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16. ABSTRACT

Changeable Message Signs (CMSs), which are also called dynamic or variable message signs, are programmable signs used on highways worldwide to provide drivers with real-time information, such as traffic updates, roadwork warnings, and other traffic and safety-related information. CMSs allow motorists to take immediate action in response to information—to slow down or change routes, for example, which leads to safer driving conditions and less congestion. More recently, in California and throughout the U.S., CMSs have been used as part of public campaigns to promote roadway safety by posting messages that encourage drivers to use seat belts, not to drink and drive, and not to speed. These messages are typically displayed on CMSs during designated time periods that coincide with broader safety campaigns.

This study was sponsored by the California Department of Transportation (Caltrans) to examine the following questions about displaying safety campaign messages on CMSs: (1) How attentive is the public to messages displayed on CMSs? (2) Is there a public safety benefit from displaying safety campaign messages on CMSs? (3) Do travelers slow down to read CMS messages and, as a result, interrupt traffic flow? This study employed a range of sources to evaluate these questions including: (1) a review of the relevant published literature on CMSs; (2) interviews with experts and stakeholders; (3) focus groups with California drivers; (3) statewide telephone and intercept surveys; (4) analysis of speed data from California highway loop detectors (taken from the PeMS database).

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An Evaluation of the Consequences and Effectiveness of Using Highway Changeable Message Signs for Safety Campaigns

Caroline Rodier, Rachel S. Finson, Jeffrey Lidicker, Susan A. Shaheen

California PATH Research Report
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An Evaluation of the Consequences and Effectiveness of Using Highway Changeable Message Signs for Safety Campaigns

Task Order 6119 Draft Final Report

October 2009

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ABSTRACT

Changeable Message Signs (CMSs), which are also called dynamic or variable message signs, are programmable signs used on highways worldwide to provide drivers with real-time information, such as traffic updates, roadwork warnings, and other traffic and safety-related information. CMSs allow motorists to take immediate action in response to information—to slow down or change routes, for example, which leads to safer driving conditions and less congestion. More recently, in California and throughout the U.S., CMSs have been used as part of public campaigns to promote roadway safety by posting messages that encourage drivers to use seat belts, not to drink and drive, and not to speed. These messages are typically displayed on CMSs during designated time periods that coincide with broader safety campaigns.

This study was sponsored by the California Department of Transportation (Caltrans) to examine the following questions about displaying safety campaign messages on CMSs: (1) How attentive is the public to messages displayed on CMSs? (2) Is there a public safety benefit from displaying safety campaign messages on CMSs? (3) Do travelers slow down to read CMS messages and, as a result, interrupt traffic flow? This study employed a range of sources to evaluate these questions including: (1) a review of the relevant published literature on CMSs; (2) interviews with experts and stakeholders; (3) focus groups with California drivers; (3) statewide telephone and intercept surveys; (4) analysis of speed data from California highway loop detectors (taken from the PeMS database). The results suggest the following: (1) driver inattention to CMS messages does not appear to be a significant problem among California drivers; (2) positive safety effects may be derived from public safety campaigns messages on CMSs when the public is familiar with and understands the messages displayed; and (3) a small percentage of drivers may slow in the presence of safety campaign messages displayed on CMSs, but this does not appear to cause disruptions in the overall flow of traffic.

EXECUTIVE SUMMARY

Background

Changeable Message Signs (CMSs), also known as dynamic or variable message signs, are programmable signs used on highways worldwide to provide drivers with real-time information, such as traffic updates, roadwork warnings, and other traffic- and safety-related information. CMSs allow motorists to take immediate action in response to information—to slow down or change routes, for example, which leads to safer driving conditions and less congestion. More recently, in California and throughout the U.S., CMSs have been used as part of public campaigns to promote roadway safety by posting messages that encourage drivers to use seat belts, not to drink and drive, and not to speed. These messages are typically displayed on CMSs during designated time periods that coincide with broader safety campaigns.

Why was this research undertaken?

This study was sponsored by the California Department of Transportation (Caltrans) to examine the following questions about displaying safety campaign messages on CMSs:

1. How attentive is the public to messages displayed on CMSs?

2. Is there a public safety benefit from displaying safety campaign messages on CMSs?

3. Do travelers slow down to read CMS messages and, as a result, interrupt traffic flow?

What was done?

This study employed a range of sources to evaluate these questions, including the following:

1. The relevant *published literature on CMSs was reviewed* to understand what is known and not known about the potential effects of displaying safety campaign messages on CMSs.

2. *Interviews with experts and stakeholders* (both in California and throughout the U.S.) were conducted to identify perceived and/or known benefits and disadvantages of displaying safety campaign messages on CMSs.

3. Two *focus groups* with California drivers were conducted to gain qualitative insight into attitudes toward CMSs and safety messages, and to help develop the statewide telephone and intercept surveys (see below).

4. *Statewide telephone and intercept surveys* were conducted to obtain a representative sample from which to evaluate the driving public's stated response to safety campaigns messages on CMSs.

5. A *statistical analysis of speed data* from loop detectors on California highways (from the PeMS database) was conducted to detect a significant change in observed vehicle speeds near CMSs with and without safety campaign message displays.

What can be concluded from this research?

1. How attentive is the public to messages displayed on CMSs?

- The results of the literature review indicate that detailed messages (e.g., license plate numbers) and flashing messages are more difficult for drivers to recall. Fiber optic signs may improve drivers' attention to messages.

- The results of the statewide telephone and intercept survey, administered while safety campaign messages were displayed on CMSs, indicate *high levels of attention to CMS messages*: between 80% and 95% of respondents, many of whom view CMS messages daily, indicate that they read CMS messages 75% to 100% of the time.

