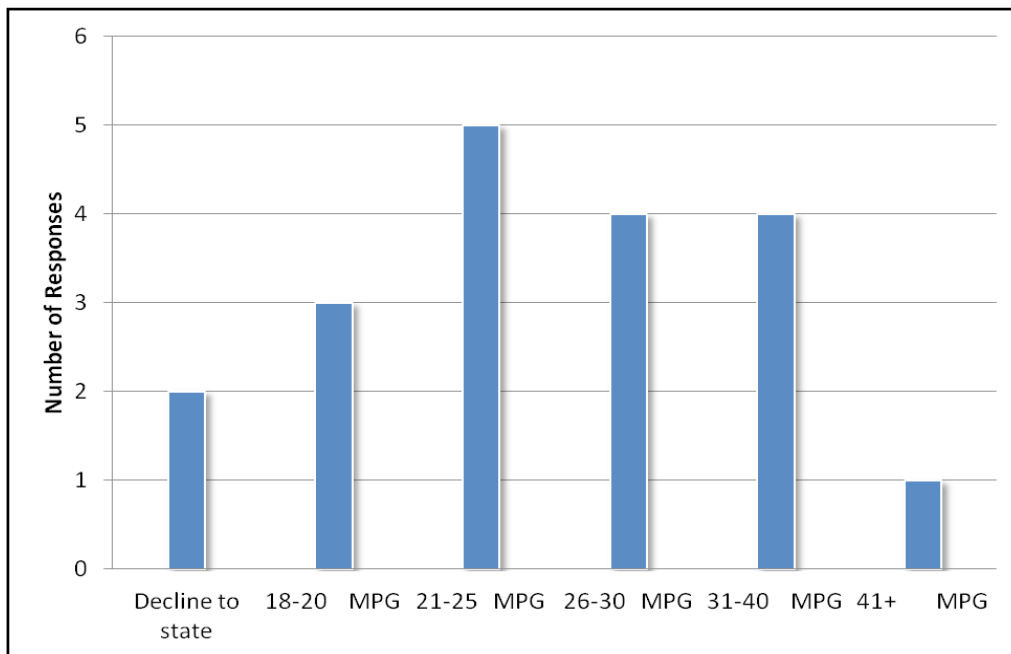


Figure 3. Fuel Economy of Focus Group Participants' Vehicles

FOCUS GROUP DISCUSSION OVERVIEW

After completing the pre-focus group questionnaire, the moderator provided participants with a brief overview of the focus group. The discussion began with participant introductions and review of the transportation modes they use. The moderator then asked participants to share any changes they had made to transportation modes or patterns within the past year, and motivations behind these changes. Next, the moderator led a discussion about public education campaigns that participants remembered from past exposure. The participants were then shown four different websites—two about carbon footprinting and two about techniques to drive more efficiently—and were asked to critique each one. The focus groups concluded with participants' ideas for improving websites used for public education campaigns. The websites were as follows:

- Carbon Footprinting Websites
 - <http://www.coolcalifornia.org/>
 - <http://www.footprintnetwork.org/>
- Ecodriving Websites
 - www.cleanmpg.com
 - www.ecodrivingUSA.com

Key Findings

The information obtained from the focus group discussions, as well as the questionnaires, revealed insights about what qualities make a public education campaign successful. For example, many of the participants cited making behavioral changes when a campaign involves a regulation or monetary penalty. Campaigns for actions that were not accompanied by the potential for a monetary penalty had less of an impact regardless of the delivery method. Generally, all of the participants emphasized a well-developed marketing plan with catchy slogans and impactful visuals as key elements of a successful public education campaign. To improve the effectiveness of campaigns, participants suggested experimenting with distribution methods to target specific audiences.

Television, billboards, and radio announcements were the delivery methods thought to be most successful for public education campaigns. Participants in both groups considered direct calling, leaflets, and junk mail unsuccessful. Most did not think of the Internet as a good way to distribute public education messages due to the “hit or miss” nature of the Internet. The participants noted that when they were on the Internet it was for a specific purpose, and they would not find or view a public education message unless they were specifically looking for that topic. Pop-up advertisements and other catchy methods to put a message in front of the viewer were thought to be ineffective, as these are associated with paid advertisements, and the participants would close these without looking at the content. However, a number of participants noted that Internet campaigns could be more effective with younger generations since they may have more exposure as a result of their different searching habits.

When presented with two websites on carbon footprinting, participants expressed concern about taking time to view and use the website's carbon calculators, reasoning that only people who are already interested in the topic would visit the sites. Ten out of 13 participants preferred the second of the two websites, citing that it made a clearer connection between economic and environmental concerns, used animation and graphics well, and allowed options for both quick and detailed calculator responses. To improve the two websites, it was suggested that the websites offer additional statistics and results to better communicate the human impact of carbon emissions on the environment.

When presented with two websites on ecodriving, participants commented on the usefulness of the information and the presentation format. Ten out of 13 participants preferred the second of the two websites, primarily because the video format presented concepts in simple terms that anyone could easily follow. The second website communicated the outcome of using ecodriving vehicle practices in dollar savings, a more impactful measurement. To improve the two websites, it was suggested that the websites offer additional information about public transportation options and target a younger population.

Focus Group Discussion

The information obtained from the focus group discussions, along with the questionnaires, revealed insights about the participants' primary transportation modes.

- Most participants cited mixing transportation modes, using a personal vehicle combined with public transit, biking, or walking modes to get to their destinations;
- Bay Area Rapid Transit (BART) was noted as a popular mode to visit San Francisco;
- One participant used a "casual carpool" system to get a ride to work;
- Another primarily bikes and takes BART, occasionally using the Zipcar car sharing service; and
- One walks as often as possible, only using the bus, BART, or car when no other options are available.

The group participants were then directed to think about and share changes in transportation mode or pattern they have made as a result of information about transportation impacts on climate change, fuel prices, and the economy.

Participants discussed changes made in response to information about the impacts of transportation on climate change:

- Participants consolidated errands to reduce the number of trips,
- Used more public transportation modes,
- Deferred car ownership,
- Increased biking, and
- Reduced car use.

Participants discussed changes made in response to fuel prices in the past few years:

- Participants developed a preference toward more fuel-efficient vehicle purchases,
- Reduced the number of recreational trips,
- Used more public transportation modes, and
- Increased walking and cycling.

The groups then discussed changes made to their transportation modes or patterns in the past few years in an effort to reduce costs:

- Walking rather than paying for bus fare, and
- Driving on long trips rather than flying.

Next the focus group participants listed all of the public education campaigns they could recall, either by name or by theme. The two focus groups resulted in a long list of public education campaigns the participants recalled:

- Spare the Air
- Bike to Work Day
- Cash for Clunkers
- Something similar to Cash for Clunkers
- First Five California
- Something similar to First Five California
- Wash hands
- Don't Litter
- Smokey Bear – Only You Can Prevent Forest Fires
- Give a Hoot Don't Pollute
- Flu shots/H1N1
- Critical Mass
- Walk or bike to school day
- Bay Bridge construction – planned closure
- Anti-smoking
- Mothers Against Drunk Driving (MADD)
- British campaign to reduce texting while driving
- Teen pregnancy
- HIV prevention (several targeted toward different communities)
- Same sex marriage messages (in relation to an election initiative)
- McGruff the crime dog - Take a bite out of crime
- Hang up and drive campaign
- Native American crying from his land being polluted
- Click-it-or-Ticket (versions in Seattle, Washington D.C., Florida, Texas).

Of the public education campaigns listed, participants considered those that were the most and least successful.

Successful	Unsuccessful
<ul style="list-style-type: none"> • Click-it-or-Ticket • Smokey Bear • Bike to Work Day • Bay Bridge Closure • Spare the Air • Teen Pregnancy 	<ul style="list-style-type: none"> • Stop Smoking • Critical Mass • MADD • HIV/AIDS • Hang up and Drive

Overall, there was a general consensus that campaigns were more successful when a fine or regulation was involved. Other characteristics that the group considered necessary for a successful public education campaign included:

- Strong, catchy visuals and music;
- Communication of consequences for not performing the action;
- Negative visuals;
- Monetary fines and rewards;
- Good slogan; and
- Campaign frequency.

Participants considered campaigns to be unsuccessful, if the behavior the campaign targeted for change still persists. Two participants from separate focus groups were concerned that certain public education campaigns (such as HIV/AIDS, hang up and drive, Stop Smoking) do not establish permanent behavioral change, noting that people revert to their previous behavior once the campaign is over.

Participants were then asked if they had made any changes as a result of a public education campaign or if they knew of anyone that had made changes.

- Two participants responded to the “Hang up and drive campaign” by complying with the law to avoid a fine;
- Two were motivated by the “Smokey the Bear” campaign to either stop smoking or consider the impact of carelessly disposing of a cigarette;
- Two participants altered their behavior as a result of “Click-It-or-Ticket” by wearing a seatbelt more or making it appear that a seatbelt is being worn without actually clicking it in;
- One said that “McGruff the crime dog” taught him that he should tell someone if he sees something that is not right; and
- One chose to obey the law after viewing a campaign promoting helmet use.

Next, participants considered the success of methods that were used to distribute the campaigns to the public:

Successful	Unsuccessful
<ul style="list-style-type: none"> • Television • Billboards on highway, BART, or bus • Television and radio service announcements • News reports • School messages • Word of mouth from peers • Law or penalty 	<ul style="list-style-type: none"> • Junk mail • Direct calling • Leaflets • Internet

Several participants agreed that the best method to distribute a public message depended on the specific audience that was targeted.

The participants then offered the following ideas for better methods to distribute information to the public:

- Viral Internet campaigns on YouTube and Facebook,
- Product placement in movies,
- Constant repetition of ads,
- Hiring professionals to design marketing campaigns, and
- Illustrating the consequences.

Next, the participants discussed their experiences with Internet public education campaigns. The groups were asked to list any Internet public education campaigns they could recall. These included:

- Faces of Meth, which was initially on the Internet, but was also shown on television;
- British campaign to prevent texting while driving, which included a strong visual, viewed on Youtube;
- Food Pyramid found when searching for nutrition information;
- HIV/AIDS awareness;
- British texting and driving prevention campaign with a graphic ad, viewed on YouTube;
- Bay Bridge closure;
- Bike to work;
- Partnership for Drug Free America, seen as a logo, not as part of a campaign;
- Fundraising for cancer (for instance, Live Strong); and
- Free rice, an online game that donates food to end world hunger.

The focus groups considered if the Internet was a good medium for distributing public education messages. Most participants did not think of the Internet as a good way to distribute these messages due to the “hit or miss” nature of the Internet. Pop-ups and advertisements were viewed as ineffective. However, it was noted that Internet campaigns

could be more effective with younger generations since they may have more exposure as a result of their different searching habits.

The groups were then directed to consider ways to make the Internet a more effective method to distribute public education messages. The participants offered the following suggestions:

- Creating a short, concise public education advertisement preceding a “YouTube” video;
- Cutting down on the number of graphics to allow for easier, quicker information access;
- Removing the requirement that visitors enter their personal information to access the information they are looking for;
- Refraining from over commercialization of a public education message;
- Using celebrities to endorse the message;
- Featuring ordinary people who take simple actions to change; and
- Including monetary incentives or disincentives as motivators to take action.

FOCUS GROUP WEBSITE REVIEW

During the second half of the focus groups, participants were asked to view four websites. The first two websites contained content regarding carbon footprinting, and the last two contained information regarding techniques for driving more efficiently. After viewing each set of websites, participants were asked to critique them and choose the one they preferred.

Carbon Footprinting Websites

The first carbon footprinting website provided resources about climate change for individuals, small businesses, local governments, youth, community organizations, and schools. Participants were shown the pull-down menus under each of these categories to give them an idea of the type of information offered. Participants were then taken through the carbon calculator on the website, which calculated a carbon footprint based on questions about the individual’s transportation, housing, and shopping. The calculator required the user to input numbers for each of the characteristics that were measured. Results were expressed in metric tons of CO₂ per year. The calculator also generated a list containing tips for reducing personal carbon footprints at the end of the calculation. The savings achieved by following these suggestions were shown in measurements of metric tons of CO₂ and dollars.

Several comments were made about the first website. These included:

- The carbon footprint calculator was too long and asked for information that would be hard to enter without having to reach for a bill or search through records;
- Viewers could vary their answers to question inputs and receive immediate results, allowing them to see how their carbon footprints would change in response to different behaviors;
- User friendly;
- The list of suggestions at the end of the calculator was helpful for motivating people through potential cost savings; and
- Appealing background and large icons.

The second carbon footprinting website featured more background information about climate change and different types of environmental footprints. It also featured an interactive carbon calculator that used housing, food, garbage, and transportation information to generate a carbon footprint number. This calculator was similar to a video game, giving users the ability to create their own “avatar” that was then placed in an environment that was developed as the user went through the calculation. The calculator also allowed participants to enter an overall basic response or a more detailed response to the lifestyle questions. Users submitted their answers via sliding bars instead of inputting numbers. Results were given in measurements of earths necessary to support such a lifestyle. At the end of the quiz, users were given the chance to pledge to undertake specific actions that would reduce their footprints. The impact of these pledges was given in measurements of acres and fields. The website also featured a frequently asked question section explaining how the mechanisms behind the calculator worked.

Participants shared varied opinions about the second website:

- The website made a clear connection between economics and environmental concerns;
- The website was considered “more memorable” and “cool;”
- Some participants felt that the website used animation and graphics well, while others felt that the graphics were amateur and unattractive with overwhelming amounts of text;
- The use of Flash on the website was seen as a problem for those running the application on smart phones or with slow Internet connections;
- Concerns about not being able to turn off the music that accompanied the application;
- Entering answers via sliding bars was preferred over inputting numbers since this was a quicker way to input a response;
- The calculator provided options to input either a quick response or a more detailed answer; and
- The results were not displayed so that the user would be able to see the effect of each of the variables on his or her total earth budget.

Overall, participants expressed concern about taking time to view and use the website carbon calculators. Only people who are already interested in the topic would go to the sites. Participants were asked to pick the best website. Three preferred the first website, and ten participants preferred the second.

Participants generated suggestions for improving the two websites and any information they would like included. These included:

- Creating results as a comparison between someone in the U.S. and another part of the world to better illustrate the scope of impact people in the U.S. are making;
- Displaying how much progress has already been made based on certain behaviors that have changed in response to concerns about the environment; and
- Calculator results should be presented in measurements of earths or days until the earth dies rather than measurements of land areas; higher impact, more urgent measurements.

Next, participants identified the targeted age range of the two websites. A variety of responses were offered, including: persons older than 40-years old, graduate students (regardless of age), blue-collar workers, 20-year olds, old people, and rich people.

Ecodriving Websites

The first ecodriving website contained information about hypermiling. Hypermiling is the use of driving techniques to maximize fuel economy. The website's format reflected that of a forum, with a small left-hand menu and a lot of text and discussion links on the homepage. Participants were shown sections of the website that defined hypermiling, provided arguments against hypermiling, and contained articles featuring tips on how to achieve better mileage than the EPA rating. Participants were also shown a mileage log where members are able to log their best mileage and participate in a ranking system.

Participants shared their opinions about the first website. Comments included:

- Participants liked that the website had information they were interested in (for instance, gasoline-electric hybrid cars);
- The content seemed targeted for car mechanics and people with an interest or specialization in cars;
- The website was too text heavy, burdening a time-constrained reader;
- Poor design, bad website format; and
- Not considered a "cool" site.

The second website featured a flash-based interface and a home page with a video of (then) Governor Arnold Schwarzenegger. Participants were shown a section of the website on becoming an "EcoDriver" that contained a video about ecodriving. Participants were also shown sections with a very short carbon calculator, an ecodriving quiz, a virtual road test, community resources and education tools, and news and events.

Participants shared their reactions to the second website.

- All participants liked the video and explained that it was easier to understand the information in this format;
- The information was applicable to everyone since it put the concepts in simple terms that anyone could easily follow;
- The video contained graphics of dollars that appropriately showed the effect vehicles could have on each individual's savings, providing feedback in dollars;
- The second website was educational and reinforced previously known information and practices; and
- The car manufacturer-sponsored advertisement provided at the end of the video created some distrust and hesitation among some participants.

Participants were asked to pick the best website. Two participants preferred the first website, ten preferred the second website, and one liked both websites.

Participants generated suggestions for improving the two websites and any information they would like included. These were:

- One participant thought there should be information about public transportation on the second website; and
- Another thought it would be good to target kids, since they are easier to appeal to.

Next, participants identified the targeted age range of the two websites. A variety of responses were offered, including: people of all ages with driver's licenses, and drivers over the age of 20. For the first website, one participant believed that it was targeting older people because there was too much information and would not provide the immediate gratification that younger people want. One said that the second website was for kids and families because it was not fast enough for young adults.

V. ECODRIVING SURVEYS

INTRODUCTION

To evaluate how ecodriving public education programs could alter driver behavior and fuel consumption, the research team employed two types of surveys. The first was a longitudinal survey evaluating personal driving behavior as well as a fuel log; the second was a series of intercept interviews that explored general attitudes towards ecodriving.

LONGITUDINAL SURVEY METHODOLOGY

The research team conducted recruitment and data collection for the longitudinal study during June through December 2010. Participants were chosen among University of California, Berkeley faculty, staff, and students. Participants were given a \$15.00 gift card for completing two or three surveys (depending on their assigned group, described below) and an additional \$5.00 gift card for completion of the fuel log survey. A total of 104 people participated throughout the entire study. They were split into an “experimental” (n=51) and “control” (n=53) group.

Researchers developed and pretested a pre- and post-survey for participants to complete online over a period of three months. The pre-survey asked each participant 62 questions to assess current driving and vehicle maintenance practices, which was used to establish a baseline for comparison. The survey also asked attitudinal questions to capture views on climate change, existing vehicle ownership, and demographics. The participants were divided into two groups according to the order in which they joined the study. If the order of a joining participant was an odd number, then the participant was assigned to the experimental group. If the participant joined as an even number, then he or she was assigned to the control group. Participants did not know which group they were in nor did they know that there were two groups. Participants in both groups were directed to take the same pre-survey upon entering the study. The experimental group was then asked to visit the website www.ecodrivingUSA.com^c during the upcoming week to introduce ecodriving and to provide more in-depth information on ecodriving practices. The experimental group was sent a follow-up, 25-question survey regarding the ecodriving information conveyed through the website (for example, what was most/least important to them, what practices they already follow, and what practices they plan to follow). The remaining participants were the study’s control group, and they were not shown the website or the experimental survey. Three months later, all participants were administered the post-survey, which asked 62 questions concerning any change in vehicle ownership, maintenance, and driving practices. Most of the questions in the post-survey were comparable to the pre-survey to evaluate whether behavior had changed.

The objective of this study design was to evaluate the degree to which exposure to static information about ecodriving would influence people’s driving behavior and maintenance practices. This design sought to control for the fact that people who join an “ecodriving” study will be inherently subject to some self-selection bias. But as this population was unwittingly split into two groups distinguished by exposure and non-exposure, researchers

^c The [ecodrivingUSA](http://www.ecodrivingUSA.com) website was removed from the Internet in Spring 2012. Please note that key information conveyed on this site is available in two fact sheets that appear in Appendix E of this report (pp. 150-151).

were better able to focus on the added value of the static information provided as the intervention.

CLIPBOARD SURVEY METHODOLOGY

During March and April of 2011, the study team conducted intercept interviews at three locations in the San Francisco Bay Area: UC Berkeley, San Francisco Union Square, and Golden Gate Park of San Francisco. Study participants were intercepted and gave consent to participate in a “clipboard” survey. No compensation was given for responding to the survey. Over the course of two months, 306 people completed the survey.

As part of the survey, participants were asked to review a fact sheet published by the EcoDrivingUSA™ campaign with information regarding ecodriving and maintenance practices. This sheet was provided to evaluate which ecodriving practices they currently engage in and which practices they would be willing to try in the future. They were then given a short, one-page survey that asked about their current driving and maintenance habits, what ecodriving practices they were willing to try, and their overall perceptions about gasoline prices and climate change. The survey also included existing vehicle ownership and demographic questions.

STUDY LIMITATIONS

There were several limitations and issues that arose along the study’s duration. Many of the survey questions relied upon stated preference responses, including questions that had participants self-assess their propensity to practice ecodriving techniques. Given their knowledge of the study purpose, self-assessment bias may have occurred in how efficiently respondents actually drive. The fuel log survey was designed to account for this issue, with an opportunity to compare stated data with revealed fuel consumption data. A future study could collect more empirical data on drivers’ actual behavior through an onboard data collection device.

The fuel log survey’s methodology in itself had several limitations and was experimental. Researchers included the fuel log to add value to the stated changes in behavior exhibited within the longitudinal survey. Respondents were asked to record their odometer readings and fuel purchases *each* time they purchased gasoline. However, several respondents neglected to remember or record their odometer reading at the gas station, so fuel economy could not be calculated for that segment. The most difficult issue arose because respondents sometimes did not fill the tank completely (they did not “top off”). This procedure was critical for fuel economy calculations; thus, data from “partial fills” could not be used in the analysis. Because of these limitations, the data collected from the fuel log produced a limited and incomplete sample that was deemed unusable. For future research, more comprehensive data collection should be pursued through the use of cost-effective onboard vehicle data collection devices.

Finally, the sample for the longitudinal survey was drawn from the population of employees and students at UC Berkeley. The sample for the clipboard survey was drawn from the San Francisco population. Both of these populations normally are not reflective of the general

population demographically. This imposes a limitation on the generalizations that can be drawn from the survey results. The results presented here are at the least reflective of the response observed from a population that is more educated than average.

LONGITUDINAL SURVEY RESULTS

The demographics of the longitudinal survey show that the experimental and control groups were broadly distributed across key demographics. The sample size of each was about 50, so it is not large enough to be reflective of the general population. Both groups exhibit a diverse income distribution, with more than 20% of each sample earning more than \$100,000. The race distribution of the samples exhibit a Caucasian share that is reflective of the state population, but Asians are over-represented while African-Americans and Hispanics are under-represented. Other ethnic populations are relatively small and represent or over-represent their state population shares.⁹⁹ The education level of the samples is higher than the state average, but more reflective of the Bay Area, where respondents were recruited. Table 7 presents a summary of the key demographics in each survey group.

Table 7. Longitudinal Survey Demographics

2009 Household Income	<i>Control</i>	<i>Experimental</i>	Race	<i>Control</i>	<i>Experimental</i>
Less than \$10,000	4 (8%)	1 (2%)	Caucasian	19 (36%)	25 (49%)
\$10,000 to \$15,000	2 (4%)	2 (4%)	Hispanic or Latino	1 (2%)	2 (4%)
\$15,000 to \$25,000	6 (11%)	4 (8%)	African-American	3 (6%)	2 (4%)
\$25,000 to \$35,000	6 (11%)	3 (6%)	Asian	17 (32%)	9 (18%)
\$35,000 to \$50,000	3 (6%)	5 (10%)	Native American or Alaskan Native	0 (0%)	1 (2%)
\$50,000 to \$75,000	4 (8%)	9 (18%)	Hawaiian or Pacific Islander	0 (0%)	2 (4%)
\$75,000 to \$100,000	8 (15%)	5 (10%)	Indian	2 (4%)	1 (2%)
\$100,000 to \$150,000	8 (15%)	10 (20%)	Arab or Middle-Eastern	2 (4%)	1 (2%)
\$150,000 to \$200,000	2 (4%)	0 (0%)	Mixed Race	2 (4%)	3 (6%)
More than \$200,000	1 (2%)	5 (10%)	Decline to Respond	4 (8%)	3 (6%)
Decline to Respond	9 (17%)	7 (14%)	Other	2 (4%)	1 (2%)
Household Category	<i>Control</i>	<i>Experimental</i>	Education	<i>Control</i>	<i>Experimental</i>
Self only	8 (15%)	14 (27%)	Grade School	0 (0%)	0 (0%)
Self with spouse/partner	14 (26%)	11 (22%)	Graduated High School	2 (4%)	2 (4%)
Self with spouse/partner and child(ren)	9 (17%)	9 (18%)	Some college	10 (19%)	8 (16%)
Self with child(ren)	1 (2%)	1 (2%)	Associate's Degree	1 (2%)	0 (0%)
Self with roommate(s)	13 (25%)	9 (18%)	Bachelor's Degree	23 (43%)	19 (37%)
Other, please specify:	7 (13%)	7 (14%)	Master's Degree (MS, MA, MBA, etc)	11 (21%)	13 (25%)
			Juris Doctorate Degree (JD)	0 (0%)	0 (0%)
			Doctorate Degree (PhD, EdD, etc.)	4 (8%)	7 (14%)
Gender	<i>Control</i>	<i>Experimental</i>	Medical Degree (MD, etc.)	0 (0%)	0 (0%)
Male	26 (49%)	23 (45%)	Other	2 (4%)	2 (4%)
Female	27 (51%)	28 (55%)			
Total	53	51	Total	53	51

The longitudinal survey results suggest that exposure to the information about eco-driving did influence people’s behavior in terms of driving and maintenance practices. These changes were large enough to exhibit a departure from the change (or lack of change) conveyed by the control group. Hence, the presentation of static information on eco-driving did appear to result in modified behavior of some individuals within the experimental group. These shifts occur while the overall shifts in behavior of the control group are generally absent. This provides evidence that the provision of eco-driving information to drivers does impact behavior. However, the shifts observed are of moderate size and do not constitute a wholesale change in behavior among all participants in the experimental group. As with most any change in transportation behavior, there is a distribution of heterogeneous effects. To broadly illustrate this issue, Figure 4 presents the experimental and control pre- and post-survey response to the question “How efficiently, in terms of fuel usage, do you think you drive your vehicle now?”