2. Is there a public safety benefit from displaying safety campaign messages on CMSs?

- There is no published literature that evaluates the public safety benefit from safety campaign messages displayed on CMS. However, there are a limited number of studies that document positive behavioral change resulting from road condition and route guidance messages displayed on CMS.

- The results of the telephone and the intercept survey implemented in conjunction with the "Click It or Ticket" and the "Report Drunk Drivers, Call 911" safety message campaigns suggest that *positive safety effects may be derived from public safety campaign messages on CMSs when the public is familiar with and understands the messages displayed*. The results for the "Report Drunk Drivers, Call 911" CMS messages, indicate a high comprehension rate (92% to 98.5%); a low rate of drunk-driver reporting (1.5% to 7.9% phone), which is consistent with the current reduced rate of drunk-driving related incidents in California; and a sizable effect on awareness of the risks and consequences of drunk driving (18.8% to 30.5%). In contrast, the survey results for the "Click it or Ticket" campaign indicate a much lower comprehension rate (53.1% to 64.6%). Only 33% of those not wearing their seat belt put it on after viewing the message, and over half of those who did not did not put on their seat belt, did not fully comprehend the message.

- The survey results were echoed in the focus groups. Many participants indicated that they already practiced safe driving habits, and thus the messages would have no affect on their behavior. However, others indicated a positive change in their behavior after seeing a safety campaign message. Some commented specifically on the "Call 911 to Report Drunk Driving" message, two indicated that they paid more attention to other drivers, and one called 911 to report a suspected drunk driver. Another participant stated that, after seeing the "Don't Speed" message, she looked at her speedometer and slowed down. Participants tended to agree that safety messages served as a reminder to drivers about the rules of the road and stated, for example, that "any prevention is a good thing," and that

"if the CMSs discouraged one person from driving drunk or reminded them to designate a driver, then the message was beneficial."

- On the other hand, the results of the telephone and intercept surveys indicated that safety messages were considered to be less helpful overall than traffic advisories, advance notice messages, AMBER Alerts, and severe weather notices. This last result is generally consistent with previous findings in the literature and with the results of the expert and stakeholder interviews and focus groups conducted as part of this research.

3. *Do travelers slow down to read CMS messages and, as a result, interrupt traffic flow?*

- Only two studies report on the effect of CMS messages (AMBER Alerts and route diversion) on driving speeds, and their results suggest that drivers may slow down to read messages. However, AMBER Alerts and route diversion messages are more cognitively demanding than the relatively short, simple, and familiar safety campaign messages and thus their findings may have limited relevance to this study. AMBER Alerts typically contain detailed content including vehicle descriptions and license plate numbers. Alternate route information requires quick thought, decision, and action on the part of the driver.

- The results of telephone and intercept surveys indicate less than 10% of respondents slowed down to read the safety messages, and less than 15% of respondents observed other drivers slowing down.

- Similarly, focus group participants indicated that they do not slow down in the presence of a CMS message; however, they have observed other drivers doing so.

- A statistical evaluation of observed speed data found that a minority of drivers (15%) traveling 2.5 to five mph over the speed limit slowed an average of $1/7^{th}$ mph (p=0.0003) in the presence of CMSs with safety messages; however, overall average driving speeds were not significantly reduced (p=0.24).

What do the researchers recommend?

Based on the findings of this study, researchers recommend the continued display of safety campaign messages on CMSs; however, the display of these messages should have a lower priority than messages related to traffic advisories, advance notices, AMBER Alerts, and severe weather notices. Safety messages should be evaluated to ensure a high level of public familiarity and understanding, and priority for display should be based on message evaluations.

Implementation Strategies

Specific guidelines that prioritize messages for display on CMSs to optimize comprehension and positive behavioral change should be developed by relevant state agencies based on the best available evidence on CMS messaging. Research on CMS messaging should be monitored and guidelines should be updated accordingly.

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Chapter 1: Introduction

Changeable Message Signs (CMSs), which are also called dynamic or variable message signs, are programmable signs used on highways worldwide to provide drivers with real-time information, such as traffic updates, roadwork warnings, and other traffic and safety-related information. CMSs allow motorists to take immediate action in response to information—to slow down or change routes, for example, which leads to safer driving conditions and less congestion. More recently, in California and throughout the U.S., CMSs have been used as part of public campaigns to promote roadway safety by posting messages that encourage drivers to use seat belts, not to drink and drive, and not to speed. These messages are typically displayed on CMSs during designated time periods that coincide with broader safety campaigns.

This study was sponsored by the California Department of Transportation (Caltrans) to examine the following questions about displaying safety campaign messages on CMSs:

1. How attentive is the public to messages displayed on CMSs?

2. Is there a public safety benefit from displaying safety campaign messages on CMSs?

3. Do travelers slow down to read CMS messages and, as a result, interrupt traffic flow?

This study employed a range of methods to evaluate these questions including the following:

1. The relevant *published literature on CMSs was reviewed* to understand what is known and not known about the potential effects of displaying safety campaign messages on CMSs.

2. *Interviews with experts and stakeholders* in California and throughout the U.S. were conducted to identify perceived and/or known benefits and disadvantages of displaying safety campaign messages on CMS. (See Appendix A)

3. Two *focus groups* with California drivers were conducted to gain qualitative insight into attitudes toward CMSs and safety messages and help develop the statewide telephone and intercept surveys.[1] (See Appendix B)

4. *Statewide telephone and intercept surveys* were conducted to obtain a representative sample from which to evaluate the driving public's stated response to safety campaigns messages on CMSs.