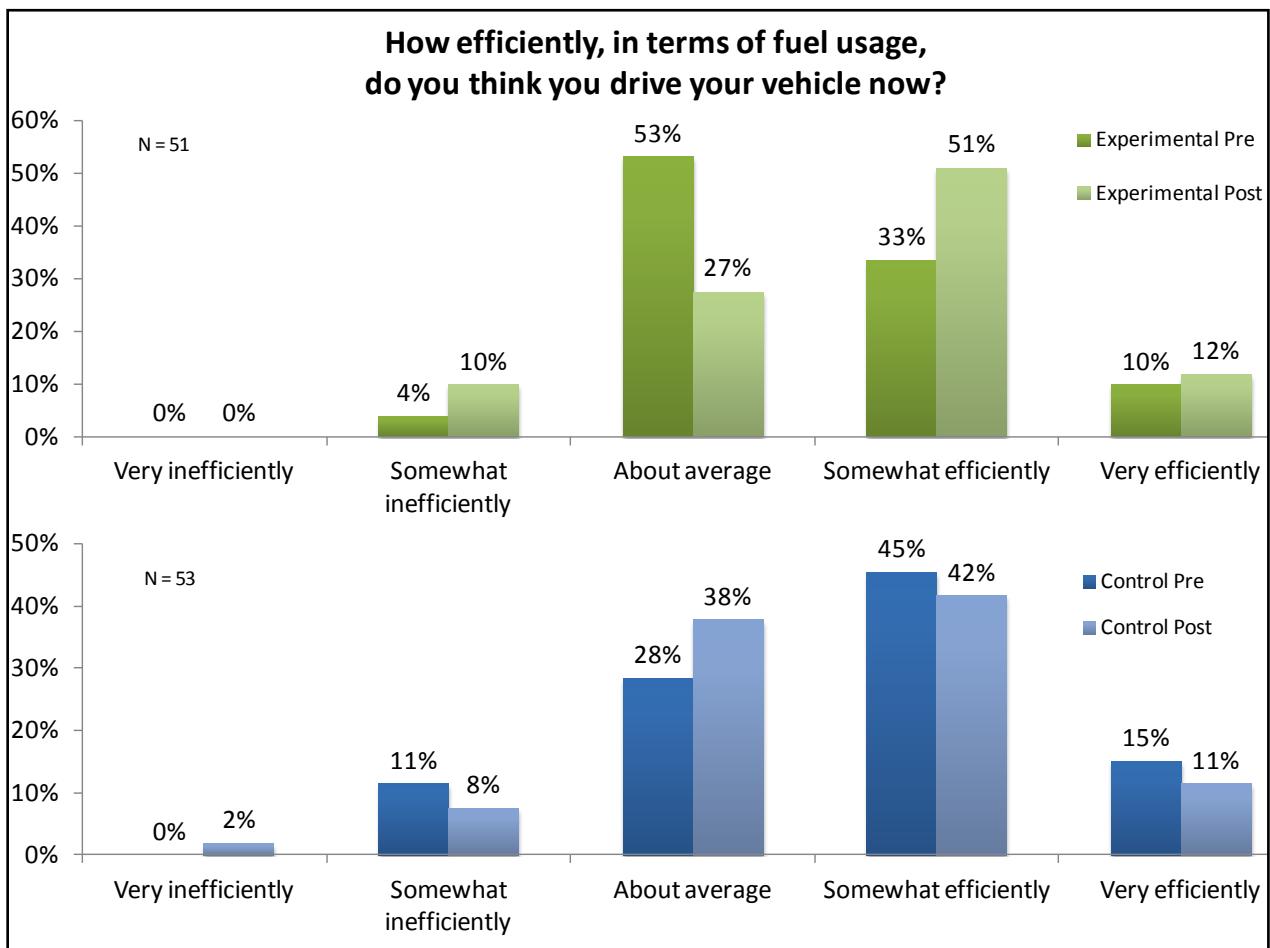


Figure 4. Self-Assessed Driving Efficiency

Figure 4 shows the pre- and post-survey response of both participant groups. The pre- (dark) and post- (light) distributions of the experimental group are presented in the top graph. While the control group pre- and post-distributions are presented on the bottom graph (also proceeding from dark to light). During the pre-survey, the majority of respondents from the experimental group had a stated perception that their driving efficiency was “about average.” With the post-survey, the majority had shifted to believe that they drove

“somewhat efficiently.” The control group exhibits a shift in the other direction. The mode of the control distribution was “somewhat efficiently” in both the pre- and post-survey, but the shift in behavior tends towards reduced perceived efficiency.

While the question in Figure 4 probed respondent “self-perceived efficiency,” additional questions explored specific changes in behavior that would lead to an improvement in self-assessed fuel efficiency. These included questions about highway cruising speed, acceleration and braking behavior, and maintenance practices. Figure 5 illustrates an example of the pre- and post-survey questions that probed cruising speed on the highway.

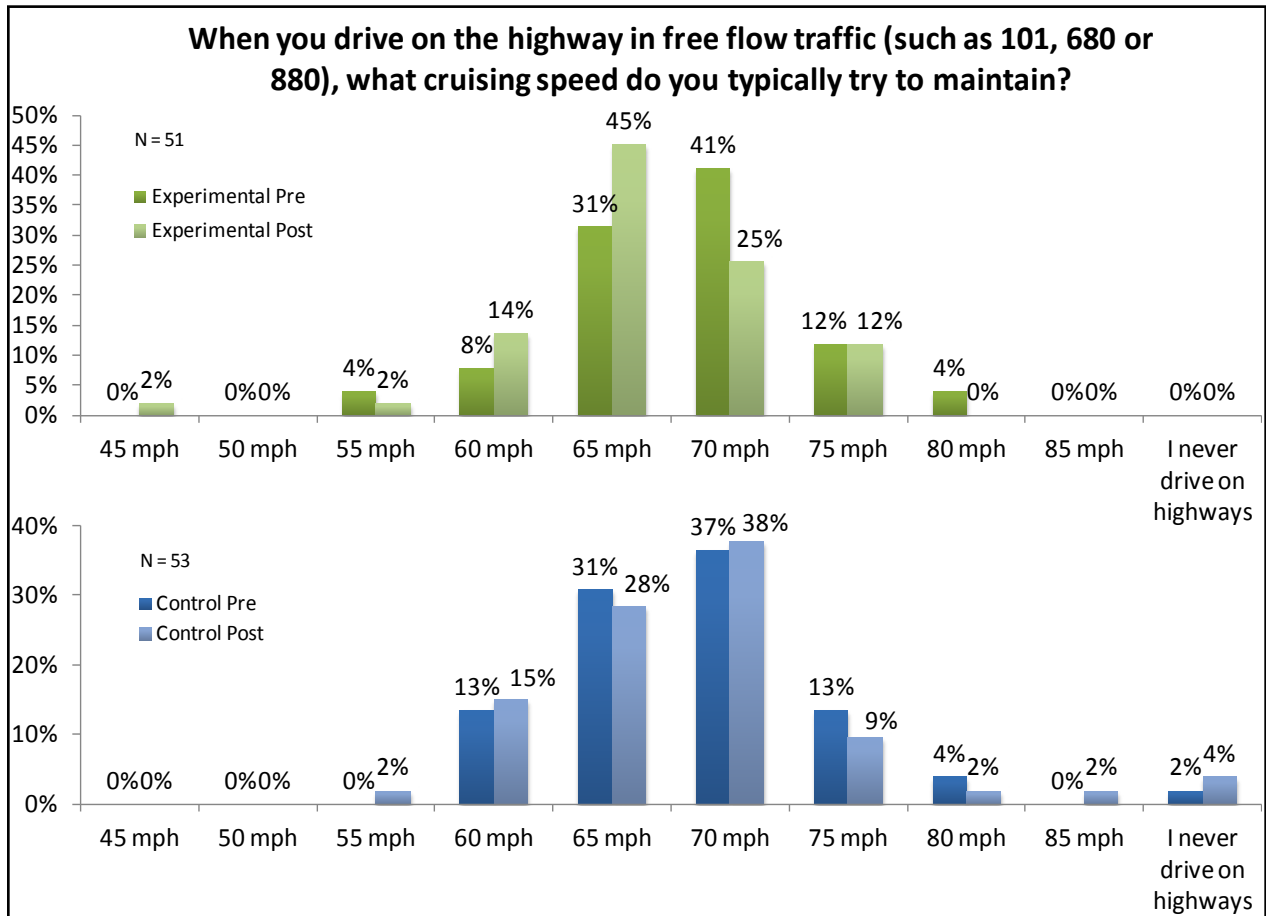


Figure 5. Shift in Highway Cruising Speed

Figure 5 illustrates one source of behavioral shift that may drive the perceived improvement of efficiency of the experimental group in contrast to the control group. During the pre-survey, the mode of both the experimental and control group distributions was 70 miles per hour (mph). During the post-survey, the mode of the control group remained at 70 mph, and the shape of the post-survey control group distribution is broadly the same. In contrast, the experimental group distribution had shifted such that the mode was 65 mph a more energy efficient highway speed. Again, the exhibited shift is part of a distribution. There are still those in the experimental group who continued to drive 75 mph, but a shift towards lower speeds was apparent.

Building on driving behavior changes, the researchers asked additional questions about how participants in both groups accelerated or decelerated to and from a stoplight. The question was asked in two parts. For deceleration, respondents were asked: “How would you best characterize the way in which you brake before a stop light or stop sign?” and this classified whether they generally braked hard or gradually. The second question asked for more specificity: “Would you say that your deceleration is...” and the distribution of response is given in Figure 6.

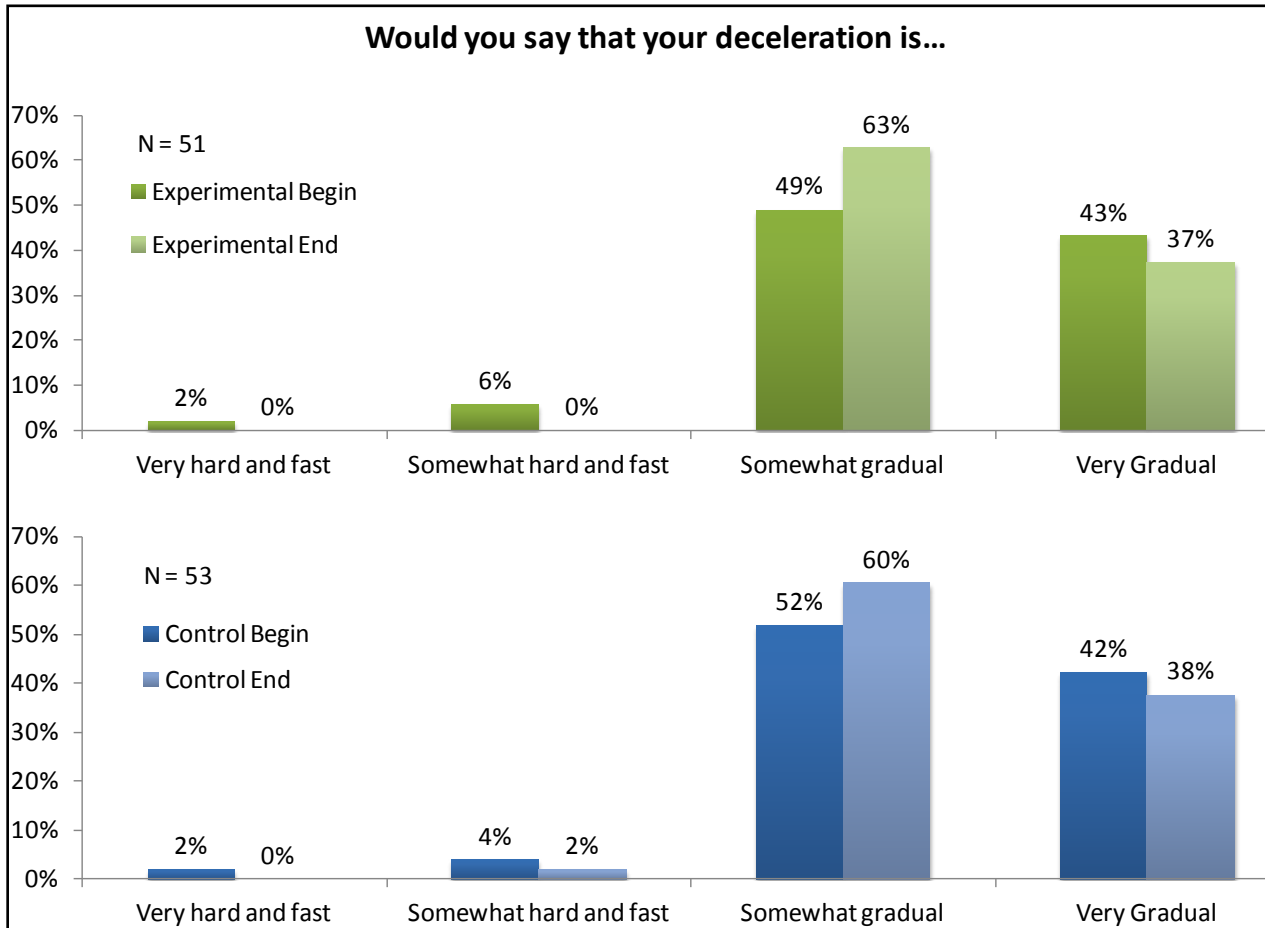


Figure 6. Shift in Deceleration Behavior

Figure 6 shows that most of the respondents in both the control and experimental group considered themselves to brake gradually. Both distributions shift in the same general direction as well, but the shift in the experimental group appears to be slightly stronger. Overall though, Figure 6 does not indicate much difference in the experimental group versus the control group in terms of braking behavior. A similar analysis of acceleration behavior shows that most people accelerate in a manner consistent with ecodriving. Respondents were asked to characterize how they accelerated after being stopped at a red light. Specifically, they were asked to define how they generally accelerated in comparison to the rest of traffic, by stating whether they moved out ahead of most traffic, stayed at pace with traffic, or fell behind most traffic. The pre- and post-survey distributions showed that the experimental group contained a larger number of participants who felt that they generally accelerated from a red light faster than the rest of traffic overall. The shift in behavior of those that accelerated faster was notable in the experimental group

distribution (shown in Figure 7). However, drawing a comparison with the control group did not illustrate major distinctions, as most in the control group were already driving at speeds which were at pace or slower than traffic in general.

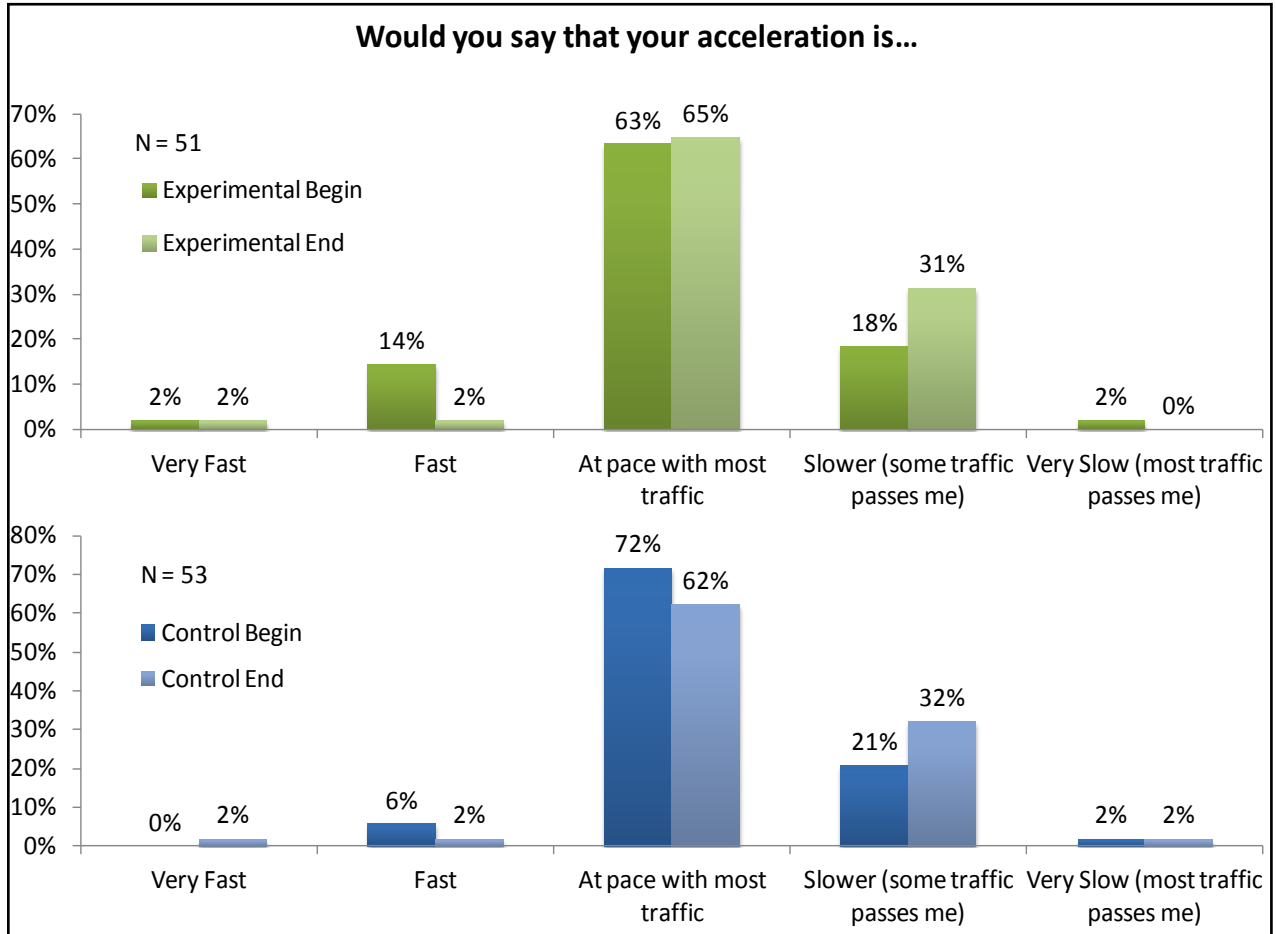


Figure 7. Shift in Acceleration Behavior

The survey probed additional aspects of driving behavior as it pertained to vehicle start up. According to the ecodrivingUSA website, modern vehicles do not need to be “warmed up,” as was the common practice decades ago. To some extent, the assumption that warming up a vehicle in cold weather improves its performance has stuck even as the vehicle technology has evolved to obviate that practice. Figure 8 illustrates the distribution of respondents in the experimental and control groups in terms of delayed driving behavior to warm up a vehicle.

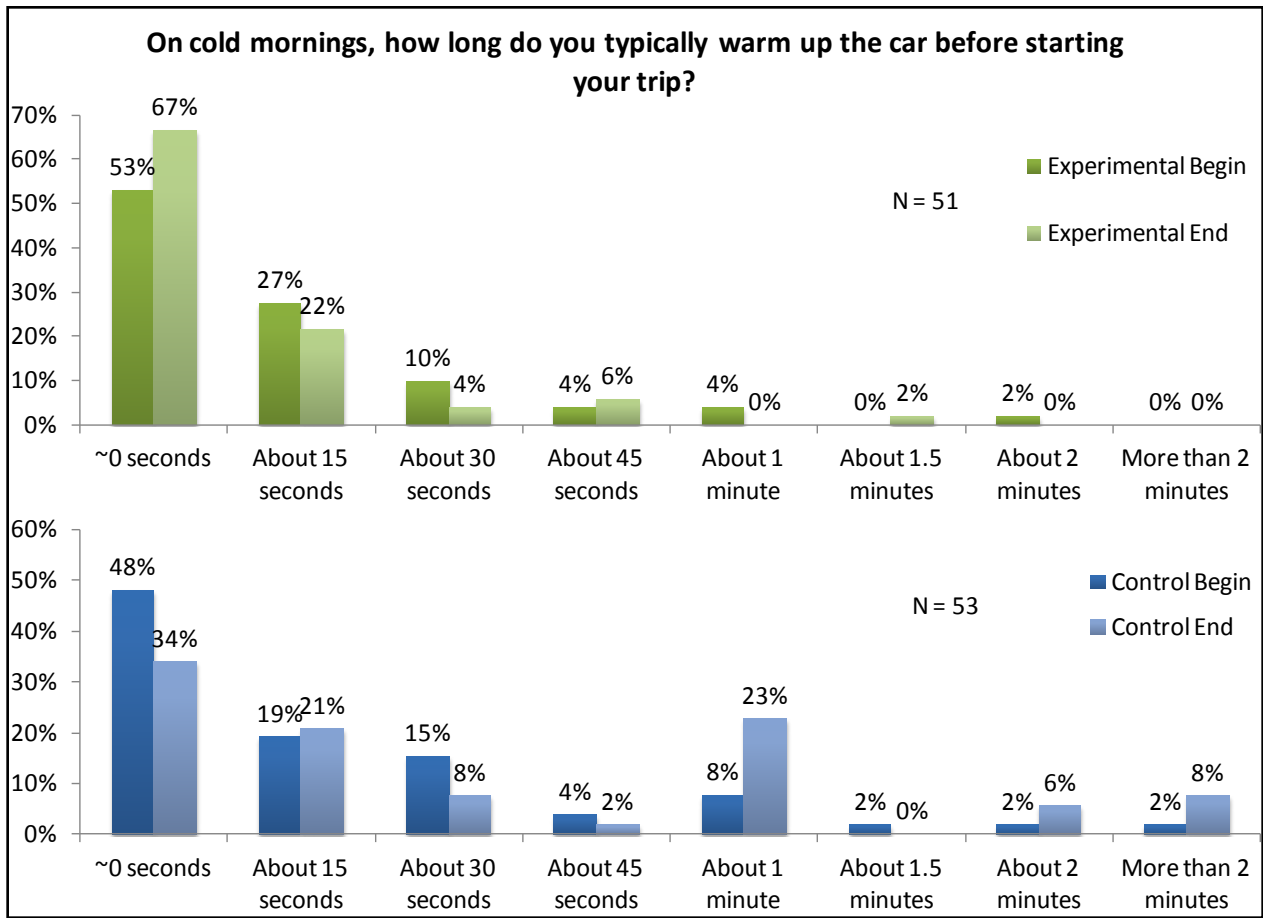


Figure 8. Shift in Drive Time from Vehicle Start

Figure 8 shows that about 50% of respondents in both the control and experimental groups would drive the vehicle immediately from the start. Interestingly, the control group exhibited shifts towards waiting a longer time to drive away after three months, whereas the experimental group exhibited a shift towards waiting less time as nearly 70% stated that they drive away at vehicle ignition. Figure 9 explores the shift in driving behavior further by asking the respondents to evaluate the degree to which they believed that they adjusted their driving behavior to improve fuel economy. Respondents were asked “When driving your primary vehicle, how often do you adjust your driving behavior in ways to improve your fuel economy?” with possible answers of “Never,” “Rarely,” “Sometimes,” “Often,” and “Always.” The distribution of the experimental response illustrates an overall shift towards more frequent active adjustments in driving behavior with the objective of improving fuel economy. In contrast, the control group exhibited no change in the pre- and post-survey distribution.

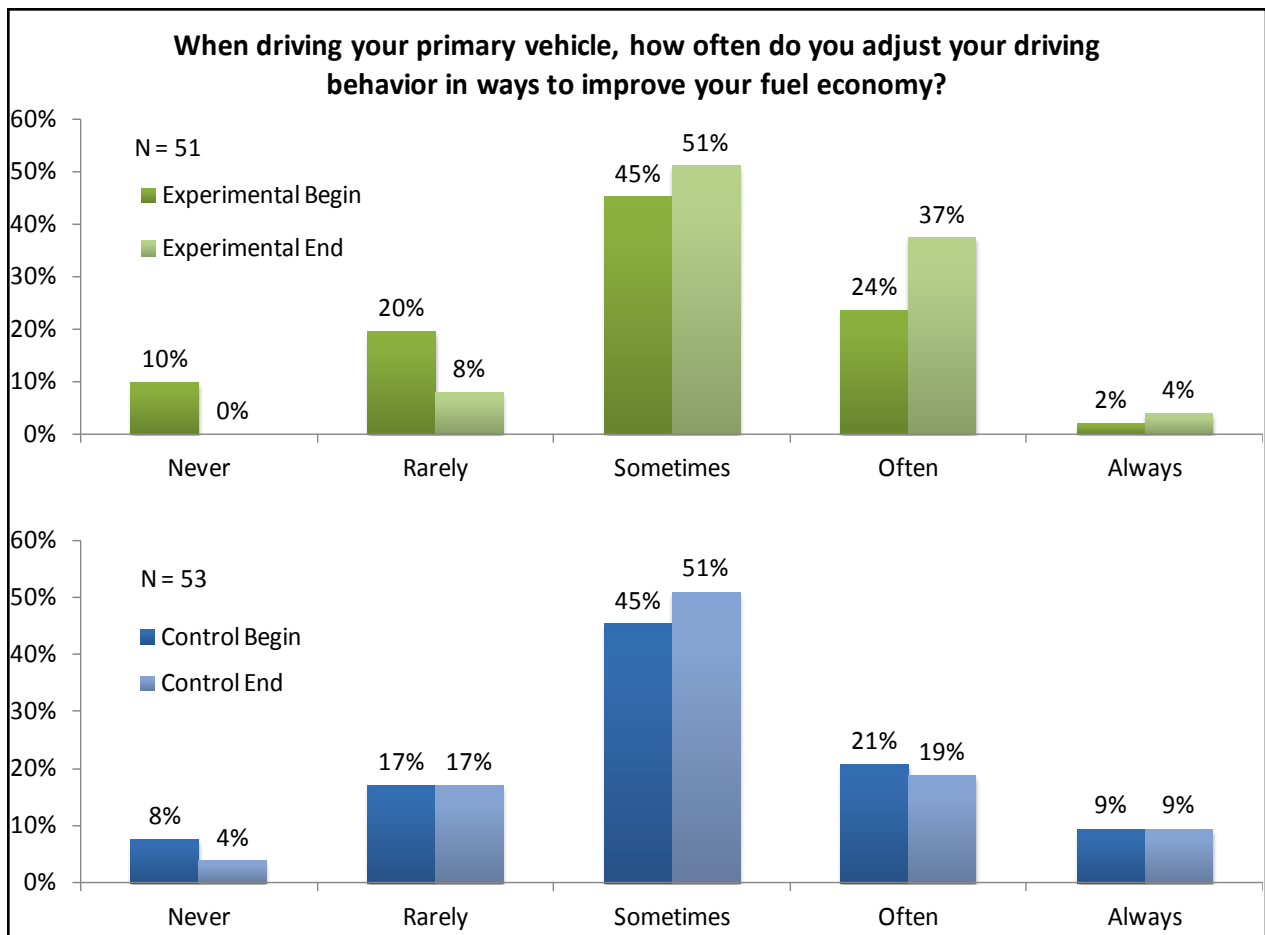


Figure 9. Active Adjustment of Driving Behavior

The pre- and post-surveys provide consistent evidence to suggest that a subset of people in the experimental group receiving information about ecodriving techniques were making a cognizant effort to adjust their driving in ways to improve efficiency over the control group. As all impacts are in the form of a distribution, there inevitably existed some members of the experimental group that did not modify their behavior. But the comparison with the control suggests that in the case of several important driving practices, respondents in the experimental group did make an effort to alter their driving in ways that they would not have if the information not been provided.

To probe this effect further, respondents in the post-survey of the experimental groups were asked directly whether they changed their driving behavior as a result of reviewing the website. This proceeded with a series of three questions presented in Table 8. The first simply asked whether the respondent had made changes in driving behavior to improve fuel economy. Those that answered, “Yes” were asked explicitly whether they had changed their behavior because of what they learned on the ecodrivingUSA.com website. Those that responded “Yes” to this second question were asked to identify which practices they adjusted. Table 8 presents the results of these three questions.

Table 8. Experimental Group Post-Survey Questions about Changes in Driving Behavior

<i>Have you made changes in your driving behavior to improve fuel economy since starting the study?</i>			<i>During the past 3 months, did you change anything about how you drove (e.g., your driving style) because of what you learned from the ecodrivingusa.com website?</i>		
Yes	36	71%	Yes	33	92%
			No, I changed the way I drive for other reasons	3	8%
			No, I still drive about the same as I did 3 months ago	0	0%
No	14	27%	Total	36	100%
I don't know	1	2%			
Total	51	100%			
<i>What driving practices did you change during the study? (please check all that apply)</i>				Count	Percent
None				0	0%
I accelerate more gradually				33	100%
I brake more gradually				26	79%
I idle my car less				11	33%
I drive closer to 60 mph on the highway				15	45%
I change how and when I use the air conditioner				18	55%
I consider using cruise control more often				9	27%
I got a FasTrak				6	18%
I already did all of these things				0	0%
I changed other practices, please explain:				0	0%
Total				33	100%

Both the pre- and post-survey also asked respondents in the experimental group about maintenance practices with their vehicle. Several specific maintenance practices were asked in both surveys, as well as a series of questions that probed specific changes in a sequence congruent to Table 8 above. The results of questions that probed changes to maintenance practices found that respondents in the experimental group were much less responsive to altering how they maintained their vehicle.

Table 9. Experimental Group Post-Survey Questions About Changes in Maintenance Behavior

<i>Do you think that your vehicle maintenance has improved over the last three months?</i>			<i>Do you think that your vehicle maintenance has improved because of what you learned from the ecodrivingusa.com website?</i>		
Yes, it's better	8	16%	Yes	7	19%
			No, my vehicle maintenance improved for other reasons	1	3%
No, it's about the same	42	82%	Total	8	100%
No, it's worse	1	2%			
Total	51	100%			
<i>What maintenance practices did you improve during the study? (please check all that apply)</i>				Count	Percent
I changed the motor oil more frequently				5	71%
I have checked to ensure that the proper motor oil is used				1	14%
I checked my tire pressure more frequently				6	86%
I placed a tire gauge in my car, where there was not one before				1	14%
I got my vehicle engine inspected				1	14%
I got my air filter inspected				2	29%
I removed excess material out of my trunk or cargo area				3	43%
I bought fuel efficient tires				1	14%
I tighten my gas cap more conscientiously				2	29%
I removed a luggage rack or bike rack from my vehicle				0	0%
I got my vehicle air conditioning inspected				1	14%
I read my vehicle's owner's manual				1	14%
I was already doing all of these things				0	0%
Other, please explain				0	0%
Total				7	100%

Table 9 shows that members of the experimental group broadly did not change their maintenance practices as a result of what they learned from the ecodrivingUSA website. Only seven respondents attributed changes to how they maintained the vehicle to the website. Most of those respondents changed the oil and checked tire pressure more frequently. A few of those respondents made other changes to their vehicle as well. The results of Table 9 are reflected in Figure 10, which compares how the experimental and control groups self assessed the level of maintenance of their vehicle during the pre- and post-surveys.

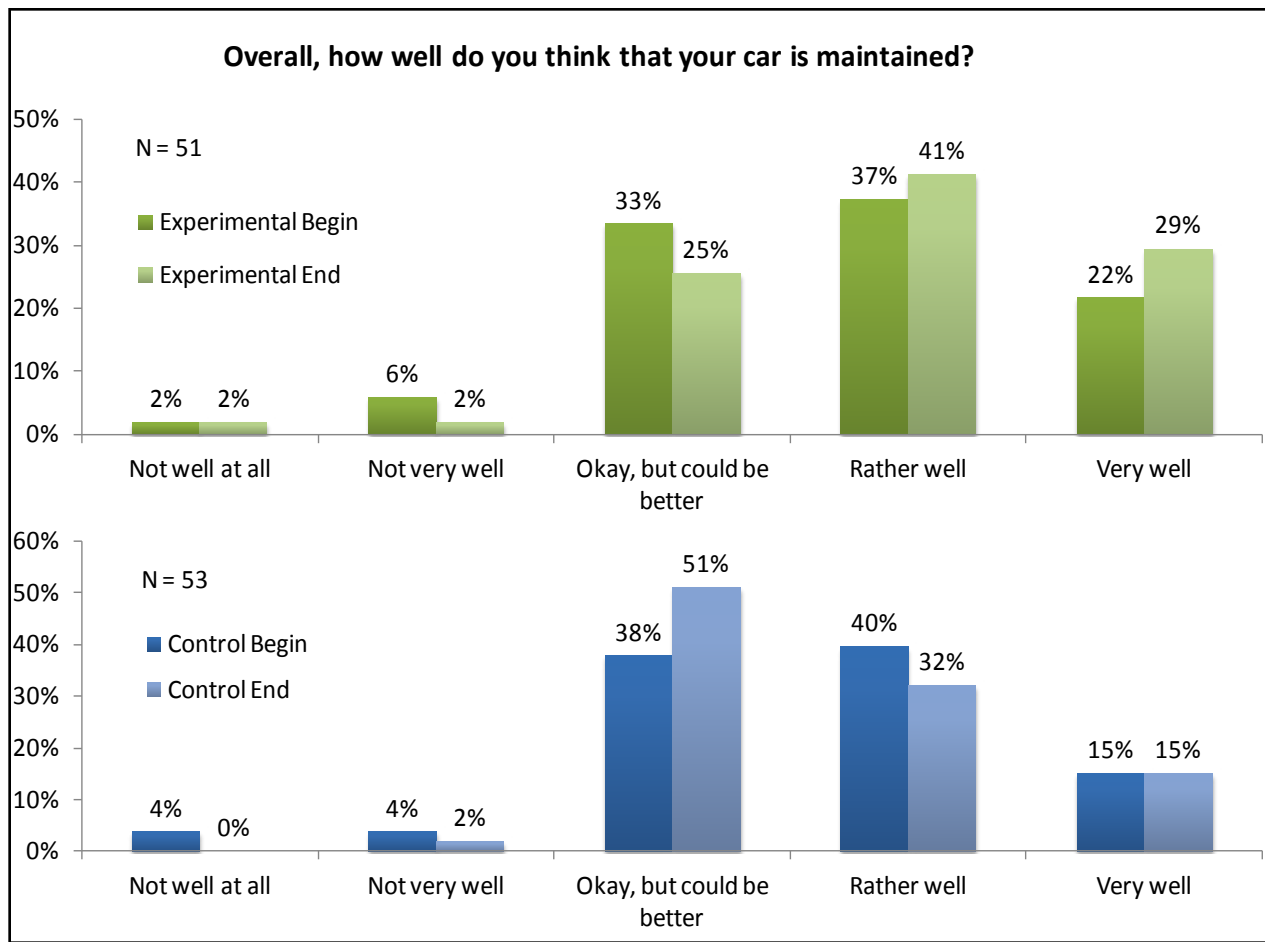


Figure 10. Self-Assessed Vehicle Maintenance

Figure 10 shows that some respondents in the experimental group did consider their vehicle maintenance to have improved as indicated by the shift in the distribution towards better maintenance assessments. Interestingly, the control group shifts towards lower levels of maintenance assessment in the post-survey. Hence, the shift in maintenance practices exhibited by the experimental group appears to be non-random and occurring as a result of the information presented on the website. But, the number of people engaging in meaningful changes in maintenance practices within the experimental group is far smaller than the majority that did alter some driving practices. Naturally, this result suggests that cognitively altering driving behavior is easier than planning better maintenance practices.

Statistical Analysis of Survey Results

The authors used non-parametric tests to evaluate the statistical significance of reported behavioral changes because the survey data were mostly ordinal in nature. This includes the Wilcoxon signed-rank test for paired samples and later the Mann-Whitney test for cross-sectional comparisons. Many of the observed shifts in driving and maintenance behavior by the experimental group were statistically significant. Table 10 presents a summary of key survey questions, the responses available for each, and the comparative results of the Wilcoxon signed-rank test. For each of these questions, responses can shift upward or downward. In the case of Figure 5, the reported highway speeds shifted downward. Table

10 reports the significance of the one-tailed Wilcoxon signed-rank test to demonstrate the general direction of distribution shift and whether the magnitude was large enough to be considered statistically significant. For example, if responses shifted more downwards than upwards (as they did in Figure 5), then the p -value for the one-tailed test of the downward shift was reported (the upward shift test value would equal to 1 minus the downward p -value). Related to Figure 5, Table 10 shows the results of the Wilcoxon signed-rank tests for highway cruising speed change. The shift in the experimental group distribution was statistically significant ($p = 0.018$), while the shift in the control group distribution was not significant ($p = 0.21$). The shift observed with other questions follow in Table 10.

Table 10. P-Values from Wilcoxon Signed-Rank Test

Question	Possible Responses	One-Tailed Test P-Value (shift direction)	
		Experimental	Control
When you drive on the highway in free flow traffic (such as 101, 680 or 880), what cruising speed do you typically try to maintain?	< 45 mph (downward-most response) 45 mph 50 mph 55 mph 60 mph 65 mph 70 mph 75 mph 80 mph 85 mph More than 85 mph I never drive on highways (upward-most response)	0.018+ (downward)	0.21 (downward)
Overall, how well do you think that your car is maintained?	Not well at all Not very well Okay, but could be better Rather well Very well	0.029+ (upward)	0.47 (downward)
How efficiently, in terms of fuel usage, do you think you drive your vehicle now?	Very inefficiently Somewhat inefficiently About average Somewhat efficiently Very efficiently	0.086* (upward)	0.27 (downward)
On cold mornings, how long do you typically warm up the car before starting your trip?	~0 seconds About 15 seconds About 30 seconds About 45 seconds About 1 minute About 1.5 minutes About 2 minutes More than 2 minutes	0.037+ (downward)	0.001+ (upward)
When driving your primary vehicle, how often do you adjust your driving behavior in ways to improve your fuel economy?	Never Rarely Sometimes Often Always	0.00076+ (upward)	0.34 (upward)
I regularly use the manufacturer recommended motor oil.	Strongly Disagree Disagree Agree Strongly Agree	0.51 (upward)	0.36 (upward)
I regularly check and properly inflate my tires at least once a month.	Strongly Disagree Disagree Agree Strongly Agree	0.0084+ (upward)	0.048+ (upward)
*statistically significant at the 10% level †statistically significant at the 5% level			

The shift in before- and after-survey responses suggest that a subset of the experimental group that received ecodriving information made a cognizant effort to adjust their driving in ways to improve efficiency in contrast to the control group. Furthermore, the number of respondents making a shift was large enough to be statistically significant at the 5% or 10% level in most cases. As all impacts reflect a distribution, there inevitably existed some experimental group members that did not modify their stated behavior. However, in contrast to the control group, experimental group respondents made an effort to alter their driving and vehicle maintenance in ways that they would not have in the absence of the study information. Table 10 shows that respondents in the experimental group exhibited a statistically significant shift towards believing that their car was better maintained ($p = 0.029$), driving more efficiently ($p = 0.086$), and adjusting their driving behavior to improve fuel economy ($p < 0.001$). In these three cases, the distribution of the control group responses did not change markedly. Table 10 also shows that respondents reduced the time that they would warm up a vehicle ($p = 0.037$), whereas the control group exhibited a significant shift towards waiting longer before driving ($p = 0.001$). In the case of the bottom two Likert-scale questions pertaining to maintenance, neither group reported shifts in their motor oil use, while both groups increased the degree to which they checked and inflated their tires.

Ecodriving Score

To evaluate how respondents in the experimental group shifted as individuals, respondents were each given two “ecodriving scores”—one for the before-survey and one for the after-survey—based on 12 survey questions that assessed their knowledge and practice of ecodriving principles (for example, acceleration and braking patterns, frequency of driving behavior adjustment, highway cruising speed, and vehicle aerodynamics). A threshold was also established, whereby respondents were grouped into two categories for each survey: “ecodriving” versus “not ecodriving.” While there is no universally established threshold, the authors defined a score of 60% as descriptive of general ecodriving practice responsiveness. This threshold is somewhat arbitrary, defining how “well” respondents scored in the context of this survey. The questions that were used for scoring, and the corresponding “ecodriving” answers, are presented in Table 11.

Table 11. Questions Used for Ecodriving Scoring

	Topic	Before	Ecodriving Responses	After	Ecodriving Responses
Driving Behaviors	Acceleration	How would you best characterize your acceleration from a stop light or stop sign during the last 3 months?	Slower (some traffic passes me), Very Slow (most traffic passes me)	How would you best characterize your acceleration from a stop light or stop sign during the last 3 months?	Slower (some traffic passes me), Very Slow (most traffic passes me)
	Braking	How would you best characterize the way in which you brake before a stop light or stop sign?	Somewhat gradual, Very Gradual	How would you best characterize the way in which you braked before a stop light or stop sign during the last 3 months?	Somewhat gradual, Very Gradual
	Fuel efficiency	How efficiently, in terms of fuel usage, do you think you drive your vehicle now?	Very efficiently, Somewhat efficiently	How efficiently, in terms of fuel usage, do you think you drive your vehicle now?	Very efficiently, Somewhat efficiently
	Adjusting driving behavior	When driving your primary vehicle, how often do you adjust your driving behavior in ways to improve your fuel economy?	Often, Always	During the past 3 months, when driving your primary vehicle, how often would you adjust your driving behavior in ways to improve your fuel economy?	Often, Always
	Highway speed	When you drive on the highway in free flow traffic (such as 101, 680 or 880), what cruising speed do you typically try to maintain?	<45 mph, 45 mph, 50 mph, 55 mph, 60 mph, 65 mph	During the past 3 months, when driving on the highway in free flow traffic (such as 101, 680 or 880) what cruising speed have you typically tried to maintain?	<45 mph, 45 mph, 50 mph, 55 mph, 60 mph, 65 mph
	Warmup time	On cold mornings, how long do you typically warm up the car before starting your trip?	0 seconds	During the past 3 months, on cold mornings, how long have you typically warmed up the car before starting your trip?	0 seconds
Maintenance Practices	Recommended motor oil	I regularly use the manufacturer recommended motor oil.	Strongly Agree, Agree	I have regularly used the manufacturer-recommended motor oil during the last 3 months.	Strongly Agree, Agree
	Regular maintenance	Overall, how well do you think that your car is maintained?	Rather well, Very well	Overall, how well do you think that your car is maintained?	Rather well, Very well
	Tire pressure check	About how often do you check your own tire pressure?	Once a month, Twice a month, Once a week, More than once a week	During the last 3 months, how often did you check your tire pressure?	Once a month, Three times a month, Twice a week, Once a week
	Tire pressure check	How often is your tire pressure checked by someone else?	Once a month, Twice a month, Once a week, More than once a week	During the last 3 months, how often was your tire pressure checked by someone besides you?	Once a month, Three times a month, Twice a week, Once a week
	Aerodynamics	Does your vehicle have a permanent luggage rack?	No	Does your vehicle currently have a luggage rack?	No
	Excess weight	Items that I regularly carry in my trunk or cargo area are heavy (besides emergency items such as a spare tire or jumper cables).	Disagree, Strongly Disagree	Items that I regularly carried in my trunk were heavy.	Disagree, Strongly Disagree

Based on the respondents answers to the questions detailed in Table 11, Figure 11 presents a matrix of the respondent scores before- and after-survey. The matrix is divided into four quadrants by dotted lines and by three shaded regions. Respondents in Quadrant IV scored above 60% for both the before and after surveys. Quadrant II defines those below the 60% threshold for both survey, and the opposite quadrants show respondents that scored above the threshold in one survey and below it in the other. The totals of each quadrant are indicated in the subtable below.

The areas separated by shaded regions indicate relative improvement. Even if respondents did not pass the (somewhat arbitrary) 60% threshold, those 29 within the upper right triangle improved between surveys, while the lower left triangle shows the six who worsened; 16 in the light gray region remained unchanged. Those respondents that improved (regardless of score) are analyzed in the next section.

		Ecodriving Score									
		0 - 10%	10 - 20%	20 - 30%	30 - 40%	40 - 50%	50 - 60%	60 - 70%	70 - 80%	80 - 90%	90 - 100%
After	Before	0 - 10%	10 - 20%	20 - 30%	30 - 40%	40 - 50%	50 - 60%	60 - 70%	70 - 80%	80 - 90%	90 - 100%
0 - 10%	0 - 10%	II									I
10 - 20%	0 - 10%					1	1				
20 - 30%	0 - 10%				1						
30 - 40%	0 - 10%			1	1		2	2	1		
40 - 50%	0 - 10%				1	8	6	4	2		
50 - 60%	0 - 10%				1	1	2	2	1	1	
60 - 70%	0 - 10%						1	4	5		
70 - 80%	0 - 10%							1	1		
80 - 90%	0 - 10%										
90 - 100%	0 - 10%	III									IV
Quadrant and Classification		Total				Improvement Category				Total	
Quadrant I (Ecodriving Not Before, but After)		13				Improved Ecodriving				29	
Quadrant II (Not Ecodriving Before or After)		26				Stayed the Same				16	
Quadrant III (Ecodriving Before, but not After)		1				Reduced Ecodriving				6	
Quadrant IV (Ecodriving Before and After)		11									

Figure 11. Distribution of Ecodriving Scores

Demographic, Attitudinal, and Vehicular Characteristics of Improved Drivers

In Figure 11, the authors divide the experimental group into “improved” and “non-improved” subsamples. Figure 3 presents key distributional differences between those that improved. Distributions of each group’s demographics and usage of the EcoDrivingUSA™ website reveal several interesting findings. Demographic distributions show that improved drivers tended to be slightly older, more educated, and wealthier all of which are typically correlated. A characteristic found to be statistically significant ($p = 0.046$, using a two-sample t-test assuming unequal variances) was gender—improved drivers tended to be female, accounting for 65% of the respondents in this category. Difference in mean household size was significant at the 10% level ($p = 0.074$), with improved drivers living in smaller households averaging 2.6 persons. With regards to respondent attitudes, improved drivers tended to have slightly higher fuel cost concerns, as well as stronger beliefs in climate change and the severity of anthropogenic contributions.

The survey inquired about the make, model and vehicle year most driven by the respondent. Interestingly, the improved subsample had newer autos than their cohorts who did not improve, with mean vehicle ages differing significantly (6.7 years vs. 11.6 years, $p = 0.0020$). Finally, the difference in mean vehicle fuel economy was also significant ($p = 0.0087$)—improved drivers’ vehicles had higher fuel economy, averaging 27 mpg (8.7 L/100 km), while non-improved drivers’ vehicles averaged 23 mpg (10 L/100 km).

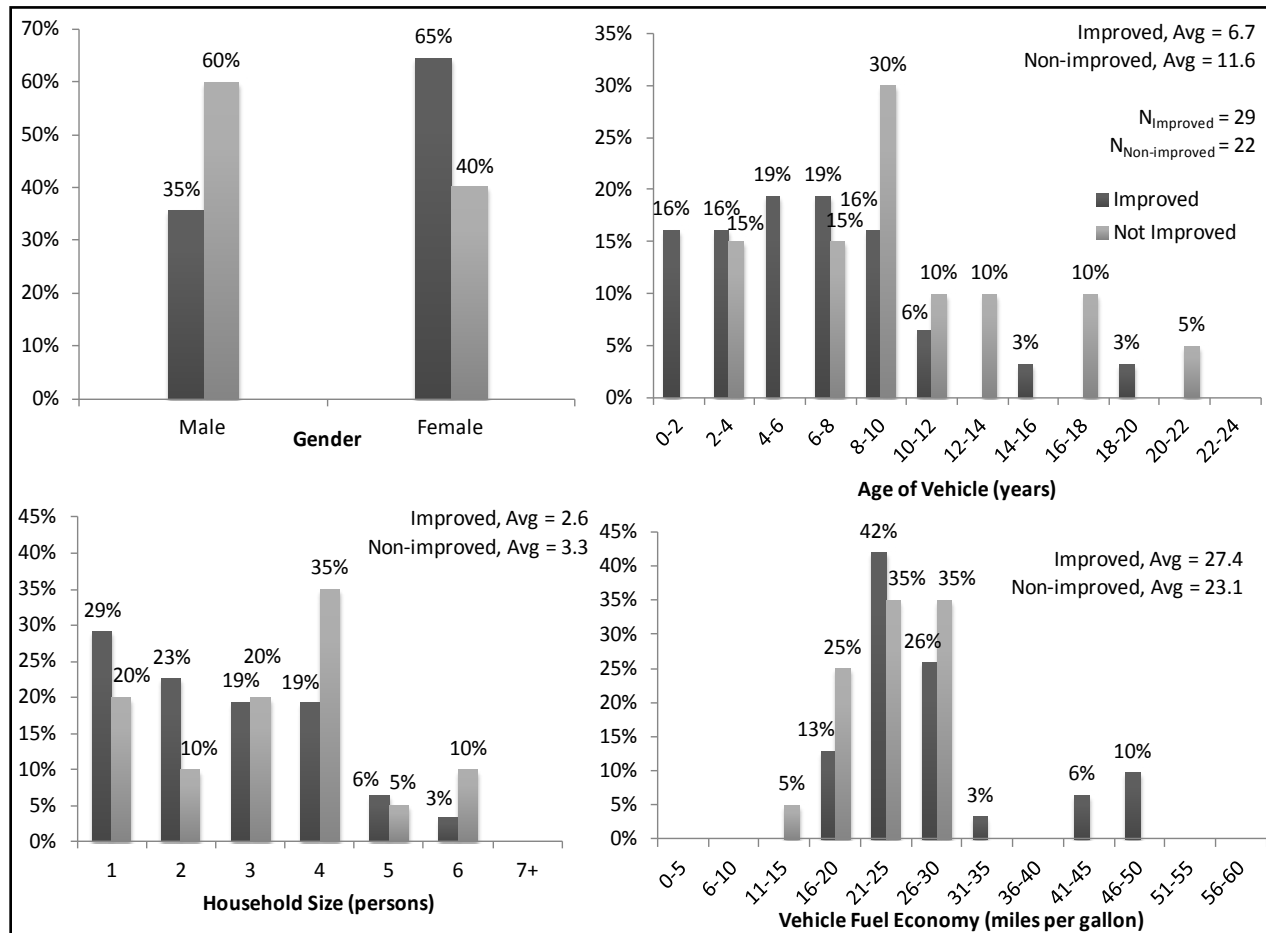


Figure 12. Distributions of Key Respondent Characteristics by Ecodriving Improvement Groups

Website and Informational Effectiveness

To evaluate which pieces of information were perceived as most useful to the experimental group after they viewed the ecodrivingUSA website, all respondents in the experimental group were given a survey to gauge their reaction to the website itself. The following tables provide the highlights of the survey results.