[1] Twenty one interviews were conducted with representatives from the U.S. Department of Transportations, California Department of Transportation District Offices, the California Highway Patrol, the National Highway Traffic Safety Administration, the California Office of Traffic Safety, the California State Automobile Association, and consulting firms.

5. A *statistical analysis of speed data* from loop detectors from California highways (taken from the PeMS database) was conducted to detect a significant change in observed vehicle speeds near CMS with and without safety campaign message displays.[2]

The motivating study questions posed by the California Department of Transportation were also consistently raised in interviews with experts and stakeholders, who were involved in the decision to display and/or implement safety campaign messages on CMSs (See Appendix A). Most acknowledged that CMS messages had the ability to target a large number of drivers in a cost effective way. However, concerns were also raised about drivers ignoring traffic-related messages if CMSs were used frequently to post other types of messages; about the lack of evidence supporting behavior benefits from displaying safety campaign messages; and about drivers slowing down to read safety campaign messages, which could lead to traffic slow downs and even congestion. In general, experts and stakeholders expressed a need for guidelines for displaying safety campaign messages on CMSs.

[2] Note that researchers attempted an analysis of how the presence of safety campaign messages on CMSs may have affected accidents; however, because of limitations in the available data, the analysis was inconclusive. The results are documented in Appendix D.

Chapter 2: Comprehension and Effectiveness

Summary

To better understand comprehension and effectiveness of public service messages on changeable message signs (CMS), both telephone and intercept surveys were conducted in conjunction with two safety campaign messages displayed on CMSs in California (USA): the “Click It or Ticket” and the “Report Drunk Drivers, Call 911.” The results of both surveys for the “Report Drunk Drivers, Call 911” CMS messages, indicate a high comprehension rate (92% to 98.5%); a low rate of drunk driver reporting (1.5% to 7.9% phone), which is consistent with the current reduced rate of drunk-driving related incidents in California; and a sizable effect on awareness of the risks and consequences of drunk driving (18.8% to 30.5%). In contrast, the survey results for the “Click it or Ticket” campaign indicate a much lower comprehension rate (53.1% to 64.6%). Only 33% of those not wearing a seat belt put it on after viewing the message, and over half of those that did not did not fasten their seat belt did not fully comprehend the message. Further analysis of the comprehension and effectiveness of the "Click It or Ticket" message may allow for better tailoring of the message to improve both comprehension rate and seat belt use. In sum, the study results suggest positive safety effects may be derived from public safety campaign messages on CMSs when the public is familiar with and understands the message displayed.

2.1 Introduction

In this chapter, drivers’ comprehension and behavioral responses to safety campaign messages displayed on CMSs are evaluated. First, relevant literature on comprehension, recall, and effectiveness of CMS messages is reviewed. Second, results of focus groups, a statewide telephone survey, and an intercept survey administered in locations downstream from CMSs displaying safety messages, are analyzed. The results of the telephone and intercept surveys focus specifically on the “Click It or Ticket” and “Report Drunk Drivers, Call 911” safety campaign messages. Finally, conclusions are drawn from the study results about the comprehension and effectiveness of the CMS messages on improving safety behavior.

2.2 Literature Review

Limited research has been published about the effectiveness of safety campaign messages on CMSs. However, there is a significant body of related literature on driver comprehension and recall of CMS messages, as well as the effectiveness of CMSs displaying other types of information, such as specific roadway information related to traffic advisories. Much of this evaluative literature is based on speed data from loop detectors, survey data, and driver simulation data. Although none of these studies are directly applicable to evaluating the display of safety campaign messages on CMSs, they are described here to provide some insight into the possible effects of such campaigns.

2.21 Comprehension and Recall of CMS Messages

The literature indicates that CMS messages that provide detailed information, such as license plate numbers, are more difficult for drivers to comprehend or recall. Rama (2001) found that

drivers favored including information such as temperature on CMSs; however, recall rates of such information were low. In Harder *et al.*'s (2003) study of 120 drivers using a driving simulator, only 39% of participants remembered the entire plate number posted on an AMBER Alert. In a study using a driving simulator, respondents spent 2.5 seconds longer, on average, reading AMBER alert messages with a license plate number than those without (Dudek et al., 2006). Adding the term "recommended" to a minimum distance message on a CMS weakened the "value" of the message because it was understood as more general type of information (Rama, 2001, p. 41). To prevent confusion, Harder *et al.* (2003) recommend that AMBER Alerts be displayed using only the bottom line of the CMSs to distinguish traffic-related, time-specific signs from AMBER Alerts.

The presentation of the text and the type of technology used on the CMS can affect message comprehension. Most CMSs are electromechanical, but researchers have experimented with newer technology, such as fiber-optic CMSs. Rama (2001) found driver recall of information displayed on fiber-optic signs to be significantly greater than the recall of information on electromechanical signs (Rama, 2001). The study noted that effectiveness of the fiber-optic CMS could be due to sign novelty and thus might diminish as drivers become used to the signs. Alternatively, the author proposed that sign effectiveness could increase as drivers become familiar with them. In addition to the sign type, whether the text is flashing or steady can affect drivers' comprehension of content and interpretation of severity. Researchers found that the flashing mode of CMSs affected driver behavior the most, but also noted "drivers had problems understanding the meaning of the flashing mode" (Rama and Kulmala, 2000, p. 92).

Given such variability in comprehension, other information sources, such as radio, may be more effective than CMSs. In their driving simulator study of 64 drivers, Dudek *et al.* (2006) found that 63% of subjects preferred CMSs that displayed radio station information rather than a license plate number, and 83% preferred radio station information over displayed phone numbers (Dudek et al., 2006). For other types of information, such as hurricane and terrorist attack updates, Ullman *et al.* (2006) state that CMSs do not contain enough space to accommodate all the necessary information.

2.22 Effectiveness of CMS Messages

The ability of CMS messages to stimulate behavioral change in drivers has been evaluated for several types of messages with differing results. Studies focusing on driver response to poor driving and weather conditions have found that CMS messages are effective. A Finnish study that included 114 telephone interviews and speed measurements, found that drivers reported that slippery road messages influenced their speed, as well as increased their monitoring of oncoming vehicles, their own driving, and the road surface (Rama, 2001).

Studies of CMSs with route guidance messages come to mixed conclusions about their effectiveness. A study using video recordings of braking due to CMSs in Norway found that about every fifth vehicle altered routes after being prompted by a CMS message (Erke and Sagberg, 2006, p. 2). Benson (1996) analyzed 517 telephone surveys in Washington, D.C. and found that three fifths of drivers were very likely to use CMSs to identify alternate routes during congestion. Another study of traffic data from highways in Minnesota with CMS warning

messages about traffic conditions found significant diversion rates, greater effects in light traffic, and no decrease in travel time (Huo and Levinson, 2006). Richards and McDonald (2007) used loop detector data and outputs from a CONTRAM model (CONtinuous TRaffic Assignment Model) and found that 2% to 30% of drivers diverted when they were near an incident reported on the CMS and when congestion was visible. However, they did not find a conclusive correlation between CMS and traffic diversion because it was not possible to determine which diversions were attributable solely to the CMS (Richards and McDonald, 2007). Using traffic data and mail-in surveys from Amsterdam, Kraan *et al.* found a small reduction (0.8% to 1.6%) in diversion for "each additional kilometer of queue length," meaning that only a "small proportion of the variation" in diversion can be explained by the CMS (Kraan et al., 2007, 66). The authors report that this small variation "should be expected because the [CMS] messages are relevant to only a small proportion of the drivers, and only few drivers have an alternate route that involves deviating from their usual route at the first downstream junction" (Kraan et al., 2007, 66). Nevertheless, during heavy congestion periods, a small reduction in demand can result in significant travel time gains (Kraan et al., 2007).

2.3 Methods

2.31 Focus Groups

Two focus groups were conducted to allow for an in-depth exploration of drivers' attitudes toward CMSs and safety messages. The focus groups were held on the evenings of April 18 and 19, 2007 in Walnut Creek, California. Participants were recruited via flyers distributed at local business parks. Potential participants were screened to ensure that participants included California residents who drove as their primary mode of travel, and were between the ages of 18 and 56 years old. Twenty-three persons participated in the two focus groups. See Appendix B for full documentation of the focus groups.

2.32 Telephone and Intercept Surveys

Both telephone and intercept surveys were conducted to evaluate the driving public's response to two safety campaign messages displayed on CMSs in Northern and Southern California, the "Click It or Ticket" campaign in May 2007 and the "Report Drunk Drivers, Call 911" in December 2007. To be eligible to participate in either survey, respondents were required to be California residents over the age 18, hold a valid driver's license, and have driven on a major freeway in California within a few days of the survey.

Using Random Digit Dialing, the telephone survey was administered to a random sample of individuals living in nine California counties: Placer, Sacramento, Alameda, Contra Costa, Santa Clara, San Francisco, San Mateo, Los Angeles, and San Diego. The sample was selected to be representative of the demographic distribution of the population in those counties. A target sample size of 500 individuals was chosen to achieve ± 5% precision of estimated population parameters with a 95% confidence level. The number of completed telephone surveys for the May 2007 campaign was 503, with a 37% response rate. The number of completed telephone surveys for the December 2007 campaign was 511, with a 30% response rate.

For the intercept survey, investigators selected locations near CMSs in California counties with a high volume of CMSs: Solano, Stanislaus, Los Angeles, Sacramento, San Diego, and San Luis Obispo. Interviewers collected data at rest areas or gas stations where visiting drivers had a high likelihood of having passed a CMS within the previous 10 miles. The number of completed intercept surveys for the May 2007 campaign was 600 surveys, with a 78% response rate. The number of completed intercept surveys for the December 2007 campaign was 600, with a 70% response rate.

As shown in Table 2.1, there are statistically significant differences in demographic attributes between the in-person and telephone surveys for both safety campaign messages (Chi square p-value < 0.0001 for all demographic characteristics). Overall, more men than women participated in the survey; however, more telephone survey respondents were female than in-person survey respondents. Respondents were more likely to be Latino in the intercept survey than in the telephone survey, and less likely to be Asian in the intercept survey than in the telephone survey. Those responding to the telephone survey were more likely than those responding to the in-person survey to have a higher level of education and income, as well as fewer children in their households.

Table 2.1 Demographic Attributes of Respondents by Campaign and Survey.