The ecodrivingUSA website had a number of features that respondents in the experimental group could explore. Naturally, they were not required to visit all of the website, they were simply asked to look at it and review key information that was deemed interesting. The first question sought to understand which features of the site they did review. Follow-up questions probed to ascertain which of these components were most effective in **motivating**

and **informing** respondents about ecodriving. The results of these three questions are summarized in Table 12.

Table 12. EcodrivingUSA Website Features Visited and Deemed Most Effective

<i>What sections of the website did you visit? (Please check all that apply)</i>	<i>Which section of the website did you find to be the most effective in informing you about the reasons and incentives for eco-driving? (choose one response)</i>				<i>Which section of the website did you find to be the most effective in informing you on how to eco-drive? (choose one response)</i>	
	Count	%	Count	%	Count	%
The introductory video	37	74%	20	40%	15	30%
The list of maintenance tips	44	88%	6	12%	5	10%
The list of driving tips	47	94%	18	36%	25	50%
The quiz (Beginner)	14	28%	2	4%	1	2%
The quiz (Intermediate)	7	14%	3	6%	1	2%
The quiz (Pro)	3	6%	0	0%	0	0%
The endorsement of eco-driving by selected state governors	9	18%	0	0%	0	0%
The Eco-driving game	14	28%	0	0%	0	0%
Other, please specify:	0	0%	0	0%	0	0%
None	0	0%	1	2%	2	4%
Total	50	100%	50	0%	49	0%

The summary of Table 12 shows that most people found the video on the front page to be one of most visited components of the site and one of the most effective mediums for conveying information. The other highly visited and informative website feature was the list of driving tips. Interestingly, nearly 90% of the respondents saw the list of maintenance tips, but only about 10% thought that they were effective in motivating or informing them about ecodriving. The survey further probed respondents to understand what maintenance practices they did not know prior to reviewing the website. Table 13 summarizes these responses.

Table 13. Maintenance Practices Not Known Prior to Visiting the Ecodriving USA Website

<i>What maintenance practices or issues did you learn from the website that you did not know before? (Check all that apply)</i>	<i>Count</i>	<i>%</i>
The owner's manual is a good information source for optimizing fuel economy	12	24%
Choosing the right motor oil can make a difference in fuel economy	15	30%
Periodic engine tune-ups will improve fuel economy	7	14%
Replacing a clogged air filter will improve fuel economy	12	24%
Low tire pressure lowers fuel economy	14	28%
Tire pressure can fall with cold weather	19	38%
A loose gas cap can cause evaporative emissions	25	50%
A luggage or bike rack lowers fuel economy through aerodynamic drag	9	18%
Removing excess weight from the vehicle can improve fuel economy	5	10%
A professionally maintained air conditioner can improve fuel economy	30	60%
I can purchase tires that can improve fuel efficiency	29	58%
None of the above	4	8%
Total	50	

Table 13 suggests that there are a number of facts about car maintenance that were not known by the respondents. These included facts about gas cap tightening, air conditioner maintenance, and fuel-efficient tires. In addition, the fact that temperatures swings can alter tire pressure and choice of motor oil can impact fuel economy were also indicated to be new information to a sizable respondent share.

While the results from Table 9 showed that most of the respondents did not engage in considerable changes in maintenance behavior, they were asked during the experimental survey whether they would engage in some of the maintenance practices suggested. Table 14 presents a summary of how responses were distributed.

Table 14. Maintenance Practices Most Likely to Be Considered

<i>Based on the information that you saw at this site, what types of maintenance practices do you think you might give more consideration to over the next three months? (Please check all that apply)</i>	Count	%
Change the motor oil more frequently	10	20%
Ensure the proper motor oil is used	11	22%
Check my tire pressure on a monthly basis	33	66%
Buy a tire gauge and keep it in my car	14	28%
Get my vehicle engine inspected	8	16%
Get my air filter inspected	18	36%
Keep excess material out of my trunk	19	38%
Consider fuel efficient tires for my next tire purchase	22	44%
Make sure my gas cap is tight	16	32%
Remove a luggage rack or bike rack from my vehicle	0	0%
Get my vehicle air conditioning inspected	11	22%
I will read my vehicle's owner's manual	14	28%
I already do all of these things	3	6%
None of the above	0	0%
Total	50	

Two-thirds of the respondents said that they would consider checking the tire pressure of their vehicle monthly. However, the data showed that fewer respondents ultimately did this. Other maintenance practices also received indications that they would be considered at levels that were ultimately not manifested in practice. This mismatch of consideration and level of practice is ultimately indicative that taking proactive maintenance practices are among the more difficult tasks associated with ecodriving.

Finally, the survey asked a similar question regarding driving activities. Not surprisingly, the stated willingness to consider the list of ecodriving practices was higher and more aligned with the proportions of actual practice. Table 15 provides a summary of the driving practices most likely to be considered by the experimental group.

Table 15. Driving Practices Most Likely to Be Considered

<i>Based on the information that you saw at this site, what types of driving practices do you think you will consider over the next three months? (Please check all that apply)</i>	Count	%
I will accelerate more gradually	30	60%
I will brake more gradually	23	46%
I will drive my car to warm it up	13	26%
I will drive closer to 60 mph on the highway	21	42%
I will change how and when I use the air conditioner	23	46%
I will use cruise control more often	16	32%
I will get a FasTrak	6	12%
I already do all of these things	8	16%
None of the above	2	4%
Total	50	

Overall, the longitudinal results based on the control and experimental design show that providing static information to people does influence the behavior of some drivers. It is clear that not everyone modifies their behavior as a result of reviewing the website, but the intervention is simply a website—a paperless provision of information. In this respect, even small shifts in behavior among the population could be deemed cost effective in reducing emissions and fuel consumption. Most people that indicated a shift in behavior based on this feedback, did so through driving modifications, which suggests that information on maintenance practices could be improved. However, it could also be indicative that maintenance practices are harder to implement, and thus may be better targeted by automation technologies.

CLIPBOARD SURVEY RESULTS

The clipboard survey collected within the Bay Area was shorter than the longitudinal survey and taken only once by respondents. While it did not probe actual behavioral changes, it was designed to evaluate the general responsiveness that a larger population would have with respect to practicing ecodriving. In this respect, the survey asked questions about what individuals currently do in terms of ecodriving and about what practices that they would consider undertaking to improve fuel economy. To begin, Figure 13 illustrates the distribution of driving practices that are employed by clipboard survey respondents.

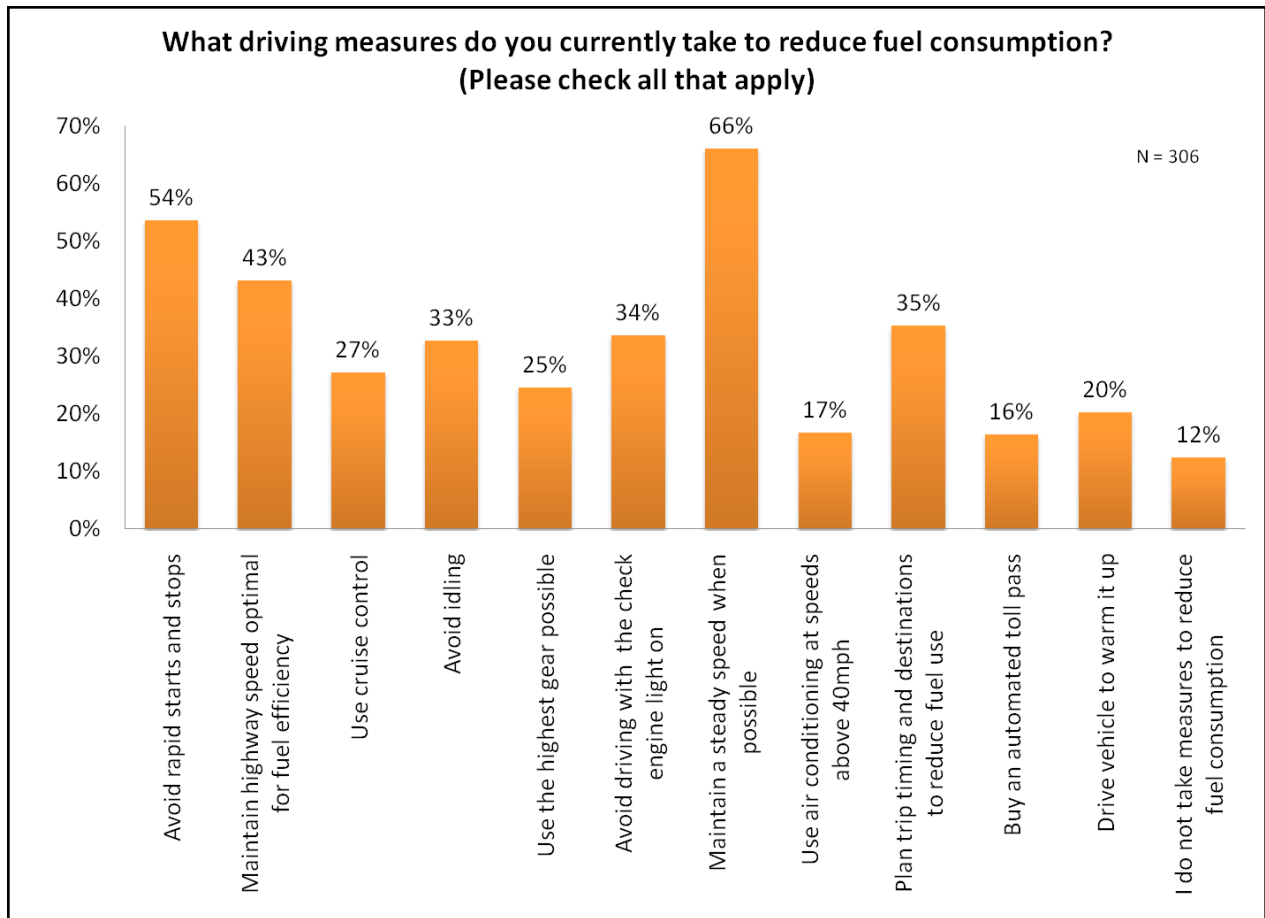


Figure 13. Driving Measures Currently Taken to Reduce Fuel Consumption

The distribution shows that fewer than 50% practice most of the driving behavioral measures that could be implemented to reduce fuel consumption. However, 88% of respondents indicated that they take at least one of the given driving measures to reduce fuel consumption. The survey asked respondents what driving behavioral practices they would be willing to adopt in addition to what they already do. Table 16 illustrates a cross tabulation of the driving behaviors that respondents currently practice with the behaviors that they expressed a willingness to practice. The left number of each cell is the actual count of respondents providing the combination of responses. The percent to the right in each cell is the total respondents practicing the behavior currently (the right most cell in each row).

Table 16. Cross Tabulation of Current Driving Practices with Additional Driving Measures that Respondents State Willingness to Take

Willing to Practice / Currently Practice	Avoid rapid starts and stops	Maintain highway speed optimal for fuel	Use cruise control	Avoid idling	Use the highest gear possible	Avoid driving with the check engine light on	Maintain a steady speed when possible	Use air conditioning at speeds above 40mph	Plan trip timing and destinations to reduce fuel use	Buy an automated toll pass	Drive vehicle to warm it up	I do not take measures to reduce fuel consumption	Total Respondents
Avoid rapid starts and stops		48 (29%)	43 (26%)	37 (23%)	25 (15%)	42 (26%)	29 (18%)	51 (31%)	49 (30%)	26 (16%)	43 (26%)	19 (12%)	164 (54%)
Maintain highway speed optimal for fuel efficiency	31 (23%)		31 (23%)	27 (20%)	24 (18%)	31 (23%)	24 (18%)	39 (30%)	34 (26%)	20 (15%)	34 (26%)	16 (12%)	132 (43%)
Use cruise control	19 (23%)	20 (24%)		20 (24%)	11 (13%)	16 (19%)	15 (18%)	27 (33%)	18 (22%)	11 (13%)	22 (27%)	11 (13%)	83 (27%)
Avoid idling	21 (21%)	32 (32%)	23 (23%)		20 (20%)	35 (35%)	23 (23%)	33 (33%)	33 (33%)	20 (20%)	25 (25%)	14 (14%)	100 (33%)
Use the highest gear possible	15 (20%)	18 (24%)	16 (21%)	14 (19%)		15 (20%)	19 (25%)	22 (29%)	18 (24%)	13 (17%)	17 (23%)	11 (15%)	75 (25%)
Avoid driving with the check engine light on	27 (26%)	38 (37%)	24 (23%)	27 (26%)	15 (15%)		22 (21%)	38 (37%)	33 (32%)	22 (21%)	24 (23%)	11 (11%)	103 (34%)
Maintain a steady speed when possible	55 (27%)	57 (28%)	45 (22%)	50 (25%)	37 (18%)	56 (28%)		61 (30%)	57 (28%)	38 (19%)	54 (27%)	20 (10%)	202 (66%)
Use air conditioning at speeds above 40mph	15 (29%)	19 (37%)	17 (33%)	18 (35%)	13 (25%)	18 (35%)	15 (29%)		17 (33%)	10 (20%)	16 (31%)	8 (16%)	51 (17%)
Plan trip timing and destinations to reduce fuel use	33 (31%)	33 (31%)	26 (24%)	30 (28%)	20 (19%)	30 (28%)	25 (23%)	35 (32%)		17 (16%)	22 (20%)	15 (14%)	108 (35%)
Buy an automated toll pass	9 (18%)	14 (28%)	11 (22%)	15 (30%)	7 (14%)	11 (22%)	10 (20%)	20 (40%)	11 (22%)		10 (20%)	7 (14%)	50 (16%)
Drive vehicle to warm it up	16 (26%)	15 (24%)	14 (23%)	14 (23%)	12 (19%)	14 (23%)	12 (19%)	13 (21%)	17 (27%)	10 (16%)		6 (10%)	62 (20%)
I do not take measures to reduce fuel consumption	12 (32%)	15 (39%)	10 (26%)	11 (29%)	7 (18%)	11 (29%)	19 (50%)	6 (16%)	9 (24%)	6 (16%)	4 (11%)		38 (12%)
Total Respondents	82 (27%)	85 (28%)	70 (23%)	73 (24%)	47 (15%)	73 (24%)	79 (26%)	79 (26%)	73 (24%)	47 (15%)	68 (22%)	40 (13%)	306

The cross-tabulation shows that most respondents are willing to practice additional driving behaviors, but surprisingly, their collective willingness was limited to a few practices and no single practice was overwhelming chosen by any subgroup. To evaluate this question from the perspective of maintenance practices, the survey asked similar questions. Figure 14 shows the distribution of participant responses to current maintenance practices.

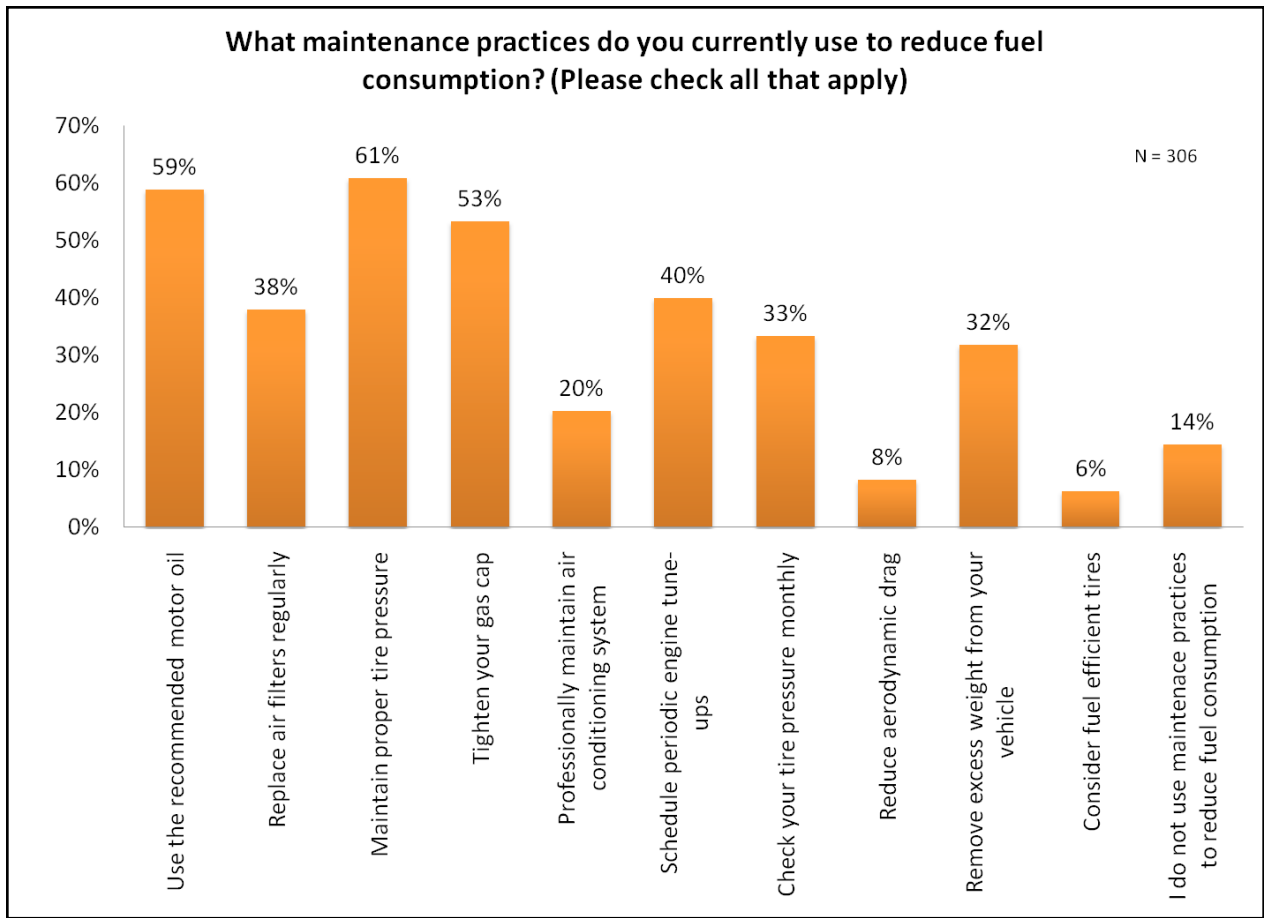


Figure 14. Current Maintenance Practices of Respondents

The distribution shows that a majority of respondents stated that they used the recommended motor oil, properly inflated tire pressure, and tightened the gas cap. A minority of respondents did the remaining practices. Participants were similarly asked in a follow up question which additional maintenance practices they would be willing to consider using to reduce fuel consumption.

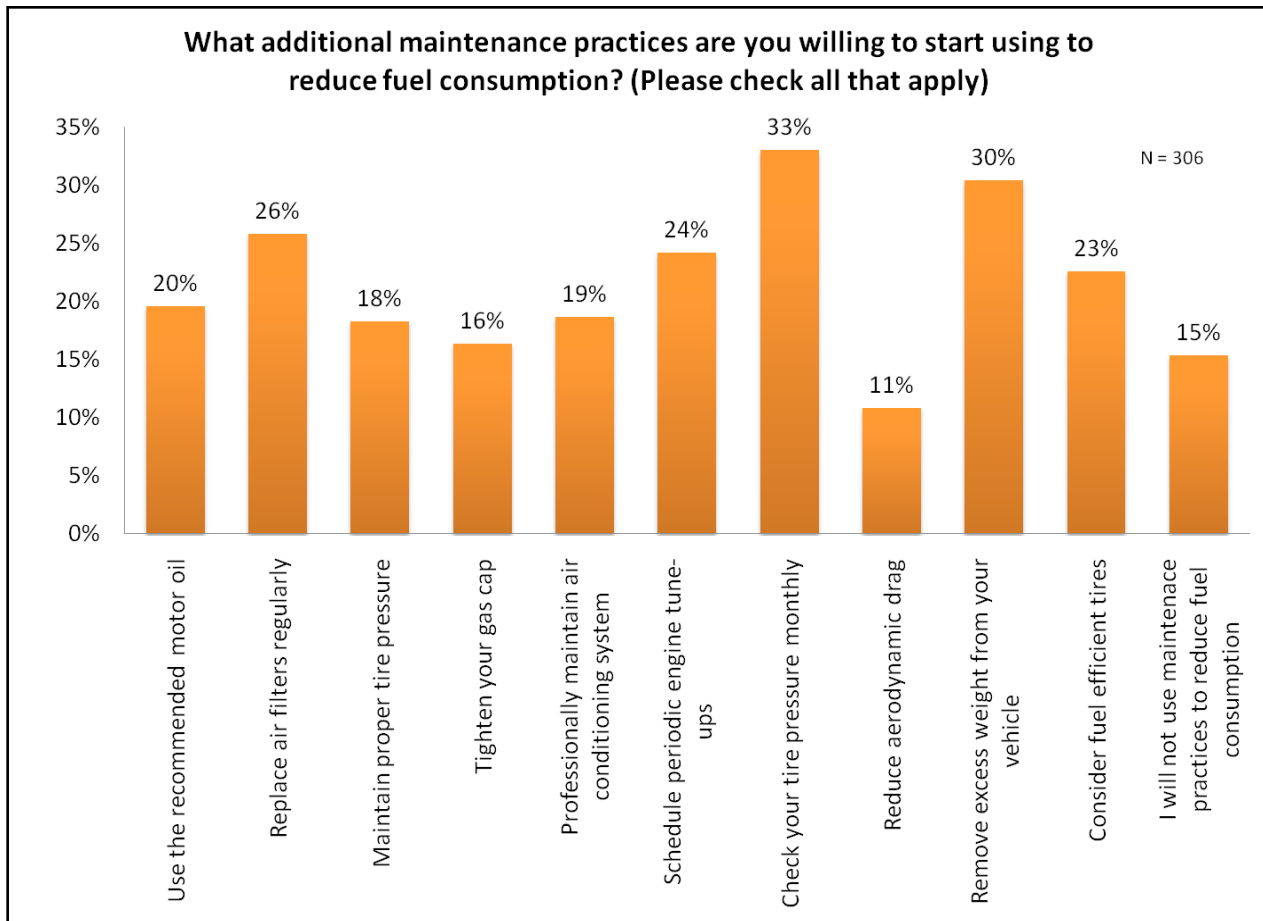


Figure 15. Additional Maintenance Practices Respondents are Willing to Consider

The distribution shows that checking tire pressure monthly was the most common response, followed by removing excess weight from the vehicle. However as with the additional driving practices, the lower percentages exhibited in Figure 15 suggest that there is a limited willingness of people to adopt new maintenance practices without additional incentives.

Overall, the clipboard survey results suggest that people within the Bay Area do make some adjustments to driving behavior and maintenance practices as motivated by fuel economy. But the survey also showed that there was considerable room for improvement. It is important to note that respondents to the short clipboard survey were not given any additional ecodriving information. Rather, the clipboard survey was meant to generate a snap shot of current driving practices within the Bay Area. When taken together, the longitudinal survey and the clipboard survey indicate that people will respond to changing behavior to improve fuel economy to some limited extent, and this response is improved with better information about ecodriving practices.

CONCLUSION

This study assessed the effectiveness of education provided by the EcodrivingUSA™ website. Based on the longitudinal results of approximately 100 respondents from the University of California, Berkeley, the comparison between the control and experimental group suggests that providing information about ecodriving does influence the behavior of some drivers. The reported shifts are statistically significant and evidence of improvement in some drivers is shown from multiple angles in the data. It is clear, however, that not everyone modifies their behavior as a result of static information, and some may do so only in small ways. Respondents given information did alter their behavior in several ways including reducing highway speeds and vehicle idling, as well as accelerating and braking more gradually. Overall, 57% of experimental group respondents increased their ecodriving score. In comparison to the rest of the sample, they were more likely to be female, drive a newer, more efficient car, and live in a smaller household. Respondents more often changed driving behaviors versus maintenance practices as a result of the ecodriving information. The resulting emission reductions, while relatively low in magnitude, are derived from an inexpensive intervention, and thus more cost-efficiently achieved.

Future ecodriving research offers opportunities to explore numerous types of interventions both independent of and in complement to the static ecodriving intervention analyzed in this study. In this respect, emerging research is evaluating dynamic interventions that provide real-time, in-vehicle feedback that coach the driver over time. Such technologies could offer considerable improvements that could be sustained over a longer-time period. This study suggests that static intervention can play a key role in reducing fuel consumption. In particular, a subset of the population is likely to be responsive to static ecodriving interventions, and the resulting reductions in fuel usage would be attained in a cost-effective manner. In concert with other technologies, these interventions could provide greater fuel economy improvements and emission reductions that could be sustained over longer periods.

APPENDIX A: EXPERT/STAKEHOLDER INTERVIEWER GUIDE: PUBLIC EDUCATION, ECODRIVING, AND CARBON FOOTPRINTING

I. Introduction

Hello, my name is XXXX. I am contacting you per our previous arrangement to ask you some questions about your experience with public education campaigns. (Reference telephone conversation or email.)

Before we begin the interview I would like to read this consent form to you and confirm that you agree to participate in this research. (If the interview is in-person, a consent form will be presented, questions answered, and a signature received before proceeding with the interview.)

II. Preliminary Information

- a) Identify name, position, and organization. Years worked for the organization?
- b) Time at which the interview took place.