	CLICK IT OR TICKET		DRUNK DRIVERS, CALL 911		SUMMARY STATISTICS	
Demographic Attributes	**Intercept**	**Phone**	**Intercept**	**Phone**	**Mean**	***p*-value**
Gender	N=599	N=503	N=600	N=511	N=2213	
Male	64.4%	44.3%	60.8%	44.8%	54.4%	<0.0001
Female	35.6%	55.7%	39.2%	55.2%	45.6%	
Ethnicity	N=599	(N=482)	N=591	N=497	N=2169	
White / Caucasian	60.3%	69.7%	72.3%	70.8%	68.0%	<0.0001
Latino	19.9%	9.1%	18.1%	13.9%	15.6%	
African-American	11.5%	6.8%	4.7%	5.2%	7.2%	
Asian	6.8%	11.6%	2.7%	7.8%	7.0%	
Native American / Hawaiian	0.3%	1.0%	0.5%	0.8%	0.6%	
Other	1.2%	1.7%	1.7%	1.4%	1.5%	
Education	N=573	N=493	N=594	N=507	N=2167	
High School or Less	19.0%	10.8%	16.5%	11.6%	14.7%	<0.0001
Some college	33.5%	32.7%	34.0%	29.6%	32.5%	
Bachelor's Degree	32.3%	30.6%	36.2%	31.4%	32.8%	
Graduate/Professional Degree	15.2%	26.0%	13.3%	27.4%	20.0%	
Income	N=522	N=396	N=495	N=397	N=1810	
Less than $25,000	3.4%	6.8%	1.6%	6.3%	4.3%	<0.0001
$25,000 to below 40,000	5.0%	13.4%	1.8%	10.1%	7.1%	
$40,000 to below 55,000	15.7%	13.1%	13.3%	13.1%	13.9%	
$55,000 to below 70,000	19.9%	11.9%	22.6%	14.4%	17.7%	
$70,000 to below 85,000	16.9%	10.9%	19.0%	9.1%	14.4%	
$85,000 to below 100,000	16.7%	10.9%	16.8%	10.8%	14.1%	
$100,000 to below 125,000	13.0%	12.4%	9.3%	11.1%	11.4%	
More than $125,000	9.4%	20.7%	15.6%	25.2%	17.0%	
People in household < 16	N=600	N=420	N=598	N=509	N=2127	
Zero	60.2%	70.7%	59.5%	67.2%	63.8%	<0.0001
1	14.5%	12.4%	12.5%	16.5%	14.0%	
2	19.2%	10.7%	24.7%	12.6%	17.5%	
3 or more	6.2%	6.2%	3.2%	3.7%	4.7%	

Some results may not sum to 100% due to rounding error.

2.4 Results

2.41 Focus Groups

Participants in the focus groups were asked whether safety campaign messages displayed on CMSs had ever changed their behavior. Most stated no because the information provided on such messages was already known to them. However, some participants did indicate a positive change in their behavior after seeing such a message. For example, two participants mentioned that after seeing a CMS with a "Call 911 to Report Drunk Driving" message that they paid more attention to how other motorists were driving. One participant reported that she called 911 to report a driver she suspected was drunk after seeing a CMS message encouraging her to do so. Another participant stated that, after seeing the "don't speed" message, she looked at her speedometer and slowed down.

2.42 Surveys

CMS Exposure and Attention to Messages

The frequency with which drivers saw CMS messages on the freeway varied somewhat by message and survey type as indicated in Table 2.2. Telephone survey respondents viewed the CMSs less frequently than intercept respondents, and were less likely to read a CMS message when they viewed it. However, overall the majority of survey respondents indicated that they view a CMS on a freeway daily or every few days and read the messages displayed on the CMSs 76% to 100% of the time. In general, respondents appeared to have relatively high exposure to CMSs and paid attention to their messages.

Table 2.2 Frequency of Viewing CMSs on Freeway and Reading CMS Messages by Campaign and Survey Type.

	CLICK IT OR TICKET		**DRUNK DRIVERS, CALL 911**		**SUMMARY STATISTICS**	
Frequency	**Intercept**	**Phone**	**Intercept**	**Phone**	**Mean**	***p*-value**
View CMSs on freeway	N=584	N=420	N=596	N=477	N=2077	
Every day	67.0%	36.2%	54.7%	40.9%	51.2%	<0.0001
Every few days	16.1%	27.1%	30.7%	26.8%	25.0%	
Once per week	6.2%	15.0%	9.2%	17.4%	11.4%	
Once every 2 weeks	3.6%	12.1%	2.0%	7.5%	5.8%	
Once every month	6.0%	8.9%	3.0%	6.9%	6.1%	
I rarely or never see the signs	1.2%	0%	.3%	.4%	.5%	
Read CMS messages	N=584	N=466	N=600	N=488	N=2138	
76 to 100% of the time	87.7%	80.0%	95.0%	85.0%	87.5%	<0.0001
51 to 75% of the time	6.2%	11.2%	3.8%	10.2%	7.5%	
26 to 50% of the time	4.3%	5.2%	.5%	2.5%	3.0%	
Less than 25% of the time	1.9%	3.6%	.7%	2.3%	2.0%	

Some results may not sum to 100% due to rounding error.

Comprehension and Response to CMS Safety Messages

<u>"Click it or Ticket"</u>

Of those respondents who had seen the "Click it or Ticket" message, most respondents (61.4%) thought the message meant "put on seat belt or get a ticket" and 34.8% believed that it meant that adults should put on their seat belts (see Table 2.3). There is a statistically significant difference in message comprehension between the intercept and the telephone survey (p-value < 0.0001). Among drivers in the intercept survey, 64.6% recognized that the sign suggested both seat belt use and the possibility of getting a ticket for not wearing a seat belt, compared to 53.1% in the telephone survey. In the telephone survey, 40.6% thought the message only suggested wearing a seat belt, compared to 32.5% in the intercept survey. Since in-person respondents saw the message closer to the time of the survey than telephone respondents, it is possible that drivers had incomplete recall of the "Click It or Ticket" message several days after seeing the sign.

Table 2.3 Comprehension of "Click It or Ticket" Message.

	Intercept (N=455)	Phone (N=175)	Mean (N=630)	*p*-value
Put on seat belt or get a ticket	64.6%	53.1%	61.4%	<0.0001
Put on Seat belt-adult	32.5%	40.6%	34.8%	
Put on Seat belt-child	0%	.6%	.2%	
Other	2.2%	0%	1.6%	
Don't know	0%	1.7%	.5%	

Some results may not sum to 100% due to rounding error.

As shown in Table 2.4, the majority of drivers (86.8%) indicated that they had their seat belts on prior to viewing the messages; however, among those who were not wearing their seat belts (13.2%) only 4.4% put their seat belts on after viewing the message. When respondents were asked if they did anything else differently after seeing the message, 83% in the phone survey and 85.7% in the intercept survey stated that they did nothing else differently; however, 1.1% (intercept) to 1.2% (phone) indicated that they did put a seat belt on a child; some indicated that they told others about the message (0.2% intercept and 3.0% phone); and 10.4% (intercept) to 12.7% (phone) indicated that the message had some positive effects on general driver safety not specific to wearing a seat belt.

Table 2.4 Actions Taken after Viewing "Click It or Ticket" on CMSs.

	Intercept	Phone	Mean	*p*-value
Did you put your seat belt on?	N=453	N=174	N=627	
Had my seat belt on.	86.8%	87.0%	86.8%	0.63
Yes	4.9%	3.1%	4.4%	
No	8.4%	9.9%	8.8%	
Did you do anything else differently?	N=447	N=165	N=612	
Put on child's seat belt	1.1%	1.2%	1.1%	<0.0001
More cautious	1.3%	7.3%	2.9%	
Told others about message	.2%	3.0%	1.0%	
Was safer – better driver	2.2%	4.8%	2.9%	
Avoid getting a ticket	6.9%	.6%	5.2%	
Nothing	85.7%	83.0%	85.0%	
Other	2.5%	.0%	1.8%	

Some results may not sum to 100% due to rounding error.

The "Click It or Ticket" campaign is part of the national Selective Traffic Enforcement Programs (STEP), which focuses on increasing nationwide seat belt use. STEP includes increased enforcement, paid advertisements, and nationwide evaluation of program effectiveness. The National Highway Traffic Safety Administration evaluation of the STEP campaign found that the rate of seat belt use in California increased from 90.4% in 2004 to 92.5% in 2005 (Solomon et al., 2007). In 2006, the rate increased again to 93.4% (NHTSA, 2007). In addition, in states that introduce primary seat belt enforcement laws, such as California, the rate of seat belt use has increased. For instance, the rate increased from 63% to 74% when New Jersey instituted a primary enforcement law in 2000 and from 58% to 71% when Alabama did the same in 2000 (NHTSA, 2004). Nationally, seat belt use in states with primary enforcement laws increased from 85% in 2006 to 87% in 2007 (Glassbrenner and Ye, 2007). However, both the increase in

seat belt use attributed to STEP and to the primary enforcement laws follow a trend of consistent annual seat belt use increase since 1983 (Solomon et al., 2007). It is difficult to determine whether the increases at the state or national level were attributable to STEP, seat belt law enforcement, or simply to other trends.

The percentage of drivers in the study reporting that they wore seat belts at the time they saw the CMSs is lower than the statewide average but about the same as the national rate in states with primary enforcement laws. In addition, the respondents (total for both telephone and intercept surveys) who put on their seat belt after seeing the CMSs was only about half that of those who did not put their seat belt on (N=26 vs. N=51). Among those who correctly comprehended the meaning of the "Click It or Ticket" message and were not already wearing a seat belt, 42.5% did not put on their seat belts after seeing the message (N=40). While these numbers are small, the magnitude of the difference between these groups raises the question of message effectiveness among drivers who do not already wear their seat belts. It is possible that drivers who chose not to put on their seat belts did not comprehend the threat of getting a ticket. In this sample, of the 51 individuals who did not buckle up after seeing the message, 29 (54.7%) interpreted the message to mean that they should put on a seat belt but did not mention the possibility of getting a ticket. For these individuals, other approaches, such as more detailed media messages, may be more effective.

"Drunk Drivers, Call 911"

Of those respondents who had seen the "Drunk Drivers, Call 911" message, the vast majority respondents accurately comprehended its meaning: 95.4% in the intercept survey and 99.5% in the phone survey, with a total comprehension rate of 96.5% for both surveys.

As shown in Table 2.5, few actually experienced a drunk driver and called the police (1.5% in the intercept survey and 7.9% in the phone survey). Most respondents also indicated that they did nothing else differently after viewing the message (66.7% in the intercept and 75% in the phone survey); however, a sizable portion indicated that the message had a positive effect on reducing drunk driving (30.5% in the intercept and 18.8% in the telephone survey). These results contrast with those from the "Click It or Ticket" campaign in that increased safety awareness is specific to drunk driving.

Table 2.5 Actions Taken after Viewing "Drunk Drivers, Call 911" on CMSs.

	Intercept	Phone	Mean	*p*-value
Did you call 911?	N=517	N=222	N=739	
Yes	1.5%	7.9%	3.4%	NA
No	98.5%	92.1%	96.6%	
Did you do anything else differently?	N=520	N=220	N=740	
Told others to call 911 to report a drunk driver	.2%	.5%	.3%	<0.0001
More on the lookout for drunk drivers	8.8%	13.2%	10.1%	
Told others to be on the lookout for drunk drivers	.6%	1.8%	.9%	
More cautious about drinking and driving	14.6%	2.3%	10.9%	
Told others to be more cautious drinking and driving	3.5%	.5%	2.6%	
Did not drink and drive	1.5%	.0%	1.1%	
Told others not to drink and drive	1.3%	.5%	1.1%	
Nothing	66.7%	75.0%	69.2%	
Other	2.7%	6.4%	3.8%	

Some results may not sum to 100% due to rounding error.