III. Expert Information

- 1) Can you tell me what public education campaigns you have been involved with?
- 2) What was/is your specific role in these public education campaigns?
- 3) How was the public message determined and how was the exact language developed? (Focus groups, etc.?)
- 4) Do you consider the message successful?
 - a) If yes, why?
 - b) If no, why not and how could it have been improved?
 - c) How did you measure the success of the message?
- 5) What methods did you use to deliver the message?
 - a) Which methods do you consider to be most successful?
 - b) How did you measure success?
- 6) Do/did you use the Internet to distribute your message?
 - a) Do you consider the Internet to be a large part or a small part of your effort to distribute your message? Why?
 - b) What aspects of the websites used to disseminate your message do you consider to be the most successful and why?
- 7) What outreach material was developed and how?
 - a) Did you have a target group in mind? And if not, why not?
 - b) Did you use different methods to reach different groups (age, ethnicity,

- and gender)? If yes, do you think your targeting approach is working?
What targeting approach do you think worked best?
- c) What method of publicity/outreach was the public most receptive to?
- 8) How did you implement your project? Did you have any problems with implementation?
- a) Did you have to obtain any special licenses?
 - b) Did you have to go through any governmental offices?
 - c) Did you coordinate with any local businesses/institutions to help with the campaign? Which ones? Did it help or hinder the success of the project?
 - d) Did you encounter any barriers that you did not anticipate?
- 9) What do you wish you had known about the process of implementing a public campaign before having launched it?
- 10) How much of an impact did you expect to make going into the campaign?
- 11) What types of measurements did you use to evaluate success of the campaign?
- 12) What was the most difficult part of the campaign? What was the smoothest part of the campaign?
- 13) Do you have anything else that you would like to share about the campaign (for instance, lessons learned)?

10. In what year were you born?

Year: _____

11. What is the last level of school that you completed?

- | | |
|--|--|
| <input type="checkbox"/> Grade school | <input type="checkbox"/> Some graduate school |
| <input type="checkbox"/> Some high school | <input type="checkbox"/> Master's degree (MS, MBA, etc.) |
| <input type="checkbox"/> Graduated high school | <input type="checkbox"/> Law Degree (JD, LL.M., etc.) |
| <input type="checkbox"/> Associate's degree | <input type="checkbox"/> Doctoral Degree (PhD, MD, etc.) |
| <input type="checkbox"/> Some college | <input type="checkbox"/> Other, please specify: _____ |
| <input type="checkbox"/> Bachelor's degree | |

12. What was your household's 2009 pre-tax income?

- | | |
|---|---|
| <input type="checkbox"/> Less than \$10,000 | <input type="checkbox"/> \$50,000 to \$75,000 |
| <input type="checkbox"/> \$10,000 to \$25,000 | <input type="checkbox"/> \$75,000 to \$100,000 |
| <input type="checkbox"/> \$25,000 to \$35,000 | <input type="checkbox"/> \$100,000 to \$150,000 |
| <input type="checkbox"/> \$35,000 to \$50,000 | <input type="checkbox"/> More than \$150,000 |
| | <input type="checkbox"/> Decline to Respond |

Thank you very much for completing this questionnaire!

Focus Group Protocol

Pre- Focus Group with Participants:

- Consent form
- Intake questionnaire

5:30-5:40 Introduction:

- Moderator introduction and focus group purpose/overview
- Participant introductions: Please tell the group your first name and what is your primary transportation mode, as well as what other modes you use on a regular basis.

5:40-5:50 General Attitudes and Perceptions:

- In the past few years, have you made changes to your transportation modes or patterns in response to things you have heard about the impact of transportation on climate change?
 - If yes, please tell the group what changes you have made.
- In the past few years, have you made changes to your transportation modes or patterns in response to fuel prices?
 - If yes, please tell the group what changes you have made.
- In the past few years have you made changes to your transportation modes or patterns to reduce costs?
 - If yes, please tell the group what changes you have made.

5:50-6:10 Public Education Campaigns:

- Can you tell me what public education campaigns you can recall? If you cannot recall the exact campaign, can you recall the topic? (Write answers on the board and spend some time trying to remember.)
- Which of these campaigns do you consider successful and why?
- Which of these campaigns do you consider unsuccessful and why?
- Have you personally made any changes as a result of one of these public education campaigns?
 - If yes, can you tell us what changes you have made and why?
 - If no, can you tell us why not?
- Do you know anyone else that has made changes as a result of one of these public education campaigns?
- Of the public education campaigns we have talked about, can you tell me how the message was distributed to the public? (Write answers on the board and spend some time trying to remember.)
- Which of these distribution methods do you consider most successful and why?
- Which of these distribution methods do you consider least successful and why?

- What aspects of public education campaigns do you think are necessary for success?
- Do you have ideas for better methods to distribute information to the public?

6:10-6:25 Internet Public Education Campaigns:

- Have you ever viewed a public education campaign on the Internet? (if not noted above)
 - If yes, can you tell us what the campaigns were and why/how you found the campaign on the Internet?
- Do you consider the Internet a good or bad method to distribute public education messages? Why?
- What do you think would make the Internet a more effective method to distribute public education messages?

6:25-6:30 Break**6:30-7:00 Viewing Carbon Footprinting Websites:**

- Review websites.
- Overall, what do you think of these websites? Were they helpful?
- What suggestions do you have to improve these websites? Make them more useful?
- Is there any information you would like to see included in these websites that you did not see?
- Of the websites that we reviewed, which did you like the best (get vote, if possible) and why?
- What age range do you think these websites would appeal to the most and why?
- Would they make “life” changes based on these website/information?
- Do they think others would make changes based on these websites?

7:00-7:30 Viewing Ecodriving Websites:

- Review websites.
- What information from these websites is useful and why, as well as what information you do not find useful and why?
- Is there information on these websites that you would find useful in your transportation decision making? If yes, what? If no, why not?
- What age range do you think these websites would appeal to the most and why?
- What suggestions do they have to improve these websites?
- Is there any information that you would like to see included in these websites that you did not see?

- Of the websites that we reviewed, which did you like the best (get vote, if possible) and why?

7:30 Dispense Incentives and Adjourn

Carbon Footprinting Websites

<http://www.coolcalifornia.org/>

1. Show participants home page.
 - Scroll over the headings (individual, business, local government, etc.), to show them the drawdown options.
2. Click “Individuals” tab.
3. Click on “Carbon Calculator” on the left hand menu.
4. See if anyone will volunteer to go through the individual calculator with the group (if not, create a profile with the group).
 - Note the “average household” and baseline footprint.
 - Review and input different options for transportation.
 - Click through housing and shopping to get to summary.
 - Scroll slowly through summary to get to “Take Action.”
5. Go to “Take Action” on left hand menu.
 - Provides info on how to reduce emissions.
 - Review the more efficient vehicle and ecodriving options/pledges.

http://www.footprintnetwork.org/en/index.php/GFN/page/personal_footprint/

1. Scroll over the headings to show the drawdown options.
2. Under the “Footprint Basics” tab.
 - Show the participants “Overview” and “World Footprint.”
3. Go to “Footprint for Nations” also under the “Footprint Basics” tab.
 - Show the participants the “Carbon Footprint” on the left column, which goes into a bit more information about what a carbon footprint is.
 - Go to “Personal Footprint” and take the quiz.
4. Take the Quiz (quickly).
 - At the end of the quiz click “explore scenarios” and do one scenario/pledge.
 - Click on FAQ to show them where they can get questions answered about calculator. (It contains a brief description of how the calculator works.)

Ecodriving Websites

www.cleanmpg.com

1. Review the parts of the website.
2. Go to “What is hypermiling?” under the Menu.
3. Click on “hypermile rebottle.”
4. Go to “Articles” next and show the different articles there are, ranging from general hypermiling tips to tips for specific vehicles.
 - Show “beating the EPA.”
 - Scroll through titles (click on one that the participants like).
5. Show participants the “Mileage log” (where members log and keep track of mileage; rank (e.g., Expert) and scroll down a little.

www.ecodrivingUSA.com

1. Show participant’s ecodriving tips in “Be an Ecodriver.”
 - Show the ecodriving video.
2. Go to “EcoCalculator.”
 - Do individual calculation (quickly).
3. Go to “EcoDriving Quiz” and show them associated “quiz leader board” (ranks people who have taken quiz).
4. Go to “Virtual Road Test.”
5. Go to “Community EcoDriving” so they know where they can get info on their own communities/other states.
 - Place cursor over CA.
6. Go to “Educational Tools” to show them the available online and printable education instruments.
 - Point out that they can download additional info.
7. Go to “News and Events” to show them where to get the most updated ecodriving info—Scroll down.

APPENDIX C: ECODRIVING AND CARBON FOOTPRINTING FOCUS GROUP SUMMARIES

FOCUS GROUP CONDUCTED IN BERKELEY, CA ON FEBRUARY 17, 2010

Overview

The purpose of the focus group was for researchers to gain a better understanding of the public's opinions about public education messages and media for delivering the messages, specifically regarding Internet-based carbon footprinting and ecodriving campaigns. A focus group to explore participant responses was conducted at the South Branch Library in Berkeley, California on February 17, 2010, with seven participants from the San Francisco Bay Area. All participants had California driver's licenses and regular vehicle access. A researcher with the Mineta Transportation Institute (MTI) and the Transportation Sustainability Research Center (TSRC) of the University of California, Berkeley facilitated the focus group discussion, while student researchers assisted and took notes. This summary begins with the findings from the pre-focus group survey and continues with a summary of the focus group discussion.

Background Survey Results

At the beginning of the focus group, researchers administered a survey that explored the demographic attributes of focus group participants, attitudes toward climate change and fuel prices, and vehicle make/model information. The demographic attributes of the focus group participants are presented in Table 17.

Table 17. Focus Groups Demographics: February 17, 2010

Gender	Household Type	Age	Educational Level	Household Income
M	Self only	40	Bachelor's degree	\$35K-\$50K
M	Self with spouse/partner	29	Some graduate school	More than \$150K
F	Self only	61	Some college	\$35K-\$50K
F	Self only	49	Bachelor's degree	\$50K-\$75K
F	Self with spouse/partner	37	Master's degree	\$75K-\$100K
F	Decline to state	Decline to state	Decline to state	Decline to state
F	Self with spouse/partner and child(ren)	54	Bachelor's degree	\$100K-\$150K

Participants were asked for the number of vehicles in their household.

- Five reported having one vehicle in their household;
- One reported having three vehicles in his household; and
- One did not own a vehicle, but uses Zipcar (a shared-use vehicle service) a few times per week.

The survey also asked participants to list the make/model and mileage information of their vehicles. This information is presented in Table 18 below.

Table 18. Make/Model and Mileage of Participants' Household Vehicles

Number of Vehicles in Household	Participant 1 Vehicle Make/Model				
0	Zipcar for work: Prefers Toyota Corolla '09 30 MPG				
Number of Vehicles in Household	Participant 2 Vehicle Make/Model	Participant 3 Vehicle Make/Model	Participant 4 Vehicle Make/Model	Participant 5 Vehicle Make/Model	Participant 6 Vehicle Make/Model
1	Toyota Avalon 2009 24 MPG	Honda Accord LX 2003 25 MPG	Nissan 1990 MPG not stated	Honda Civic DX 1999 32 MPG	Honda Civic DX 1998 30 MPG
Number of Vehicles in Household	Participant 7 Vehicle Make/Model				
3	Volvo 1984 20 MPG; VW Passat 2001 20 MPG; Subaru Forester 2001 22 MPG				

The survey probed for an estimate of the number each participant drove annually.

- Three participants drove 5,000 miles per year or less;
- Three participants drove between 5,000 and 10,000 miles per year; and
- One participant did not answer the question.

Next, the survey asked participants to indicate their level of agreement with several comments regarding climate change and fuel costs.

The first statement was: “The earth is currently experiencing climate change.”

- Four participants strongly agreed; and
- Three participants agreed with this statement.

The second statement was: “Human activity contributes to climate change.”

- Three participants strongly agreed; and
- Four participants agreed with this statement.

The third statement was: “Dependence on foreign oil is a serious problem facing the United States.”

- Five participants strongly agreed; and
- Two participants agreed with this statement.

The final statement was: “The cost of fuel is currently too high.”

- Four participants strongly agreed;
- Two participants agreed; and
- One participant disagreed with this statement.

This information is summarized in Figure 16.

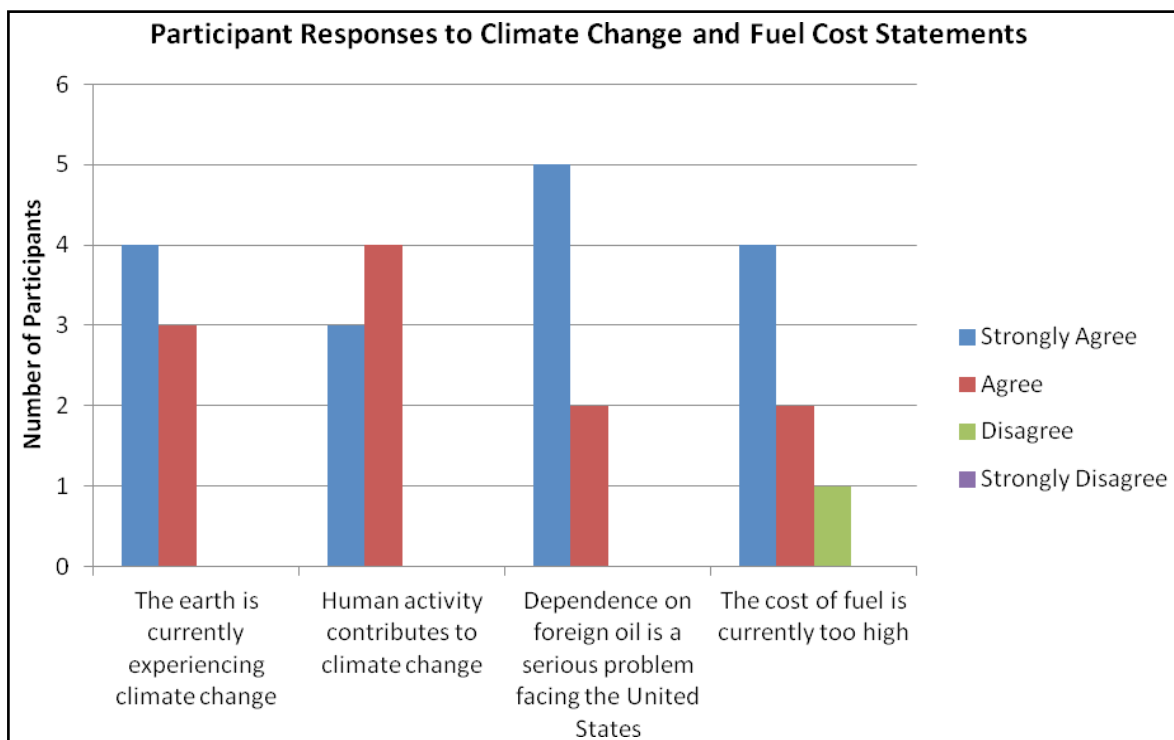


Figure 16. Response to Attitudinal Questions in First Focus Group

Focus Group Discussion Overview

After completing the pre-focus group survey, the moderator provided participants with a brief study overview and initiated the focus group discussion. The discussion began with participant introductions about the transportation modes they use. The moderator then asked participants to share any changes they had made to transportation modes or patterns within the last year, and motivations behind these changes. Next, the moderator led a discussion about public education campaigns that participants remembered. After this discussion, participants were shown four different websites, two about carbon footprinting and two about techniques to drive more efficiently, and asked to critique each one. The focus group concluded with participants' ideas for improving websites used for public education campaigns.

Introduction

Participants were asked about their primary transportation modes and other modes they used on a regular basis.

- Two participants drive to work, but take Bay Area Rapid Transit (BART) into San Francisco or walk when possible;
- One participant primarily bikes and takes BART, but uses Zipcar three days per week for work;
- One participant gets a ride to work from the “casual carpool” and takes BART to return home;
- One participant uses his car or motorcycle frequently, but uses BART or cabs to get to and from San Francisco;
- One participant walks as often as possible, only using the bus, BART, or car when no other options are available; and
- One participant only uses her vehicle for errands and recreation, and BART or bus for travel to work and San Francisco.

General Attitudes and Perceptions

Participants were asked whether or not they had made changes to their transportation modes or patterns in the last few years in response to information they had heard about transportation impacts on climate change.

- One participant did not own a car for four years as a result of concerns about climate change and environmental impact, and just purchased one recently;
- One sold two of his cars and switched to biking as his main form of transportation in response to environmental concerns; and
- Another combined trips when running errands to cut down on her carbon footprint and also retired an older vehicle that she had been driving.

Participants were then asked about changes they had made to transportation modes or patterns in the past few years in response to fuel prices.

- One participant purchased a more fuel-efficient vehicle and stopped “cruising around” in his car. This participant also mentioned that the walkability of the city was an important factor in his decision to reduce his driving.
- One participant stated that she tried to walk for errands closer to home; and
- Another participant stated that fuel costs affected her choice of vehicle when she purchased her car (for example, she wanted one with good mileage).

The last question in this series inquired about any changes they had made to their transportation modes or patterns in the past few years in an effort to reduce costs.

- One participant answered that he chose to drive down to Los Angeles rather than taking an airplane; however, he also noted that this might be more of a convenience issue rather than a price issue.

Public Education Campaigns

The moderator asked participants to name any public education campaigns they could recall. If they could not recall an exact campaign or slogan they were asked to name the topic.

Participants listed the following 13 public education campaigns:

- Spare the Air,
- Bike to Work Day,
- Cash for Clunkers,
- Something similar to Cash for Clunkers,
- First Five California,
- Something similar to First Five California,
- Wash hands,
- Click-It-or-Ticket,
- Don't Litter,
- Smokey Bear – Only You Can Prevent Forest Fires,
- Give a Hoot Don't Pollute,
- Flu shots/H1N1, and
- Critical Mass.

Next, participants were asked which campaigns they considered most and least successful, and why.

Overall, there was a general consensus that campaigns were more successful when a fine or regulation was involved. Several participants found specific campaigns successful.

- One participant thought Click-it-or-Ticket was successful because everyone wears a seatbelt in their car now;
- Another participant thought the success of Click-It-or-Ticket could be attributed to the fine that people had to pay, if they were caught driving without seatbelts;
- One participant named the Smokey Bear campaign because he still remembered it from childhood; and
- One participant believed that Bike to Work Day was successful because some people actually decided to start biking to work after participating in the one-day event.

Most participants found many other campaigns unsuccessful because the campaigns had very little impact on the public and in changing behavior.

- One participant felt that Spare the Air was effective on the days when public transit was free, but was doubtful about the number of people that actually made a permanent behavioral change as a result of it.
- One found Critical Mass to be counter effective, as it often irritated drivers and nurtured more hostility than understanding.
- One participant stated that she did not believe any of the listed educational campaigns were successful. She specifically referred to Stop Smoking as an example of a campaign where the law would be more effective because people did not stop smoking as a result of the campaign.

Participants were then asked if they had made any changes as a result of a public education campaign or if they knew of anyone that had made changes.

- One participant saw a campaign promoting helmet use when riding a motorcycle, but thought it would only become effective when it became a law; and
- One participant mentioned wearing her seatbelt more often now as a result of Click-It-or-Ticket. However, she was not sure if her motivation to do so was a result of her awareness of the consequence of not wearing her seatbelt or the fine she could incur.
- Another participant commented that people are motivated to change their behavior only if they see that not changing it will affect them personally (for instance, when money and law are involved).

The last general comments on this topic explored other motivations people had for changing their behavior.

- One participant expressed her observation that public education campaigns take a really long time to affect behavior, citing “Don’t Litter” as an example;

- Two participants agreed that societal changes and pressures played a role in affecting behavioral change on a larger scale (for example, strangers yelling at people for littering); and
- One participant thought that the type and ease of the desired behavioral change affected the effectiveness of campaigns (for instance, “easy” actions like putting on a seatbelt are more successful than something else that would take more effort).

Next, the moderator asked participants to recall the methods that were used to distribute the campaigns to the public and which methods they thought were most successful or unsuccessful.

- Participants mentioned television, the media, the Internet, signs on BART and in bus shelters, and radio as distribution methods. One participant also mentioned schools as a means of distributing public education campaign messages.
- Methods that were considered successful included school, television, word of mouth, peers, and signs on BART and the bus. However, several participants noted that the best method to distribute a public message depended on the specific audience that was targeted. Again, one participant mentioned that the law and a fee or penalty was most effective to support a campaign.
- Methods that were considered least successful included leaflets, telephone calls, and the Internet. A few participants considered the Internet unsuccessful because they felt that no one specifically searches for public education campaigns and would therefore rarely be exposed to them by chance. Generally, participants disapproved of any promotion materials that were long in length or required too much reading.

Participants were then asked for their opinions about any aspects of public education campaigns that they thought were necessary for success.

- All participants agreed on the need for strong visuals for the campaign to be “catchy,” as well as the clear communication of the consequences of not performing the action promoted in the campaign;
- Participants all agreed that images that would make a big impact and leave a lasting impression were necessary, including negative visuals;
- One participant mentioned that monetary fines and rewards (for example, a tax refund) would be good incentives to affect change through a public education campaign;
- One participant also mentioned the need for graphics and music; and
- Another mentioned the need for a good slogan.

Participants were then asked about any ideas they had for better methods to distribute public information.

- In addition to rewards and fines, several participants thought that constant repetition was important for success;

- One participant conceded that repetition was annoying, but it was effective at helping the public remember campaigns;
- Two mentioned the need for marketing strategies in public education campaigns and the usefulness of having sufficient funds to hire professionals to design the campaigns; and
- Another thought that illustrating the consequences for not paying attention to the public campaign message would be helpful.

Internet Public Education Campaigns

The moderator asked participants about their experiences with Internet public education campaigns.

Participants named the following public education campaigns they had seen on the Internet:

- Faces of Meth, which was initially on the Internet, but was also shown on television;
- British campaign to prevent texting while driving, which included a strong visual, viewed on Youtube;
- Food Pyramid found when searching for nutrition information;
- HIV/AIDS awareness;
- Fundraising for cancer (for example, Live Strong); and
- Free rice, an online game that donates food to end world hunger.

Participants were then asked if they considered the Internet a good or bad method to distribute public education messages.

- Overall, the participants did not think of the Internet as a good way to distribute public education messages. Several mentioned the “hit or miss” nature of Internet public education campaigns, noting that people would need to be actively looking for, or already have an interest in the topic to find a public education message on the Internet.
- Most participants agreed that certain generations might have more exposure to Internet campaigns as a result of their different searching habits (for example, younger people might see more because they watch online videos more than older people); and
- One participant mentioned not knowing what form a public education campaign would take on the Internet (for instance, a pop-up window, sidebar, or advertisement).

At this point, one participant answered that she viewed public education campaigns as ads. The moderator continued this line of discussion and asked participants if they would pay attention to an ad if they saw it online.

- Two participants stated that they only focus on their specific search and pay little attention to ads and other announcements when on the Internet;

-
- Other participants discussed the need for public education ads to be able to catch a person's immediate interest to get them to click on a link/ad;
 - One participant said that she would look at it if it was clever;
 - Another agreed that if it were very visual and had an unusual or bizarre image ("really good hook"), she would click on it;
 - One participant also mentioned placing ads so that they were related to specific search queries that users entered, making ad placement more effective;
 - All participants agreed that visual and catchy was necessary; and
 - Several participants brought up the issue of sponsored placement among search results—for example, if a link to the public education campaign showed up within the first 10 results of a search engine, many of the participants would overlook it and assume it to be a sponsored result of that search engine.

Finally, participants were asked for their thoughts on making the Internet a more effective method to distribute public education messages.

- Two participants thought the Internet would be effective, if the public education message was short and displayed just prior to an online video (similar to an ad preceding a "YouTube" clip). The participants noted that the public education message would have to be short enough so a person would still find it worthwhile to sit through, while being entertaining enough to keep the person from changing websites.
- Another participant thought too much commercialization of a public education message might cause some people to be less receptive because it would no longer be perceived for the common good.
- Participants agreed that it was important to use marketing techniques to create good public education campaigns, but it was important not to appear to be selling something.
- When asked for an example of a type of public message campaign that would hold the audience captive, one participant volunteered a Smokey Bear campaign in which the audience is introduced to a beautiful forest that suddenly goes into flame and smoke and ends with the slogan of the campaign. The participant stated that this was an "in and out message that was rather enjoyable."
- Several participants liked the idea of using celebrities to increase the effectiveness of public education campaigns.
- One participant brought up another public message campaign featuring everyday people as heroes conserving water and explained how the simple message resonated with her by showing her simple actions that she could take.
- One participant also mentioned money as a motivator to cause change.
- Another again mentioned that recommendation by peers or word of mouth as an effective means of spreading Internet public education campaigns.

WEBSITES

During the second half of the focus group, participants were asked to view four websites. The first two websites contained content regarding carbon footprinting, and the last two websites contained information regarding techniques for driving more efficiently. After viewing each set of websites, participants were asked to critique them and choose the one they preferred.

Carbon Footprinting Websites

The first carbon footprinting website provided resources about climate change for individuals, small businesses, local governments, youth, community organizations, and schools. Participants were shown the pull down menus under each of these categories to give them an idea of the type of information offered. Participants were then taken through the carbon calculator on the website, which calculated a carbon footprint based on questions about the individual's transportation, housing, and shopping. The calculator required the test taker to input numbers for each of the characteristics that were measured. Results were expressed in metric tons of CO₂ per year. The calculator also generated a list containing tips for reducing personal carbon footprints at the end of the calculation. The savings achieved by following these suggestions were shown in measurements of metric tons of CO₂ and dollars.