Over the last 20 years, California and other U.S. states have enacted legislation, including illegal blood alcohol concentration *Per Se* laws, administrative licensing revocation laws, legal drinking age laws, and zero tolerance laws to reduce drunk driving. This legislation has been supplemented by numerous anti-drunk driving programs sponsored by states, communities, and other non-governmental organizations. The combination of these efforts sent a clear signal to the public about the significant risks and consequences of drunk driving. Dang (2008) finds that drivers involved in alcohol-related crashes have decreased from 1982 to 1997 and have leveled off since then. In 2005, California reported 1,117 fatal crashes in which operators had a blood alcohol content equal to or greater than 0.08 g/dL (NCSA, 2006). Dang (2008) concludes that current laws and programs, like **"**Drunk Drivers, Call 911" messages on CMSs**,** have effectively maintained this reduction in drunk driving-related crashes. The survey in this study is consistent with Dang's (2008) findings: relatively low reporting rate (3.4% mean) and a sizable portion of respondents indicating that the CMS message had a positive effect on their awareness of the risks and consequences of drunk driving (27% mean).

2.4 Conclusion

CMSs are increasingly employed in the U.S. and internationally on roadways to alert motorists to downstream delays, roadway conditions, and travel times to key destinations. More recently, in California and throughout the U.S., CMSs have been used as part of public campaigns to promote roadway safety. To better understand comprehension and effectiveness of these public service CMS messages, both telephone and intercept surveys were implemented in conjunction with two safety campaign messages displayed on CMSs in California, the "Click It or Ticket" in May 2007 and the "Report Drunk Drivers, Call 911" in December 2007. The available published literature on the comprehension and effectiveness of CMS messages is limited and does not specifically address safety campaigns.

Legislation and programs to reduce drunk driving have been implemented over the last 20 years in California and other U.S. states, resulting in significant reductions in drunk driving-related crashes that have been approximately maintained since 1997 (Dang, 2008). The results of both

the intercept and telephone surveys for the “Report Drunk Drivers, Call 911” CMS message, indicate a very high comprehension rate for this message (98.5% intercept, 92.1% for telephone, and 96.6% mean). The results also indicate a relatively low reporting rate (1.5% intercept, 7.9% phone, and 3.4% mean), which is consistent with the current frequency of drunk driving-related crashes. Importantly, the survey results indicate that a sizable portion of respondents indicated that the CMS message had a positive effect on their awareness of the risks and consequences of drunk driving (30.5% intercept, 18.8% telephone, and 27% mean). These results suggest that when the public understands and is familiar with a public safety campaign, it may have a positive impact on maintaining its effects, which, in this case, is the reduced rate of drunk driving-related crashes.

In contrast to the “Report Drunk Drivers, Call 911” campaign, the survey results for the “Click It or Ticket” campaign indicate a much lower comprehension rate (53.1% to 64.6%). While the number of drivers already wearing their seat belts at the time they saw the "Click It or Ticket" message was high (86.8% to 87%), it was not as high as the statewide average (92.5%). In addition, the number of respondents (total for both telephone and intercept surveys) who put on their seat belts after seeing the CMS was only about half that of those who did not put on their seat belts (N=26 vs. N=51). Among those who correctly comprehended the meaning of the “Click It or Ticket” message and were not already wearing a seat belt, 42.5% did not put on their seat belts after seeing the message (N=40). In this sample, of the 51 individuals who did not buckle up after seeing the message, 29 (54.7%) interpreted the message to mean that they should put on a seat belt but did not mention the possibility of getting a ticket. While these numbers are small, the magnitude of the difference between these groups raises the question of the effectiveness of the message among drivers who do not already wear their seat belts. It is possible that drivers who chose not to put on a seat belt did not comprehend the threat of getting a ticket. These results suggest the need for more research on comprehension and effectiveness of the "Click It or Ticket" campaign. Further analysis of these questions would allow for better tailoring of the message to improve the rate of seat belt use.

Chapter 3: Public Preferences

Summary

To determine public preferences for changeable message sign (CMS) safety messages and other message types (e.g., travel time, traffic diversion), both telephone and intercept surveys were implemented in conjunction with two safety campaign messages displayed on CMSs in California (USA): “Click It or Ticket” and “Report Drunk Drivers, Call 911.” Overall the majority of all survey respondents indicated that they view a CMS on a freeway daily (52%), and read the messages displayed on the CMS 76% to 100% of the time (88%). Approximately 60% of respondents indicated that they thought the safety campaign specific to the survey, “Click It or Ticket” or “Report Drunk Drivers, Call 911,” improved their safety awareness and reduced accidents. When presented with a range of CMS safety messages, on average, respondents considered “Report Drunk Drivers/Call 911” and “Don’t Drink and Drive/Save Lives” to be helpful to very helpful; however, “Don't Speed/Save Lives,” “Click it or Ticket,” and “Report Drunk Drivers/Call CHP [California Highway Patrol]” were considered less helpful. When presented with a range of CMS message topics, on average, respondents considered advisories, advance notice messages (e.g., fog alert), AMBER Alerts, severe weather notices, and travel time advisories to be helpful to very helpful; however, safety messages were considered to be less helpful. These findings parallel the results in the literature that drivers prefer messages that help them shorten their commute times and consider other types of messages, such as safety messages, less useful.

3.1 Introduction

Public preference for certain CMS safety messages and CMS message topics are of interest because they may affect drivers’ attention to and effectiveness of messages displays. This chapter begins with a review of the relevant literature on public preferences for CMS messages. Next, we describe the results of focus groups and intercept and telephone surveys implemented in California to assess the public’s perceptions about the effectiveness of CMS safety messages and their preferences for different types of CMS messages. Finally, conclusions are drawn from the analysis.