Several comments were made about the first website.

- All participants agreed that the carbon footprint calculator was too long and asked for information that would be hard to enter without having to reach for a bill or search through records;
- Participants liked the list of suggestions at the end of the calculator because the suggestions motivated people with potential cost savings; and
- One participant felt that the money saved was more of a motivation than the environmental savings expressed in tons of carbon.

The second carbon footprinting website featured more background information about climate change and different types of environmental footprints. It also featured an interactive carbon calculator that used housing, food, garbage, and transportation information to generate a carbon footprint number. This calculator was similar to a video game, giving users the ability to create their own "avatar" that was then placed in an environment that developed more as the user went through the calculation. The calculator also allowed participants to enter an overall basic response or a more detailed response to questions. Users entered their answers via sliding bars instead of inputting numbers. Results were given in measurements of earths necessary to support such a lifestyle. At the end of the quiz, users were given the chance to pledge to undertake specific actions that would reduce their footprints. The impact of these pledges was given in measurements of acres and fields. The website also featured a FAQ section explaining how the mechanisms worked behind the calculator.

Participants shared a number of opinions about the second website.

- One participant liked the sliding bar since it made it unnecessary to type in a number;
- Another participant liked the option of inputting a quick response or a more detailed answer;
- One participant expressed concern about not being able to turn off the music that accompanied the application;
- One commented that people who visit the site are already interested in and borderline obsessed with the topic of carbon footprinting;
- Another stated that he would not go through the calculator because it was too much work, but that he would visit the website if it had upfront information (versus having to complete the quiz) about tax rebates and monetary incentives that he could obtain as a result of making changes to his lifestyle; and
- Two participants also commented on the connection between economics and environmental concerns—if people did not have to worry about their next paycheck, they would have more time to worry about the environment.

Participants were then asked about their overall impression of both websites. Participants mainly shared their opinions about the second website.

- One participant thought the second website was “cool,” but that she would also have to wait until she had more time before trying to go through the calculation;
- Others voiced similar opinions, noting that the websites had too many words, the calculators were too long, and that people were too busy to take the quizzes;
- One liked the animation; and
- Another noted that people who were not already concerned about their carbon footprint would never get to the website.

Participants were asked about suggestions for improving the two websites and any additional information they would like included.

- One participant wanted the results expressed as a comparison between someone in the U.S. and another part of the world to better illustrate the size of the impact people in the U.S. are making, and consequently, to better appreciate the effect of each small behavioral change;
- Two wanted to see how much progress has already been made based on certain behaviors that have changed in response to concerns about the environment (for instance, how many energy saving light bulbs have been put in, how many people are now riding bikes); and
- All participants agreed that calculator results should be presented in measurements of earths or days till the earth dies since these measurements hold more meaning for most people than land area measurements.

Finally, participants were asked to pick the best website, identify the targeted age range, and if they would make any “life” changes based on the two websites.

- All participants preferred the second website due to the better graphics.
- When asked about the targeted age range, one participant thought that the website targeted 20 year olds; one participant felt that the website would be flashier if it targeted 20 year olds; and one participant felt that it targeted old, rich people because 20 year olds who just graduated would be more concerned about money.
- When asked if they would make any changes in their own lives, one participant responded that she would think about different aspects of the calculator results, if she had the time to go through the calculations; and some participants agreed that the websites would have to be more graphic and use scare tactics to cause any changes in people’s lifestyles.

Ecodriving Websites

The first ecodriving website contained information about hypermiling. Its format reflected that of a forum, with a small, left-hand menu and lots of text and discussion links on the homepage. Participants were shown sections of the website that defined hypermiling, provided arguments against hypermiling, and contained articles featuring tips on how to achieve better mileage than the EPA rating. Participants were also shown a mileage log where members are able to log their best mileage and participate in a ranking system.

Overall reaction to this website was negative. Comments included:

- Poor design, bad website format, and that one would need to have a lot of free time to navigate the website.
- One participant said that he would lose his credibility, if he sent this link to friends, as it was not a “cool” site.

The second website featured a flash-based interface and a home page with a video of Governor Arnold Schwarzenegger. Participants were shown a section of the website on becoming an “EcoDriver” that contained a video about ecodriving. Participants were also shown sections with a very short carbon calculator, an ecodriving quiz, a virtual road test, community resources and education tools, and news and events.

Participants shared their reactions to this second website.

- All participants liked the video. Some specific comments included: “really good,” “interesting,” and “it was really thought out;”
- Participants also liked that the video put the concepts into simple terms that anyone could easily follow;
- One participant would be more interested in the ecodriving game, if there were mouse controls rather than key controls;
- One liked the money graphic that was shown at the end of the calculator; and

- One participant mentioned that the calculator could be more attractive and perhaps use a sliding bar instead of spaces for inputting numbers.

Participants were then asked about their overall impressions of this second set of websites.

- One participant liked the video on the second website because it explained ecodriving in a simple way.
- Another felt the first website had too much text and was overwhelming and cluttered, while the second one was clean, well laid out, and nicely presented.

Participants were asked which ecodriving website they preferred and which of the four websites they liked best.

- All participants indicated a preference for the second ecodriving website for both questions.

Participants were also asked about information from these last two websites that they did or did not find useful.

- Participants generally found the last website to be useful, particularly the video, due to the immediacy of the information (for example, how much money saved) and that only small lifestyle changes were suggested rather than larger ones on other websites;
- One participant commented that one had to already be interested in the subject matter since there was so much information in the video on the last website; and
- Another did not find the articles on the third website helpful, while the video on the last website had a lot of information about simple things she could do, giving her the sense that she should do them since they were such small changes.

Participants were asked if they would find any of the information from the four websites (but particularly the last two) useful in their transportation decision making.

- Most participants wanted to follow the tips on the last website's video since they were simple and only required small behavioral changes.
- One participant mentioned having calculated her footprint based on a different calculator she had found that was in a checklist format. She liked the format because checking off behavioral changes she had already accomplished made her feel like she was doing something right. When asked why she had gone to that website, she said that she had been looking for it and again voiced concerns about websites being "dot-coms" or something commercial that would try to sell her something.

Participants were then asked about the age range they thought these websites would appeal to most.

- One participant said the first of the last two websites was targeting older people because there was too much information—it would not provide the immediate gratification that younger people want;
- One said that the second website in the first set of carbon footprinting websites had a sponsorship ad that turned her off to the website;
- Another felt the second of the ecodriving websites was for kids and families because it was not fast enough for young adults; and
- One person commented that it was necessary to target the younger population to save the environment, and websites should be catchier for this reason.

Participants were also asked about any information they wanted to see included but did not find in the last two websites.

- One participant commented that nothing, including these websites, was going to change the way she drives since driving has become a habit for her; and
- Another agreed, noting that these types of campaigns should be targeted towards younger people who are more likely to change their behaviors.

Finally, participants were asked about any tips they recalled from the last website that they would be willing to try.

- Several participants said that they would now use air conditioning when driving above 40 mph; and
- One participant stated that she would now check the tire pressure, gas cap, and try to drive the speed limit.

Closing

The moderator asked participants for any final thoughts they had regarding the information that had been covered in the focus group discussion.

- One participant thought there should be information about public transportation on the last website and felt the auto manufacturer sponsors might be the reason public transportation options were not included; and
- Another thought it would be good to target kids since they are easier to appeal to, they are in a learning mode, and they spend a lot of time on the Internet.

FOCUS GROUP CONDUCTED IN BERKELEY, CA ON FEBRUARY 25, 2010

OVERVIEW

The purpose of the focus group was for researchers to gain a better understanding of the public's opinions about public education messages and media for delivering the messages, specifically Internet-based carbon footprinting and ecodriving campaigns. A focus group to explore participant responses was conducted at the West Branch Library in Berkeley, California on February 25, 2010, with six participants from the San Francisco Bay Area. All participants had California driver's licenses and regular access to vehicles. A team researcher facilitated the focus group discussion, while student researchers assisted and took notes. This summary begins with the findings from the pre-focus group survey and continues with a summary of the focus group discussion.

Background Survey Results

At the beginning of the focus group, TSRC researchers administered a survey that explored the demographic attributes of focus group participants, attitudes toward climate change and fuel prices, and vehicle make and model information.

The demographic attributes of the focus group participants are presented in Table 19.

Table 19. Focus Group Demographics: February 25, 2010

Gender	Household Type	Age	Educational Level	Household Income
M	Self only	39	Bachelor's degree	\$35K-\$50K
F	Self only	43	Some graduate school	More than \$150K
F	Self only	58	Some college	\$35K-\$50K
F	Self with spouse/partner	47	Bachelor's degree	\$50K-\$75K
M	Self with child(ren)	59	Master's degree	\$75K-\$100K
F	Self only	72	Decline to state	Decline to state

Participants were asked for the number of vehicles in their household.

- Three reported having one vehicle in their household;
- One noted having two vehicles in his household;
- One reported having four vehicles in his household; and
- One declined to respond.

The survey also asked participants to list the make/model and mileage information of their vehicles. This information is presented in Table 20.

Table 20. Make/Model and Mileage of Participants' Household Vehicles

Number of Vehicles in Household	Participant 1 Vehicle Make/Model	Participant 2 Vehicle Make/Model	Participant 3 Vehicle Make/Model
1	Honda Civic 1996 27 MPG	Toyota Corolla 2004 31 MPG	Pontiac Grand Prix 2008 21 MPG
Number of Vehicles in Household	Participant 4 Vehicle Make/Model		
2	Toyota Prius 2002 40 MPG; Mazda Miyata 1998 30 MPG		
Number of Vehicles in Household	Participant 5 Vehicle Make/Model		
4	Honda Civic 1989 36 MPG; Toyota Pickup 1986 25 MPG; Toyota Pickup 2007 18 MPG; Honda Motorcycle 1986 65 MPG		
Number of Vehicles in Household	Participant 6 Vehicle Make/Model		
Decline to Respond	Decline to Respond		

The survey probed for an estimate of the number each participant drove annually.

- Four participants drove 5,000 miles per year or less;
- One drove more than 10,000 miles per year; and
- One participant declined to respond.

Next, the survey asked participants to indicate their level of agreement with several comments regarding climate change and fuel costs.

The first statement was: "The earth is currently experiencing climate change."

- Three participants strongly agreed; and
- Three agreed with this statement.

The second statement was: "Human activity contributes to climate change."

- Three participants strongly agreed;
- Two agreed; and
- One participant disagreed with this statement.

The third statement was: “Dependence on foreign oil is a serious problem facing the United States.”

- Four participants strongly agreed; and
- Two agreed with this statement.

The final statement was: “The cost of fuel is currently too high.”

- One participant strongly agreed;
- Two agreed;
- Two disagreed; and
- One participant strongly disagreed with this statement.

This information is summarized in Figure 17.

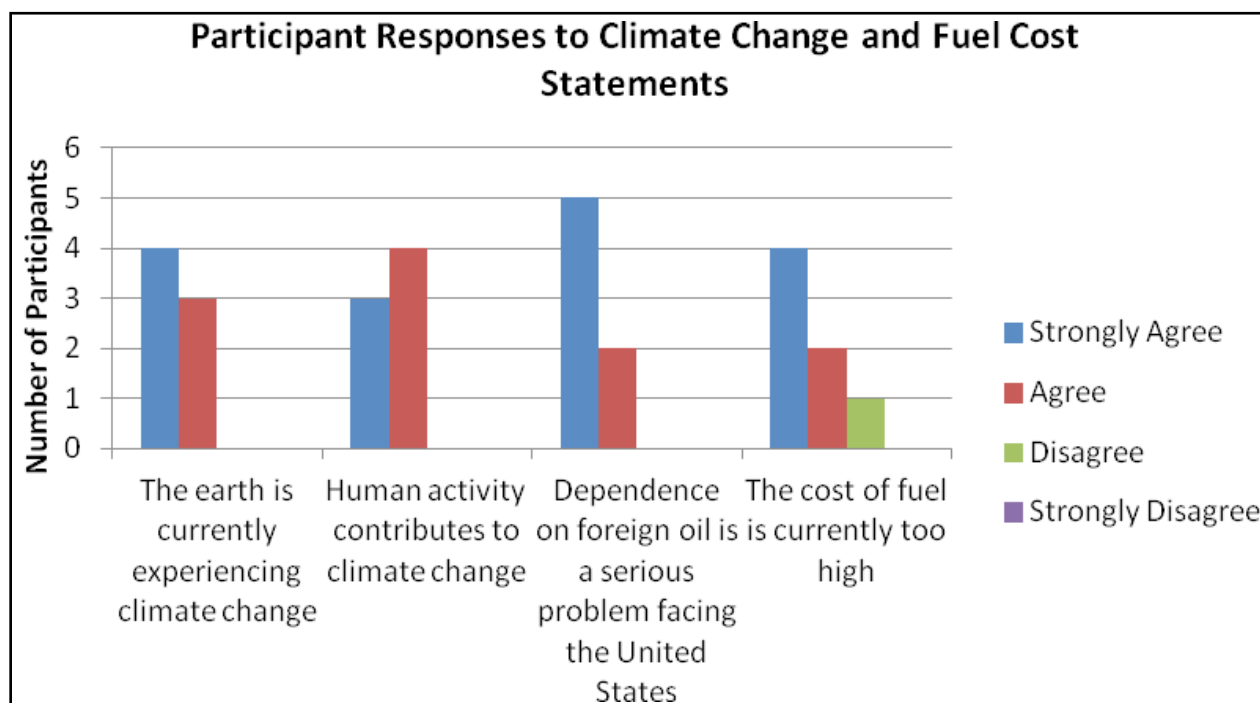


Figure 17. Response to Attitudinal Questions in Second Focus Group

Focus Group Discussion Overview

After completing the pre-focus group survey, the moderator provided participants with a brief study overview and initiated the focus group discussion. The discussion began with participant introductions about the transportation modes they use. The moderator then asked participants to share any changes they had made to their transportation modes or patterns within the last year and motivations behind these changes. Next, the moderator led a discussion about public education campaigns that participants remembered. After this, participants were shown four different websites, two about carbon footprinting and two about techniques to drive more efficiently, and asked to critique each one. The focus

group concluded with participants' ideas for improving websites used for public education campaigns.

Introduction

Participants were asked about their primary transportation modes and other modes they used on a regular basis.

- One participant always uses her car since she does not like public transportation;
- One primarily drives, but also walks and sometimes bikes;
- One primarily used her car until it broke down two weeks prior, but now walks, bikes, and takes the bus;
- One splits her transportation use between car and Bay Area Rapid Transit (BART), with occasional bus use;
- One splits his transportation use between car and bicycling, with some walking and occasional BART trips to the city; and
- One participant uses BART for 60 to 70 percent of her transportation use and a car for all other trips.

General Attitudes and Perceptions

Participants were asked whether or not they had made changes to their transportation modes or patterns in the last few years in response to information they had heard about transportation impacts on climate change.

- One participant has been consolidating her errands for years to avoid making so many trips;
- Another participant also tries to complete as many errands as possible in one trip; and
- One participant now takes the bus for errands for environmental reasons, but also because he now has more time available.

Participants were then asked about changes they had made to transportation modes or patterns in the past few years in response to fuel prices.

- One participant reduced the number of trips she takes to Los Angeles to visit family, and takes a bus instead of driving;
- One participant tries to ride his bike more; and
- One participant ended up taking BART more often when his company increased commuter check benefits by 30 percent in response to increased gas prices.

The last question in this series inquired about changes the participants had made to their transportation modes or patterns in the past few years in an effort to reduce costs.

- One participant felt that bus fares are frequently raised and uses this as a motivation to walk more; and
- One participant said that her transportation modes and patterns have not changed.

Public Education Campaigns

The moderator asked participants to name any public education campaigns they could recall. If they could not recall an exact campaign or slogan, they were asked to name a topic.

Participants listed the following 13 public education campaigns:

- Bike to work day,
- Walk or bike to school day,
- Bay Bridge construction–planned closure,
- Anti-smoking,
- Mothers Against Drunk Driving (MADD),
- British campaign to reduce texting while driving,
- Teen pregnancy,
- HIV prevention (several targeted toward different communities),
- Smokey Bear,
- Same sex marriage messages (in relation to an election initiative),
- McGruff the crime dog–Take a bite out of crime,
- Hang up and drive campaign,
- Native American crying from his land being polluted,
- Spare the Air, and
- Click-it-or-Ticket (versions in Seattle, Washington D.C., Florida, Texas).

Next, participants were asked which campaigns they considered the most and least successful, and why.

Several participants found specific campaigns successful.

- One participant found the Bay Bridge closure particularly successful since people were warned up to six months in advance, and many resources were available for people who wanted more information;
- One participant thought Click-it-or-Ticket was successful because campaign signs were posted everywhere;
- Another thought Click-it-or-Ticket was successful because the law included a fine for driving without a seat belt;

- One participant found Click-it-or-Ticket successful because it was easy to comply with;
- One participant thought Spare the Air was somewhat successful because she could tell that there was less pollution and better air quality in certain areas, such as Aquatic Park in Berkeley;
- A participant also noted that the BART system was noticeably more crowded on Spare the Air days, although he felt the campaign was more effective on the days when BART was free;
- One participant mentioned that more people were biking now;
- Another commented that the increased number of cyclists was initially a reaction to the increasing fuel prices, but that many people continued to bike even after fuel prices fell;
- One thought that teen pregnancy campaigns were successful because the teen pregnancy rate had gone down;
- Two participants conversely mentioned that the teen pregnancy rate had just gone up in the last year; and
- One noted that public education campaigns should be different for different regions and demographic profiles.

Most participants found many other campaigns unsuccessful.

- Several participants felt that MADD was not successful since so much drunk driving still happens;
- One participant thought the HIV/AIDS campaigns were unsuccessful because she had heard reports of HIV increasing in the U.S.;
- One felt that the hang up and drive campaigns were unsuccessful because phone companies keep developing different techniques to help keep drivers talking; and
- Another was concerned some campaigns were successful while active, but that people revert to their previous behavior once the campaign is over. This individual thought this was the case with hang up and drive, HIV/AIDS, and teen pregnancy.

Participants were then asked if they had made any changes as a result of a public education campaign or if they knew of anyone that had made changes.

- One participant no longer drives and talks on her mobile phone; however, she never liked doing so to begin with.
- Another had already received a ticket for not using her seatbelt and has changed her behavior slightly by making it appear that she is wearing a seatbelt without actually clicking it in.
- One now uses a speakerphone when he is driving to comply with the law and avoid a fine. He also recognizes the danger in using a mobile phone while driving.
- One said that McGruff the crime dog taught him that he should tell someone, if he sees that something is not right. He also mentioned that *when* he saw it (during

Saturday morning cartoons in his youth) may have been just as responsible for its effectiveness as the actual campaign message.

- One participant said that Smokey Bear stopped her from smoking.
- Another participant said that Smokey Bear still had an impact on him even though he was a smoker and said that he still looks for puddles for putting out his cigarette. He also added that the image from the “Indian crying over his polluted land” campaign has stayed with him over the years.
- Another mentioned that information her daughter had brought back from school taught her about the negative effects of smoking and led her to quit smoking.
- One participant also mentioned the effect of the same sex marriage campaigns had on his friend’s voting decision.

Next, the moderator asked participants to recall the methods that were used to distribute the campaigns to the public and which methods they thought were most successful or unsuccessful.

- Participants mentioned television, billboards, people standing with signage, radio, bumper stickers, signs in stores and other venues, the Internet, and signs on BART and in bus shelters.
- Methods that were considered successful included television, billboards, and service announcements via television and radio (not a commercial or advertisement). One participant mentioned not watching television, but that if the campaign announcement was a news item, he would watch it on television. Another participant also cited Contra Costa County’s “keep our waterways clean” advertisement featuring a dirty dog as an example of how effective a message could be if the public could relate to it.
- Methods that were considered least successful included junk mail and direct calling. One participant commented that he did not think there was a “most” effective method for distributing information because this would vary depending on the targeted audience.

Participants were then asked for their opinions about any aspects of public education campaigns that they thought were necessary for success.

- One participant mentioned the need for frequency; and
- Most agreed that the campaign message had to be attention grabbing, “catchy,” and memorable with use of strong visuals. Several anti-smoking ads and billboards were referred to as examples (for example, a woman with a hole in her throat and a female reaper passing out cigarettes).

Participants were then asked about any ideas they had for better methods to distribute public information.

- One participant felt messages had to be displayed on the Internet to reach younger people, since younger people spend their time on “Facebook” or texting;

- One mentioned that something could be posted on “YouTube” and “go viral” (meaning, it spreads like wildfire across the Internet) at no cost; and
- Another agreed, but also mentioned the issue of privacy, if information about website viewers was needed before websites were able to determine what type of public message to display. This individual also mentioned that distribution methods would have to vary depending on the target audience.
- One participant suggested product placement in movies, and another thought trailers with DVDs that could not be skipped might be effective.

Internet Public Education Campaigns

The moderator asked participants about their experiences with Internet public education campaigns.

Participants named the following public education campaigns they had seen on the Internet:

- British texting and driving prevention campaign with a graphic ad, viewed on “YouTube;”
- Bay Bridge closure;
- Bike to work; and
- Partnership for Drug Free America, seen as a logo, not as part of a campaign.

One participant mentioned having seen messages as pop-ups on news websites, but not on websites like “Facebook” or “Twitter.”

Participants were then asked if they considered the Internet a good or bad method to distribute public education messages.

- One participant answered that the Internet was not a good method right now, but people were working hard to make it better;
- Another said that it would be a good method, if viewers could not refuse pop-ups;
- One mentioned that parents can make viewing a public education message a condition of watching television or going online and agreed that this would require parental intervention;
- One commented that he never looks at ads on the top or bottom of a web page, but if the campaign message was made as a news item, he would look at it; and
- One participant mentioned that the Internet was a good method because it allowed people to find information about a message, if they wanted.

Finally, participants were asked for their thoughts on making the Internet a more effective method to distribute public education messages.

- One participant commented that site designers had to stop “over engineering” their websites and cut down on the number of graphics so people can access information quicker; and
- Another said that visitors should not be required to enter any personal information before getting to the information they are looking for.

WEBSITES

During the second half of the focus group, participants were asked to view four websites. The first two websites contained content regarding carbon footprinting, and the last two websites contained information regarding techniques for driving more efficiently. After each set of websites, participants were asked to critique them and choose the one they preferred.

Carbon Footprinting Websites

The first carbon footprinting website provided resources about climate change for individuals, small businesses, local governments, youth, community organizations, and schools. Participants were shown the pull down menus under each of these categories to give them an idea of the type of information offered. Participants were then taken through the carbon calculator on the website, which calculated a carbon footprint based on the parameters of transportation, housing, and shopping. The calculator required the test taker to input numbers for each of the parameters. Results were expressed in metric tons of CO₂ per year. The calculator also generated a list containing tips for reducing personal carbon footprints at the end of the calculation. The savings achieved by following these suggestions were shown in measurements of metric tons of CO₂ and dollars.

The second carbon footprinting website featured more background information about climate change and different types of environmental footprints. It also featured an interactive carbon calculator that used housing, food, garbage, and transportation information to generate a carbon footprint number. This calculator was similar to a video game, giving users the ability to create their own “avatar” that was then placed in an environment that developed more as the user went through the calculation. The calculator also allowed participants to enter an overall basic response or a more detailed response to questions it asked. Users entered their answers via sliding bars instead of inputting numbers. Results were given in measurements of earths necessary to support such a lifestyle. At the end of the quiz, users were given the chance to pledge to undertake specific actions that would reduce their footprints. The impact of these pledges was given in measurements of acres and fields. The website also featured a FAQ section explaining how the mechanisms behind the calculator worked.

Participants were then asked about their overall impression of both websites.

- One participant liked the first website because of the background and bigger icons, but felt that the second website had too many words and amateur graphics that would not make kids want to spend time on it;
- One liked that the first website gave enough feedback for each parameter it used to calculate a carbon footprint;
- One liked the first site because viewers could vary their answers to questions and see immediate results, allowing them to see how their carbon footprints would change in response to different behaviors; and
- One participant thought the first website was easier to use.
- Participants voiced doubts about people taking the time to view the websites.
- One participant expressed concern about how to get younger people on either of the websites and doubted that it was possible unless it was part of a mandatory class;
- One felt that only people who already care about the earth would go to the websites;
- Another thought that these campaigns should be advertised in areas where people would already be receptive to these kinds of messages (for instance, Berkeley Bowl or Trader Joe's), since people were not going to find these websites when surfing on the Internet; and
- One participant felt that neither website applied to her since she already used so few resources and did not need the websites to tell her anything new.

Participants were asked about suggestions for improving the two websites and any additional information they would like to include that would be helpful.

- One participant did not like the use of Flash on the websites because it was too slow and would not run on smartphones, like the iPhone. Another participant agreed, and he also suggested that the websites use a contest to attract younger people.
- One participant commented on the idea of the “typical consumer” and the need for Internet public education campaigns to define their audience. This individual noted that Berkeley residents might not be “typical.”

Participants were asked to pick the best website. Three preferred the first website, and three preferred the second website.

- One participant liked the first one better because she felt the second one was oversaturated with information;
- One did not like either website, but felt that if she had to choose, she would select the second one because it got her attention due to its similarity to a book she had read;
- Another also liked the second one more because it was more memorable to her than the first one; and
- One participant liked the second one, but was frustrated about not being able to see the effect of each of the variables on his total budget of earth on the quiz. He

wanted to see the impact of each variable so that he could figure out what changes would have more of an impact on his total footprint (for example, if eliminating meat consumption has a greater impact than biking more often). Also, he felt that the second website was a bit slow.

Finally, participants were asked to identify the targeted age range, and if they would make any “life” changes based on the two websites.

- One participant thought that the websites targeted 40-year olds and up.
- One said graduate students in general (regardless of age) because these people would be more interested in analyzing their energy use. This individual also suggested showing an annual dollar budget or tons of CO₂ on the side of the quiz.
- One person thought that younger people would be discouraged from returning to the quiz on the second website because of how long it took to get to it, and they might love it or hate it because of the quality of graphics used. He also commented that the demographics interested in this website might not line up by age.
- Another thought that blue collar workers would be interested in these websites and suggested focusing on monetary savings to attract more people to the website. Another participant agreed.
- When asked if they would make any changes in their own lives, one participant responded that he already had done so as part of a team building exercise at work to determine who needed the most earths to sustain their lifestyle. Results had an immediate impact on him and led him to take BART more often. Another commented that it would be good to expose his daughter to these websites and that she would likely make changes in response to them.

The moderator then asked for any final comments about the first two websites.

- Several participants agreed that people would have to already be interested in these issues to visit these websites and were not sure how to attract persons that did not share these types of concerns. One participant said these websites were a bit like “singing to the choir.”

Ecodriving Websites

The first website contained information about hypermiling. Its format reflected that of a forum, with a small, left-hand menu and a lot of text and discussion links on the homepage. Participants were shown sections of the website that defined hypermiling, provided arguments against hypermiling, and contained articles featuring tips on how to achieve better mileage than the EPA rating. Participants were also shown a mileage log where members are able to log their best mileage and participate in a ranking system.

The second website featured a flash-based interface and a home page with a video of Governor Arnold Schwarzenegger. Participants were shown a section of the website on becoming an “EcoDriver” that contained a video about ecodriving. Participants were also

shown sections with a very short carbon calculator, an ecodriving quiz, a virtual road test, community resources and education tools, and news and events.

Participants were then asked about their overall impressions of this second set of websites, and which of the two they preferred.

Two participants liked the first website.

- One participant liked the first site best because she liked the mention of gasoline-electric hybrid cars and had an interest in purchasing one; and
- Another liked the first one because it had information she was interested in.

Three participants liked the second website.

- One participant said it caught her interest and taught her something she could easily do, like unload her car;
- One liked the video on the second website; and
- Another participant liked the second website because it was applicable to everyone and had graphics of dollars that appropriately showed the effect vehicles could have on each individual's savings.

One participant liked both websites. He liked the first website, but was not sure that anyone except car mechanics and people with an interest in cars would view it. He liked the responsive graphics, good video, and tips on the second website, but did not quite trust it because of the car company sponsors.

Participants were also asked about information from these last two websites that they did or did not find useful.

- One participant thought the second website had a lot of useful information because she wanted to know which car had the best mileage;
- Another thought the second site was useful because it gave feedback in dollars;
- One felt that the second website was educational and reinforced information that she already knew (for instance, removing extra items from car) and made her decide to unload her vehicle;
- One participant, despite his reaction to sponsors, felt that the second website had tips that would be educational and useful to many gas-engine car drivers and stated that he might go back and use some of that information as well; and
- One found that it was easier to ingest information from the second site but was still interested in the first of the two to look at more information. She also commented that there was not enough time for her to read the first of these last two websites during the overview since it was so text heavy, and this may be a design issue.

Participants were asked about the age range they thought these websites would appeal to most.

- One thought that people of all ages with driver's licenses, specifically those 16 years of age and older, would be interested in these websites because she thought that owning a car would make people pay more attention to money and would be a motivation for clicking on the website links.
- One participant disagreed and did not think that teenagers would be interested, but rather, older people in their 20s may be more inclined to view the websites because they would have already started thinking of costs and environmental issues. She added that she was already frugal, so she thought of environmental issues as a motivation.

The moderator then asked if anyone saw anything else useful.

- One participant said she learned something by completing her information in the quizzes and seeing her results. She also said that she worked with younger kids and indicated that they might be interested in these websites because they are aware of gas prices.
- Another commented that parents are the best teachers for children.

Participants were asked for suggestions to improve the websites.

- A few agreed that they did not understand why the California governor was featured on the homepage of the second website;
- One participant liked that the car sponsors were only shown briefly at the end of the video on the second website; and
- One wanted the first website, which she felt was too text heavy, to be more condensed and accessible.

Participants also were asked about any information they wanted included, but did not find in the last two websites.

- One participant wanted to see more information about alternative technologies and vehicles.
- Finally, participants were asked which of the four sites they liked the best. Three liked the fourth website most.
- One participant liked the fourth website a lot, but was concerned that it did not identify its intended audience. This individual thought the fourth website was the most effective for educating the greatest number of people, noting the money backing the campaign had played an important role in making it so effective.
- One participant liked the third website best, as well as the information on the fourth, and wished that there was some way to combine the two because she is convinced that gasoline vehicles will be replaced with hybrids and electric vehicles.

Closing

The moderator asked participants for any final thoughts they had regarding the information that had been covered in the focus group discussion.

- One participant felt that website designs have to keep pace with what people are seeing on commercial sites.

APPENDIX D: ONLINE BEFORE-AND-AFTER SURVEYS AND FUEL LOG

FIRST SURVEY

This survey was given to all participants in both the control group and the experimental group.

Note: Sample does not show survey branching.

University of California, Berkeley

CONSENT TO PARTICIPATE

Public Education, Ecodriving, and Carbon Footprinting Survey

You are being asked to participate in a research study led by researchers at the University of California, Berkeley. You were selected as a possible participant in this study because you are faculty, staff or student at UC Berkeley and you responded to our recruitment regarding participation in our ecodriving and carbon footprinting study. Your participation in this study is voluntary.

PURPOSE OF THE STUDY

Researchers at the University of California, Berkeley are conducting this research to gain information about public education, ecodriving, and carbon footprinting. This research is sponsored by the Mineta Transportation Institute and will help provide a stronger understanding of public education campaigns, ecodriving, and carbon footprinting.

PROCEDURES

If you volunteer to participate in this study, we would like to ask you to complete this on-line survey and one or two follow-up on-line surveys. You will also be asked to keep a fuel log for the three months you participate in the study. You may also be asked to view websites regarding ecodriving and carbon footprinting.

POTENTIAL RISKS AND DISCOMFORTS

Some of the questions may make you uncomfortable. You may choose to not answer any questions that make you uncomfortable.

POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

You will not directly benefit from your participation in this research. The results of the study will provide researchers with an understanding of the general views of public education

efforts, ecodriving, and carbon footprinting. You may learn techniques that will improve the efficiency of your driving and overall travel.

PAYMENT FOR PARTICIPATION

You will receive a \$15.00 gift card for completing the surveys (two or three surveys) and an additional \$5.00 for completing the fuel log.

CONFIDENTIALITY

You will not be identified in this study, and no information that is obtained will be connected with you in any way.

IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact Rachel Finson at (510) 725-7609 at the Transportation Sustainability Research Center (TSRC), at the University of California Berkeley, Richmond Field Station, 1357 S.46th Street, Bldg. 452, Richmond, CA. 94804.

RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal rights because of your participation in this research study. If you have questions regarding your rights as a research subject, contact the Office for Protection of Research Subjects at (510) 642-7461 or subjects@berkeley.edu. The office is located at 2150 Shattuck Avenue, Suite 313 University of California at Berkeley, Berkeley, CA. 947704-5940. The IRB Administration has also developed a website designed to make you familiar with your rights. The website discusses your basic rights as a research participant, an explanation of the informed consent process, the basic requirement that written consent be in a language understandable to you, and suggested sample questions to ask the research investigator regarding your participation in the study. This website can be accessed at: <http://cphs.berkeley.edu>.

Before we begin, we need to establish an ID for your survey. As part of your participation you will take more than one survey. This ID will be used to link this survey with the surveys that you take later. Your ID is the last four digits of a phone number of your choice affixed to your zip code. For example, if the phone number you use is (610) 665-2719 and your zip code is 21218. Then your ID is 2719-21218.

It does not matter which phone number you use, but please remember the one you select because you will be asked to enter this ID again during later surveys.

Please indicate the make, model and year of the vehicle that you drive most (e.g., your primary vehicle).

Make:

Model:

Year:

Approximately what fuel economy do you think you currently get in your primary vehicle?

1. Don't know
2. Miles per gallon

Approximately how many miles per year is this vehicle driven?

1. Don't know
2. Miles driven per year

What percent of these annual miles would you say are driven by you as the driver?

1. 0% (I never really drive this vehicle)
2. 10 %
3. 20 %
4. 30 %
5. 40 %
6. 50 %
7. 60 %
8. 70 %
9. 80 %

10. 90 %
11. 100 % (I almost always am the driver of this vehicle)

How important was fuel economy to you when you bought this vehicle?

1. Extremely important
2. Very important
3. Somewhat important
4. Not too important
5. Not important at all

How efficiently, in terms of fuel usage, do you think you drive your vehicle now?

1. Very efficiently
2. Somewhat efficiently
3. About average
4. Somewhat inefficiently
5. Very inefficiently

When driving your primary vehicle, how often do you adjust your driving behavior in ways to improve your fuel economy?

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

When you drive on the highway in free flow traffic (such as 101, 680 or 880), what cruising speed do you typically try to maintain?

1. Less than 45 miles per hour
2. 45 miles per hour
3. 50 miles per hour
4. 55 miles per hour
5. 60 miles per hour
6. 65 miles per hour
7. 70 miles per hour
8. 75 miles per hour
9. 80 miles per hour
10. 85 miles per hour
11. More than 85 miles per hour
12. I never drive on highways

During a typical month, what percent (by distance) of all your driving would you say is driven on highways?

1. 0% (I never really drive on highways)
2. 10 %
3. 20 %
4. 30 %
5. 40 %

6. 50 %
7. 60 %
8. 70 %
9. 80 %
10. 90 %
11. 100 % (I almost always drive on highways)

On cold mornings, how long do you typically warm up the car before starting your trip?

1. ~0 seconds
2. About 15 seconds
3. About 30 seconds
4. About 45 seconds
5. About 1 minute
6. About 1.5 minutes
7. About 2 minutes
8. More than 2 minutes

Please consider the degree to which you agree or disagree with the following statements.

I regularly check and properly inflate my tires at least once a month.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

I regularly use the manufacturer recommended motor oil.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

I have my air filter regularly inspected and changed when it is dirty.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

I regularly carry a large number of items in my trunk or cargo area during daily travel (besides emergency items such as a spare tire or jumper cables).

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

The items that I do carry in my trunk or cargo area are needed on a daily basis (besides emergency items such as a spare tire or jumper cables).

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

Items that I regularly carry in my trunk or cargo area are heavy (besides emergency items such as a spare tire or jumper cables).

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

How often do you use items that are regularly carried in your trunk or cargo area?

1. Every day
2. 5 to 6 times a week
3. 3 to 4 times a week
4. 1 to 2 times a week
5. Once every two weeks
6. Once a month
7. Less than once a month
8. Never

How would you best characterize your acceleration from a stop light or stop sign during the last 3 months?

1. Sudden or jackrabbit-like
2. Slow

Would you say that your acceleration is...

1. Very Fast
2. Fast
3. At pace with most traffic

Would you say that your acceleration is...

1. At pace with most traffic
2. Slower (some traffic passes me)
3. Very Slow (most traffic passes me)

How would you best characterize the way in which you brake before a stop light or stop sign?

1. Hard and fast
2. Gradually

Would you say that your deceleration is...

1. Very hard and fast
2. Somewhat hard and fast

Would you say that your deceleration is...

1. Somewhat gradual
2. Very Gradual

Does your vehicle have an in-vehicle dashboard display of your fuel economy and energy use?

1. Yes
2. No
3. Don't know

How regularly do you use the information in this display to adjust your driving?

1. All the time
2. Most of the time
3. Some of the time
4. Infrequently
5. Not at all

Do you have a smart phone (e.g., iPhone) with an app for GPS navigation?

1. Yes
2. No
3. Don't know

How regularly do you use the information in this display to adjust your driving?

1. All the time
2. Most of the time
3. Some of the time
4. Infrequently
5. Not at all

Does this smart phone app also give you information on fuel economy?

1. Yes
2. No
3. Don't know

Do you have a dedicated external GPS navigation device (such as a Garmin or Magellan)?

1. Yes
2. No
3. Don't know

How regularly do you use the information in this display to adjust your driving?

1. All the time
2. Most of the time
3. Some of the time
4. Infrequently
5. Not at all

When is the last time that you had the oil changed in your vehicle?

1. I cannot remember
2. More than 6 months ago
3. 6 months ago
4. 5 months ago
5. 4 months ago
6. 3 months ago
7. 2 months ago
8. 1 month ago
9. Less than 1 month ago

How often do you get your oil changed?

1. Less than once every 2 years
2. Every 1 to 2 years
3. Once every 6 months to a year
4. Once every 6 months
5. Once every 5 months
6. Once every 4 months
7. Once every 3 months
8. Once every 2 months
9. Once a month
10. More than once a month

How many miles are generally travelled between oil changes?

1. Less than 1000
2. 1000 to 2000
3. 2000 to 3000
4. 3000 to 4000
5. 4000 to 5000
6. 5000 to 6000
7. 6000 to 7000
8. 7000 to 8000
9. 8000 to 9000
10. 9000 to 10000
11. More than 10000

What typically triggers you to get an oil change?

1. Once I travel a certain amount of miles
2. Once a certain amount of time has passed
3. Once another maintenance issue needs to be addressed
4. Once I see the check engine light
5. Once someone tells me to do it
6. Other, please specify:

Beyond just an oil change, how often do you get other maintenance service on your vehicle engine?

1. Less than once every 5 years
2. Once between every 3 to 5 years
3. Once between every 2 to 3 years
4. Once between every 1 to 2 years
5. Once every 6 months to 12 months
6. Once every 6 months
7. Once every 5 months
8. Once every 4 months
9. Once every 3 months
10. Once every 2 months
11. Once a month
12. Less than once a month

When is the last time a check engine light came on in your vehicle?

1. This past month
2. 1 to 3 months ago
3. 3 to 6 months ago
4. 6 to 9 months ago
5. 9 to 12 months ago
6. 1 to 2 years ago
7. 3 to 5 years ago
8. More than 5 years ago
9. The check engine light has never been on
10. The check engine light is always on

When is the last time that you had to take your current primary vehicle to a mechanic to address a check engine light?

1. This past month
2. 1 to 3 months ago
3. 3 to 6 months ago
4. 6 to 9 months ago
5. 9 to 12 months ago
6. 1 to 2 years ago
7. 3 to 5 years ago
8. More than 5 years ago
9. Never with this car
10. The check engine light is always on

Overall, how well do you think that your car is maintained?

1. Not well at all
2. Not very well
3. Okay, but could be better
4. Rather well
5. Very well

Do you own a tire pressure gauge?

1. Yes
2. No
3. Don't know

Do you carry a tire pressure gauge in your car?

1. Yes
2. No
3. Don't know

About how often do you check your own tire pressure?

1. Never
2. Once every 6 months
3. Once every 5 months
4. Once every 4 months
5. Once every 3 months
6. Once every 2 months
7. Once a month
8. Twice a month
9. Once a week
10. More than once a week

How often is your tire pressure checked by someone else?

1. Never
2. Once every 6 months
3. Once every 5 months
4. Once every 4 months
5. Once every 3 months
6. Once every 2 months
7. Once a month
8. Twice a month
9. Once a week
10. More than once a week

Do you know roughly what the max pounds per square inch (psi) is for the tires on your primary vehicle?

1. I do not know what the max psi is.
2. Max psi

To what psi do you generally inflate your tires when you do check the pressure?

1. I do not know
2. psi

Do you have a FasTrak toll tag in your primary vehicle?

1. Yes
2. No
3. Don't know

How often do you cross a Bay Area bridge?

1. Never
2. 1 time every 3 months
3. 1 time every 2 months
4. Once a month
5. 2 to 3 times a month
6. Once a week
7. 2 – 4 times a week
8. 5 or more times a week

Does your vehicle have a permanent luggage rack?

1. Yes
2. No
3. Don't know

How often are items attached to your luggage rack?

1. All the time
2. Most of the time
3. Some of the time
4. Very Rarely
5. Never

Does your vehicle have a permanent bike, ski, kayak or other rack on it?

1. Yes
2. No
3. Don't know

Please state your opinion as to whether you agree or disagree with the following statements.

The earth is currently experiencing climate change.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree

Human activity contributes to climate change.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree

Dependence on foreign oil is a serious problem facing the United States.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree

The cost of fuel is currently too high.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree

At what price of fuel would you start to cut back your driving?

Which issue do you think is more important: climate change or improved energy security for the United States? Please select one response.

1. Climate change
2. Improved energy security for the United States
3. Both equally important
4. Neither is very important
5. Don't know

In what year were you born?

1. Decline to Respond
2. Year:

Not counting yourself, how many other household members fall into the following age categories.

- Under 5 years old: _____
- Between 5 and 14 years old: _____
- Between 15 to 18 years old : _____
- Between 19 to 30 years old : _____
- Between 31 to 45 years old : _____
- Between 46 to 60 years old : _____
- Between 61 to 80 years old : _____
- Older than 80 years old : _____

Please check the category below that best describes your household.

1. Self only
2. Self with spouse/partner
3. Self with spouse/partner and child(ren)
4. Self with child(ren)
5. Self with roommate(s)
6. Other, please specify: _____

Please indicate your approximate annual household pre-tax income in 2009?

1. Less than \$10,000
2. \$10,000 to \$15,000
3. \$15,000 to \$25,000
4. \$25,000 to \$35,000
5. \$35,000 to \$50,000
6. \$50,000 to \$75,000
7. \$75,000 to \$100,000
8. \$100,000 to \$150,000
9. \$150,000 to \$200,000
10. More than \$200,000
11. Decline to Respond

What is the highest grade of school or level of education that you have completed?

1. Grade School
2. Graduated High School
3. Some college
4. Associate's Degree
5. Bachelor's Degree
6. Master's Degree (MS, MA, MBA, etc)
7. Juris Doctorate Degree (JD)
8. Doctorate Degree (PhD, EdD, etc.)
9. Medical Degree (MD, etc.)
10. Other

Please indicate your race among the following choices.

1. Caucasian
2. Hispanic or Latino
3. African-American
4. Asian
5. Native American or Alaskan Native
6. Hawaiian or Pacific Islander
7. Indian
8. Arab or Middle-Eastern
9. Mixed Race
10. Decline to Respond
11. Other

Please state your gender:

1. Male
2. Female

RESPONSE SURVEY

This survey was given to members of the experimental group one week after they completed the first survey.

Note: Sample does not show survey branching.

Please visit the website www.ecodrivingUSA.com.

Spend a few minutes reviewing the content. There are a few key places that you should visit. They include “Be an EcoDriver,” “EcoDriving Practices,” and “Maintenance Practices.” Other places that you might want to visit include the EcoCalculator, the EcoDriving Quiz, and the Virtual Road Test, among other locations. Spend as much time as you need on the site to learn what you feel is helpful in terms of understanding EcoDriving. Then please take the survey below. Thank you very much for your participation in this study.

As before, please enter the ID you created in the first survey. Recall that your ID is the last four digits of a phone number that you chose affixed to your zip code. For example, if the phone number you use is 610-665-2719 and your zip code is 21218. Then your ID is 2719-21218.

Please be sure to use the same phone number that you used before for reconstructing this ID.

Did you look at the website?

1. Yes
2. No

Approximately how much time did you spend on the website altogether?

1. Less than 5 minutes
2. 5 to 10 minutes
3. 10 to 20 minutes
4. 20 to 30 minutes
5. 30 to 45 minutes
6. 45 to 1 hour
7. 1 to 2 hours
8. More than 2 hours

What sections of the website did you visit? (Please check all that apply)

1. The introductory video
2. The list of maintenance tips
3. The list of driving tips
4. The quiz (Beginner)
5. The quiz (Intermediate)
6. The quiz (Pro)
7. The endorsement of ecodriving by selected state governors
8. The Ecodriving game
9. Other, please specify:

Which section of the website did you find to be the most effective in informing you about the reasons and incentives for ecodriving? (choose one response)

1. The introductory video
2. The list of maintenance tips
3. The list of driving tips
4. The quiz (Beginner)
5. The quiz (Intermediate)
6. The quiz (Pro)
7. The endorsement of ecodriving by selected state governors
8. The Ecodriving game
9. None of the sections were effective.
10. Other, please specify:

Why did you think this section was most effective in explaining reasons and incentives for ecodriving?

Which section of the website did you find to be the most effective in informing you on how to ecodrive? (choose one response)

1. The introductory video
2. The list of maintenance tips
3. The list of driving tips
4. The quiz (Beginner)
5. The quiz (Intermediate)
6. The quiz (Pro)
7. The endorsement of ecodriving by selected state governors
8. The ecodriving game
9. None of the sections were effective.
10. Other, please specify:

Why did you think this section was most effective in informing you on how to ecodrive?

After visiting the website, how would you characterize your motivation to ecodrive?

1. Greatly increased
2. Somewhat increased
3. The same as before
4. Somewhat decreased
5. Greatly decreased

What about your experience with the website decreased your motivations to ecodrive?

What about your experience with the website increased your motivations to ecodrive?

To what extent do you believe that you have been practicing ecodriving up until now?

1. I did not practice ecodriving
2. I rarely practiced ecodriving
3. I sometimes practiced ecodriving
4. I often practiced ecodriving
5. I always practiced ecodriving

Please indicate which maintenance practices you followed prior to viewing the website?
(please check all that apply)

1. I used the proper motor oil
2. I checked my tire pressure on a monthly basis
3. I scheduled regular vehicle tune-ups
4. I regularly inspected my air filter
5. I keep excess material out of my vehicle
6. I make sure my gasoline cap is tight
7. I have fuel efficient tires on my vehicle
8. I have read my vehicle's owner's manual
9. I have had my air conditioner professionally maintained
10. None of the above

Please indicate which driving practices you followed prior to viewing the website?

1. I eased into acceleration slowly from stop signs and stop lights
2. I brake smoothly when approaching red lights and stop signs
3. I do not warm up my car for more than 30 seconds
4. I regularly use cruise control
5. I did not consider how fast I was driving when using air conditioning
6. None of the above

Now that you have seen this website, how likely do you think it is that you will apply some of the suggested practices of ecodriving (over what you currently do)?

1. Very likely
2. Somewhat likely
3. Somewhat unlikely
4. Very unlikely
5. I already practice them all in the way the website recommended

Which types of practices do you think will dominate your approach? Maintenance practices or driving practices?

1. More maintenance practices than driving practices
2. An equal combination of both
3. More driving practices than maintenance practices
4. I do not and will not implement any of these practices

Why do you believe that maintenance practices will dominate your approach?

1. I already use more driving practices than maintenance practices
2. It is easier to adjust maintenance than driving practices
3. Other, please specify:

Why do you believe that driving practices will dominate your approach to improving your ecodriving?

1. I already use more maintenance practices than driving practices
2. It is easier to adjust driving than maintenance practices
3. Other, please specify:

What maintenance practices or issues did you learn from the website that you did not know before? (Check all that apply)

1. The owner's manual is a good information source for optimizing fuel economy
2. Choosing the right motor oil can make a difference in fuel economy
3. Periodic engine tune-ups will improve fuel economy
4. Replacing a clogged air filter will improve fuel economy
5. Low tire pressure lowers fuel economy
6. Tire pressure can fall with cold weather
7. A loose gas cap can cause evaporative emissions
8. A luggage or bike rack lowers fuel economy through aerodynamic drag
9. Removing excess weight from the vehicle can improve fuel economy
10. A professionally maintained air conditioner can improve fuel economy
11. I can purchase tires that can improve fuel efficiency
12. None of the above

Were there any other maintenance practices that you did not know about prior to visiting the website?

1. No
2. Yes, please specify:

Based on the information that you saw at this site, what types of maintenance practices do you think you might give more consideration to over the next three months? (Please check all that apply)

1. Change the motor oil more frequently
2. Ensure the proper motor oil is used
3. Check my tire pressure on a monthly basis
4. Buy a tire gauge and keep it in my car
5. Get my vehicle engine inspected
6. Get my air filter inspected
7. Keep excess material out of my trunk
8. Consider fuel efficient tires for my next tire purchase
9. Make sure my gas cap is tight
10. Remove a luggage rack or bike rack from my vehicle
11. Get my vehicle air conditioning inspected
12. I will read my vehicle's owner's manual
13. I already do all of these things
14. None of the above

What driving practices or issues did you learn about ecodriving that you did not know prior to visiting the site? (Check all that apply)

1. Rapid starts and stops can reduce fuel economy
2. Using air conditioning when driving above 40 mph is more efficient than opening windows
3. Driving speeds above 60 mph drops fuel efficiency
4. Warming up the car is no longer needed
5. Driving a steady speed can help avoid red lights
6. Using cruise control can help improve fuel economy

Were there any other driving practices that you did not know about prior to visiting the website?

1. No
2. Yes, please specify:

Based on the information that you saw at this site, what types of driving practices do you think you will consider over the next three months?

1. I will accelerate more gradually
2. I will brake more gradually
3. I will drive my car to warm it up
4. I will drive closer to 60 mph on the highway
5. I will change how and when I use the air conditioner
6. I will use cruise control more often
7. I will get a FasTrak
8. I already do all of these things
9. None of the above

How effective do you think ecodriving will be in improving your fuel economy?

1. Very effective
2. Somewhat effective
3. Somewhat ineffective
4. Very ineffective

By what percent do you think you might be able to improve your fuel economy?

FINAL SURVEY

This survey was given to all participants in both the control group and the experimental group.

Note: Sample does not show survey branching.

As before, please enter the ID you created in the first survey. Recall that your ID is the last four digits of a phone number that you chose affixed to your zipcode. For example, if the phone number you used was (610) 665-2719 and your zip code is 21218. Then your ID is 2719-21218.

Please be sure to use the same phone number that you used previously for reconstructing this ID.

Over the past 3 months, approximately what fuel economy do you think you have gotten in your primary vehicle?

1. Don't know
2. Miles per gallon

How would you characterize the change in your fuel economy over the past 3 months?

1. Increased significantly
2. Increased moderately
3. Stayed the same
4. Decreased moderately
5. Decreased significantly

Do you think that your fuel economy has improved because of what you learned from the ecodrivingUSA.com website?

1. Yes
2. No, my fuel economy improved for other reasons

Why do you believe that your fuel economy is now worse?

Over the last 3 months, what percent of the miles driven on your primary vehicle would you say were driven by you?

1. 0% (I never really drove this vehicle)
2. 10 %
3. 20 %
4. 30 %
5. 40 %
6. 50 %
7. 60 %
8. 70 %
9. 80 %
10. 90 %
11. 100 % (I was almost always the driver of this vehicle)

Over the past 3 months, did the vehicle that you were primarily driving change (e.g., did you get a new vehicle or lose the vehicle that you started the study with)?

1. Yes
2. No

Please indicate the make, model and year of the vehicle that you changed to primarily driving during the study.

Make

Model

Year

How efficiently, in terms of fuel usage, do you think you drive your vehicle now?

1. Very efficiently
2. Somewhat efficiently
3. About average
4. Somewhat inefficiently
5. Very inefficiently

Driving Practices

The following section includes some general questions about your driving practices.

During the past 3 months, when driving your primary vehicle, how often would you adjust your driving behavior in ways to improve your fuel economy?

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Have you made changes in your driving behavior to improve fuel economy since starting the study?

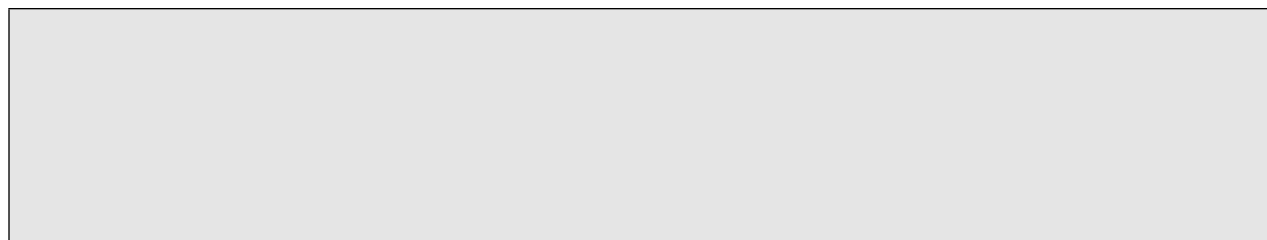
1. Yes
2. No
3. I don't know

During the past 3 months, did you change anything about how you drove (e.g., your driving style) because of what you learned from the ecodrivingusa.com website?

1. Yes
2. No, I changed the way I drive for other reasons
3. No, I still drive about the same as I did 3 months ago

What driving practices did you change during the study? (please check all that apply)

1. None
2. I accelerate more gradually
3. I brake more gradually
4. I idle my car less
5. I drive closer to 60 mph on the highway
6. I change how and when I use the air conditioner
7. I consider using cruise control more often
8. I got a FasTrak
9. I already did all of these things
10. I changed other practices, please explain:



For the following questions, we will ask about your driving practices in more detail.

During the past 3 months, when driving on the highway in free flow traffic (such as 101, 680 or 880) what cruising speed have you typically tried to maintain?

1. Less than 45 miles per hour
2. 45 miles per hour
3. 50 miles per hour
4. 55 miles per hour
5. 60 miles per hour
6. 65 miles per hour
7. 70 miles per hour
8. 75 miles per hour
9. 80 miles per hour
10. 85 miles per hour
11. More than 85 miles per hour
12. I never drive on highways

During the past 3 months, what percent (by distance) of all your driving would you say was driven on highways?

1. 0% (I never drove on highways)
2. 10 %
3. 20 %
4. 30 %
5. 40 %
6. 50 %
7. 60 %
8. 70 %
9. 80 %
10. 90 %
11. 100 % (I always drove on highways)

During the past 3 months, on cold mornings, how long have you typically warmed up the car before starting your trip?

1. ~0 seconds (I generally did not warm up my car at all)
2. About 15 seconds
3. About 30 seconds
4. About 45 seconds
5. About 1 minute
6. About 1.5 minutes
7. About 2 minutes
8. More than 2 minutes

For some of the following questions, you will be asked to consider the degree to which you agree or disagree with certain statements. For all questions, please consider your response in the context of the last 3 months of your driving.

During the last 3 months, I regularly carried a large number of items in my trunk during daily travel (besides emergency items such as a spare tire or jumper cables).

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

The items that I did carry in my trunk were needed on a daily basis (besides emergency items such as a spare tire or jumper cables).

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

During the last 3 months, how often did you use items that were regularly carried in your trunk or cargo area?

1. Every day
2. 5 to 6 times a week
3. 3 to 4 times a week
4. 1 to 2 times a week
5. Once every two weeks
6. Once a month
7. Less than once a month
8. Not once in the last 3 months

Items that I regularly carried in my trunk were heavy.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

How would you best characterize your acceleration from a stop light or stop sign during the last 3 months?

1. Sudden or jackrabbit-like
2. Slow

Would you say that your acceleration was...

1. Very Fast (ahead of all traffic)
2. Fast (with the fastest traffic)
3. At pace with most traffic

Would you say that your acceleration was...

1. At pace with most traffic
2. Slower (some traffic passes me)
3. Very Slow (most traffic passes me)

How would you best characterize the way in which you braked before a stop light or stop sign during the last 3 months?

1. Hard and fast
2. Gradually

Would you say that your deceleration was...

1. Very hard and fast
2. Somewhat hard and fast

Would you say that your deceleration was...

1. Somewhat gradual
2. Very Gradual

Does your current primary vehicle have an in-vehicle dashboard display of your fuel economy and energy use?

1. Yes
2. No
3. Don't know

How regularly did you use the information in this display to adjust your driving during the last 3 months?

1. All the time
2. Most of the time
3. Some of the time
4. Infrequently
5. Not at all

Do you have a smart phone (e.g., iPhone) with an app for GPS navigation?

1. Yes
2. No
3. Don't know

How regularly did you use the information in the smart phone display to adjust your driving during the last 3 months?

1. All the time
2. Most of the time
3. Some of the time
4. Infrequently
5. Not at all

Does this smart phone app also give you information on fuel economy?

1. Yes
2. No
3. Don't know

Do you have a dedicated external GPS navigation device (such as a Garmin or Magellan)?

1. Yes
2. No
3. Don't know

How regularly do you use the information in the external GPS display to adjust your driving?

1. All the time
2. Most of the time
3. Some of the time
4. Infrequently
5. Not at all

Vehicle Maintenance

The following section includes some general questions about your vehicle maintenance.

Overall, how well do you think that your car is maintained?

1. Not well at all
2. Not very well
3. Okay, but could be better
4. Rather well
5. Very well

Do you think that your vehicle maintenance has improved over the last three months?

1. Yes, it's better
2. No, it's about the same
3. No, it's worse

Do you think that your vehicle maintenance has improved because of what you learned from the ecodrivingusa.com website?

1. Yes
2. No, my vehicle maintenance improved for other reasons

What maintenance practices did you improve during the study? (please check all that apply)

1. None
2. I changed the motor oil more frequently
3. I have checked to ensure that the proper motor oil is used
4. I checked my tire pressure more frequently
5. I placed a tire gauge in my car, where there was not one before
6. I got my vehicle engine inspected
7. I got my air filter inspected
8. I removed excess material out of my trunk or cargo area
9. I bought fuel efficient tires
10. I tighten my gas cap more conscientiously
11. I removed a luggage rack or bike rack from my vehicle
12. I got my vehicle air conditioning inspected
13. I read my vehicle's owner's manual
14. I was already doing all of these things
15. Other, please explain

Why do you believe that your vehicle maintenance has gotten worse?

The following questions ask additional details about your vehicle maintenance practices.

During the last 3 months, I have regularly checked and properly inflated my tires at least once every month.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

I have regularly used the manufacturer-recommended motor oil during the last 3 months.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

During the last 3 months, I have had my air filter inspected.

1. Strongly Agree
2. Agree
3. Disagree
4. Strongly Disagree
5. Don't know

After the inspection, was it recommended that you change the filter?

1. Yes
2. No
3. Don't know

Did you have the filter changed?

1. Yes
2. No
3. Don't know

When is the last time that you had the oil changed in your vehicle?

1. More than 6 months ago
2. 6 months ago
3. 5 months ago
4. 4 months ago
5. 3 months ago
6. 2 months ago
7. 1 month ago
8. Less than 1 month ago
9. Don't know

From now on, how often will you get your oil changed?

1. Less than once every 2 years
2. Every 1 to 2 years
3. Once every 6 months to a year
4. Once every 6 months
5. Once every 5 months
6. Once every 4 months
7. Once every 3 months
8. Once every 2 months
9. Once a month
10. Less than once a month

How many miles do you expect to travel between oil changes in the future?

1. Less than 1000
2. 1000 to 2000
3. 2000 to 3000
4. 3000 to 4000
5. 4000 to 5000
6. 5000 to 6000

7. 6000 to 7000
8. 7000 to 8000
9. 8000 to 9000
10. 9000 to 10000
11. More than 10000

From now on, how often do you expect to get other maintenance service on your vehicle engine (beyond an oil change)?

1. Less than once every 5 years
2. Once between every 3 to 5 years
3. Once between every 2 to 3 years
4. Once between every 1 to 2 years
5. Once every 6 months to 12 months
6. Once every 6 months
7. Once every 5 months
8. Once every 4 months
9. Once every 3 months
10. Once every 2 months
11. Once a month
12. Less than once a month

As of today, what typically triggers you to get an oil change?

1. Once I travel a certain amount of miles
2. Once a certain amount of time has passed
3. Once another maintenance issue needs to be addressed
4. Once I see the check engine light
5. Once someone tells me to do it
6. Other, please specify:

Has a check engine light come on in your vehicle during the last three months?

1. Yes
2. No
3. Don't know

When is the last time that you had to take your current primary vehicle to address a check engine light?

1. This past month
2. 1 to 3 months ago
3. 3 to 6 months ago
4. 6 to 9 months ago
5. 9 to 12 months ago
6. 1 to 2 years ago
7. 3 to 5 years ago
8. More than 5 years ago
9. Never with this car
10. The check engine light is always on

Do you own a tire pressure gauge?

1. Yes
2. No
3. Don't know

Do you carry a tire pressure gauge in your car?

1. Yes
2. No
3. Don't know

During the last 3 months, how often did you check your tire pressure?

1. Not once in the last 3 months
2. Once in the last 3 months
3. Twice in the last 3 months
4. Once a month
5. Three times a month
6. Twice a week
7. Once a week
8. More than once a week

During the last 3 months, how often was your tire pressure checked by someone besides you?

1. Not once in the last 3 months
2. Once in the last 3 months
3. Twice in the last 3 months
4. Once a month
5. Three times a month
6. Twice a week
7. Once a week
8. More than once a week

Do you know roughly what the max pounds per square inch (psi) is for the tires on your primary vehicle?

1. I do not know what the max psi is.
2. Max psi

To what psi do you generally inflate your tires when you do check the pressure?

1. I do not know
2. I never check the pressure
3. psi

Do you have a FasTrak toll tag in your current primary vehicle?

1. Yes
2. No
3. Don't know

How often have you crossed a Bay Area bridge in the last three months?

1. Never
2. 1 time every 3 months
3. 1 time every 2 months
4. Once a month
5. 2 – 3 times a month
6. Once a week
7. 2 – 4 times a week
8. 5 or more times a week

Does your vehicle currently have a luggage rack?

1. Yes
2. No
3. Don't know

How often are items attached to your luggage rack?

1. All the time
2. Most of the time
3. Some of the time
4. Very Rarely
5. Never

Does your vehicle have a permanent bike, ski, kayak or other rack on it?

1. Yes
2. No
3. Don't know

Do you think that you will continue to practice any changes that you have made to your DRIVING practices after this study is over?

1. Definitely
2. Probably
3. Probably not
4. Definitely not
5. I did not make any changes to my driving practices during the study

Do you think that you will continue to practice any changes that you have made to your MAINTENANCE practices after this study is over?

1. Definitely
2. Probably
3. Probably not
4. Definitely not
5. I did not make any changes to my maintenance practices during the study

Thank you very much for completing the survey. Please press the submit button below!

FUEL LOG

The fuel log was optional for participants in both the control group and the experimental group.

Welcome to the fuel log!

We ask that you keep this log of your gasoline purchases throughout your participation in this study. Ideally, we would like to know about all gasoline put into your primary vehicle, whether its pumped by you or by someone else that uses the car.

Collecting the necessary information to track your fuel economy is easy. Just follow these simple steps:

1. Once you finish pumping gas, print out a receipt.
2. Before you drive away, write down the odometer number on the back of the receipt. This is the total number of miles that your vehicle has ever been driven.
3. Store the receipt in your wallet or purse; you now have all the information you need on the receipt.
4. The next time you're on the Internet, enter the information from the receipt into the log.

As long as you keep your receipts until the information is entered, it's okay to enter 2 or 3 at a time if you have collected a few. The key thing is to REMEMBER THE RECEIPT and ODOMETER NUMBER, as these cannot be retrieved later.

If you can, it is better to fill the car up completely each time (topping off not necessary). This will improve the accuracy of our calculations. If you do a partial fill, that's okay too, we'll simply ask you to indicate that.

Please continue!

Please enter your survey ID. Remember, your ID is the last 4 digits of the phone number you chose in the first survey affixed to your zipcode (ex. 7751-11790)

Your Survey ID:

Please enter the following information from the first refueling since starting the study.

	Date on Receipt (MM/DD/YY)	Gallons on Receipt (ex. 10.421)	Odometer Reading (ex. 101402)	Full fill or partial? (F/P)	Missing info on this refueling? (Y/N)
Refueling #1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If you forgot your receipt or you are missing information, just put a Y in the rightmost column. You can enter the information from your next refueling on the following page when you get that receipt.

If that is all the information that you have for now, just click “Save and Continue Later.” You will be asked to enter your email address (which we do not see). You will then get an email from QuestionPro with a link that will take you back where you left off. Keep this email until you refuel again. Then return to the survey and save a new entry.

If you have multiple receipts to enter, you can press continue and enter another one. Then press “Save and Continue Later” when you’re done.

Note: Fuel log repeats after this point.

APPENDIX E: ECODRIVING INTERCEPT SURVEY

University of California, Berkeley: Vehicle and Travel Efficiency Study CONSENT TO PARTICIPATE

The Transportation Sustainability Research Center at UC Berkeley is conducting a study of vehicle and travel efficiency, and your input will be helpful in providing driver perspective. If you participate you will review an information/fact sheet and respond to questions in a short survey. Your participation in this study is completely voluntary, you may choose to skip any questions that you do not want to answer and you may discontinue taking the survey at any time without penalty. You will not receive any compensation for responding to the survey. You will not be identified in this study, and no information that is obtained will be connected with you in any way.

I have reviewed this information and would like to take the survey: _____
Participant Initials

Please review the ecodriving and maintenance practices information/fact sheet and answer the following survey questions.

1. Approximately how many miles a year do you drive? _____

2. Please note the make, model and year of all car(s) that you own or lease:

Make	Model	Year	Estimated MPG

How often do you typically refuel your personal vehicle?

- Twice a week or more
 Once a week
 Once every two weeks
 Once a month
 Less than once a month
 Never

3. Does the cost of gas influence your auto travel?


- Yes
 No
 Depends, please specify: _____

4. What driving measures do you currently take to reduce fuel consumption? (Please check all that apply)

- Avoid rapid starts & stops
 Maintain a steady speed when possible
 Maintain highway speed optimal for fuel efficiency
 Use air conditioning at speeds above 40mph
 Use cruise control
 Plan trip timing and destinations to reduce fuel use
 Avoid idling
 Buy an automated toll pass

- Use the highest gear possible
 - Drive vehicle to warm it up
 - Avoid driving with the *check engine* light on
 - I do not take measures to reduce fuel consumption
5. What additional driving measures are you willing to take to reduce fuel consumption? (Please check all that apply)
- Avoid rapid starts & stops
 - Maintain a steady speed when possible
 - Maintain highway speed optimal for fuel efficiency
 - Use air conditioning at speeds above 40mph
 - Use cruise control
 - Plan trip timing and destinations to reduce fuel use
 - Avoid idling
 - Buy an automated toll pass
 - Use the highest gear possible
 - Drive vehicle to warm it up
 - Avoid driving with the *check engine* light on
 - I will not take additional measures to reduce fuel consumption
6. What maintenance practices do you currently use to reduce fuel consumption? (Please check all that apply)
- Use the recommended motor oil
 - Check your tire pressure monthly
 - Replace air filters regularly
 - Reduce aerodynamic drag
 - Maintain proper tire pressure
 - Remove excess weight from your vehicle (e.g., golf clubs)
 - Tighten your gas cap
 - Consider fuel efficient tires
 - Professionally maintain air conditioning system
 - I do not use maintenance practices to reduce fuel
 - Schedule periodic engine tune-ups consumption
7. What additional maintenance practices are you willing to start using to reduce fuel consumption? (Please check all that apply)
- Use the recommended motor oil
 - Check your tire pressure monthly
 - Replace air filters regularly
 - Reduce aerodynamic drag
 - Maintain proper tire pressure
 - Remove excess weight from your vehicle (e.g., golf clubs)
 - Tighten your gas cap
 - Consider fuel efficient tires
 - Professionally maintain air conditioning system
 - I will not use additional maintenance practices to reduce
 - Schedule periodic engine tune-ups fuel consumption

8. Vehicle exhaust is a major contributor to global warming, smog, and/or other environmental problems.
- Strongly Disagree
 - Disagree
 - Neutral
 - Agree
 - Strongly Agree
9. Oil dependency is a serious problem for the United States.
- Strongly Disagree
 - Disagree
 - Neutral
 - Agree
 - Strongly Agree
10. What is your gender? Male Female
11. What is your age? 18-25 26-35 36-45 46-55 55 or older
12. What is the last level of school that you completed? Please specify: _____
13. What was your household's 2009 pre-tax income?
- | | |
|---|---|
| <input type="checkbox"/> Less than \$10,000 | <input type="checkbox"/> \$50,000 to \$75,000 |
| <input type="checkbox"/> \$10,000 to \$25,000 | <input type="checkbox"/> \$75,000 to \$100,000 |
| <input type="checkbox"/> \$25,000 to \$35,000 | <input type="checkbox"/> \$100,000 to \$150,000 |
| <input type="checkbox"/> \$35,000 to \$50,000 | <input type="checkbox"/> More than \$150,000 |
| <input type="checkbox"/> Decline to Respond | |
14. Please indicate your race among the following choices. (Check all that apply)
- Caucasian
 - Hispanic
 - African-American
 - Indian/Pakistani
 - Asian
 - Native American or Alaskan Native
 - Hawaiian or Pacific Islander
 - Middle Eastern or Arab
 - Other: _____



ecoDrivingusa™

You can reduce
CO₂ NOW

EcoDriving™ Practices

Subtle changes in driving habits can produce significant benefits, such as saving money at the gas pump and reducing CO₂ emissions.

1 Believe You Can Reduce Fuel Use and Emissions
Typically, practicing moderate levels of EcoDriving can reduce fuel use by an average of 15%.

8 Navigate to Reduce Carbon Dioxide
Planning driving trips, even Saturday shopping, can help reduce fuel use and CO₂ emissions.

2 Avoid Rapid Starts and Stops
Rapid acceleration and braking, often called "jack rabbit" starts and stops, use fuel and cost money at the gas pump.

9 Avoid Idling
Idling uses gas and because the car is going nowhere, it translates into 0 mpg.

3 Keep on Rolling in Traffic
Maintaining a constant speed in your commute increases fuel economy, because it takes much more energy to move a stopped vehicle than to keep a vehicle moving.

10 Buy an Automated Pass for Toll Roads
By purchasing an "EZ Pass" for a toll road or bridge, a driver avoids stopping and starting the vehicle and idling in lines.

4 Ride the "Green Wave"
A steady speed often can help drivers avoid red lights and keep the car moving more efficiently.

11 Use the Highest Gear Possible
By using overdrive gearing where possible, such as on the highway, your vehicle's engine speed goes down, saving fuel and engine wear while reducing CO₂ emissions.

5 Use Air Conditioning at Higher Speeds
When driving at slower speeds (less than 40 mph), such as driving in urban areas, open windows are better. At higher speeds (over 40 mph), open windows use more fuel than the air conditioner.

12 Drive Your Vehicle to Warm It Up
Your vehicle will reach its optimum operating temperature much faster when you are driving, rather than idling.


6 Maintain an Optimum Highway Speed for Good Mileage
Observing the speed limit and not exceeding 60 mph (where legally allowed) can improve mileage by 7-23%.

13 Keep Your Cool
Always roll down the windows when getting into a hot car to blow out the hot air. Try to park in the shade. And consider investing in a heat reflector or window shades.

7 Use Cruise Control
According to a test conducted by Edmunds.com, cruise control can provide a 7% average fuel savings, compared to driving without the device operating.

14 Obey Your Check Engine Light
When the onboard diagnostics alert light comes on, there is the possibility that your emissions are increased and your fuel economy is going down.

Do more at www.EcoDrivingUSA.com



Calculate Your CO₂

Visit EcoDrivingUSA.com to calculate your potential CO₂ savings or estimate the savings your state could achieve if it adopted EcoDriving.

Spread the Word

Communicate the benefits of EcoDriving in your area. Download printable tips, posters and manuals as well as online tools such as banner ads and widgets.

Source: www.fueleconomy.gov




Figure 18. Ecodriving Fact Sheet (Page 1)



You can reduce
CO₂ NOW

Maintenance Practices

Today's automobile is a complex machine with more than 3,000 interactive parts. Regular maintenance can help your vehicle run longer, as well as reduce carbon dioxide (CO₂) emissions.

1 Read Your Owner's Manual
Typically your owner's manual will provide a recommended service schedule to keep your vehicle operating efficiently.

8 Reduce Aerodynamic Drag
Wind resistance can reduce mileage, so you can maximize your mileage by removing luggage racks, roof-top carriers, and ski racks when they are not needed.

2 Use the Recommended Motor Oil
According to the U.S. EPA, you can improve your fuel economy by 1-2% by using the manufacturer's recommended grade of motor oil.

9 Tighten Your Gas Cap
As much as 30 gallons of gasoline could be lost annually to evaporation when the fuel cap is not fully tightened.

3 Schedule Periodic Engine Tune-ups
Typically, a tune up can improve gas mileage by an average of 4%.

10 Remove Excess Weight from Your Vehicle
An extra 100 pounds in the trunk typically reduces mileage by about 2%.

4 Replace Air Filters Regularly
According to the U.S. Department of Energy, replacing a clogged air filter can increase your mileage by 10%.

11 Maintain Your Air Conditioning System — Professionally
Insist on professional service with recovery and recycling so that refrigerant can be reused and not released to the atmosphere.

5 Check Your Tire Pressure Monthly
The Department of Energy estimates that 1.2 billion gallons of fuel were wasted in 2005 as a result of driving on under-inflated tires.

12 Consider Purchasing Fuel-Efficient Tires
Your tires can make a difference. "Lower rolling resistance" tires are now available, and these tires can improve mileage.

6 Check the Weather, then Check Your Tires
Tire pressure changes an average of 1 PSI (pounds per square inch) for every 10 degrees Fahrenheit change in air temperature.

7 Invest in a Tire Pressure Gauge
Tire pressure monitoring systems will indicate when your tires are under-inflated by 25%, but it is always advisable to check your tires with a tire pressure gauge before you see the warning light.

Source: www.fueleconomy.gov

Do more at www.EcoDrivingUSA.com

Hit the Road



Test your EcoDriving skills in our virtual road test—choose your route and start driving. Just make sure you check your tire pressure and trunk cargo before you get started.

Join the Movement



Every day, cities and states are doing their part to promote eco-friendly programs and practices. Visit the site and take action today.



AUTO ALLIANCE
DRIVING INNOVATION™



Figure 19. Ecodriving Fact Sheet (Page 2)

ABBREVIATIONS AND ACRONYMS

GHG	Greenhouse Gases
CO₂e	Carbon Dioxide Equivalent
t	Metric Ton
AB 32	Assembly Bill 32 (“The Global Warming Solutions Act of 2006”)

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