3.2 Literature Review

Of continuing interest to transportation professionals is what type of CMS messages motorists consider most valuable and effective. Public preference for CMS content is important because it affects how drivers respond to them and how much attention they pay to them. Several studies have assessed public preference for CMS message content (including information about traffic congestion, alternate routes or diversions, safety messages, surface street conditions, parking, construction, and travel times) using telephone, in-person, or Internet surveys of drivers who frequently pass CMS on freeways or arterials.

One study, using telephone surveys in Washington, D.C., found that two thirds of respondents were in favor of using CMS for safety messages (N=517) (Benson, 1996). However, respondents preferred specific safety messages, like "signal before changing lanes" and "lights on in bad

weather," over general messages, such as "tailgating is deadly" and "drive to survive" (Benson, 1996). In another survey (Internet) study of 598 Dutch drivers, Muizelaar and Arem (2006) found that most respondents preferred messages with advice for the fastest route, followed by more detailed information, such as length, location, cause, and congestion duration. In Peng *et al.*'s (2004) on-site revealed-preference survey, respondents preferred CMSs with information about freeway accidents, freeway travel times, and alternate routes, whereas CMS messages about surface street conditions, parking, and construction were lower priorities (Peng *et al*., 2004). Peng *et al.* state that these preferences are mainly driven by drivers' primary interest in saving time. Finally, using an online survey in the San Francisco Bay Area, Huey and Margulici also found that most respondents (70%) considered travel time messages useful (Huey & Margulici, 2006). In Huey and Margulici's survey of drivers in the San Francisco Bay Area, the majority of respondents felt that the amount of sign content was appropriate (84%).

Only one study explored public preference for the use of graphics and videos on CMSs. In focus groups with 125 participants, only 33% of respondents supported using CMSs to display television pictures of road conditions (Benson, 1996). In addition, twice as many motorists preferred words over graphics to display lane closure information (Benson, 1996, p. 55).

Overall, drivers in most of these studies reported a preference for messages related to travel routes and times. However, drivers in all studies did consider other types of messages useful as well, including specific safety messages. This study builds upon these studies by conducting a statewide telephone survey of public preferences for CMS messages in addition to intercept surveys that coincide with the way in which these messages are presented.

3.3 Methods

See Chapter 2 (section 2.31 and 2.32) for a description of the focus group, telephone, and intercept survey methodologies.

3.4 Results

3.41 Focus Groups

Despite the fact that a minority of participants indicated that safety campaign messages on CMSs would change their behavior (as described in Chapter 2 above), the majority of participants indicated that, in general, they thought these messages may be beneficial and effective. Participants stated that safety messages served as a reminder to drivers about the rules of the road. As one participant stated, "any prevention is a good thing." Similarly, another stated that "if the CMSs discouraged one person from driving drunk or reminded them to designate a driver, then the message was beneficial." A small minority thought that the messages were of no value at all. Many participants also felt that other drivers might pay more attention to the safety messages, if they were linked to enforcement.

3.42 Surveys

CMS Exposure and Attention to Messages

The frequency with which drivers saw CMS messages on the freeway varied somewhat by message and survey type, as indicated in Table 3.1. Telephone survey respondents viewed the CMSs less frequently than intercept respondents and were less likely to read a CMS message when they viewed it. However, overall the majority of all survey respondents indicated that they view a CMS on a freeway daily (52%), and read the messages displayed on the CMS 76% to 100% of the time (88%). In general, respondents appeared to have relatively high exposure to CMSs and attention to their messages.

Table 3.1 Frequency of Viewing CMS on Freeway and Reading CMS Messages by Campaign and Survey Type.

	CLICK IT OR TICKET		**DRUNK DRIVERS, CALL 911**		**SUMMARY STATISTICS**	
Frequency	**Intercept**	**Phone**	**Intercept**	**Phone**	**Mean**	***p*-value**
View CMS on freeway	N=584	N=420	N=596	N=477	N=2077	
Every day	67.0%	36.2%	54.7%	40.9%	51.2%	<0.0001
Every few days	16.1%	27.1%	30.7%	26.8%	25.0%	
Once per week	6.2%	15.0%	9.2%	17.4%	11.4%	
Once every 2 weeks	3.6%	12.1%	2.0%	7.5%	5.8%	
Once every month	6.0%	8.9%	3.0%	6.9%	6.1%	
I rarely or never see the signs	1.2%	0%	.3%	.4%	.5%	
Read CMS messages	N=584	N=466	N=600	N=488	N=2138	
76 to 100% of the time	87.7%	80.0%	95.0%	85.0%	87.5%	<0.0001
51 to 75% of the time	6.2%	11.2%	3.8%	10.2%	7.5%	
26 to 50% of the time	4.3%	5.2%	.5%	2.5%	3.0%	
Less than 25% of the time	1.9%	3.6%	.7%	2.3%	2.0%	

Some results may not sum to 100% due to rounding error.

Attitudes about Safety Messages

Respondents who viewed the CMS message in each campaign were asked whether they thought the message improved their safety awareness (see Table 3.2). Over 50% of respondents in the phone and intercept survey agreed that it did. For the "Drunk Drivers, Call 911" campaign, about 40% of intercept survey respondents agreed that it improved their safety, as did 66% from the telephone survey. About 60% of phone survey respondents from both campaigns agreed that CMS safety messages result in fewer roadway accidents (see Table 3.3).

Table 3.2 Respondents' Opinions on Whether CMS Safety Message Increased Their General Safety Awareness.

Increased Safety Awareness	CLICK IT OR TICKET		DRUNK DRIVERS, CALL 911	
	Intercept (N=475)	**Phone** (N=174)	**Intercept** (N=518)	**Phone** (N=521)
Yes	60.2%	55.7%	40.9%	66.2%
No	34.8%	43.1%	57.1%	31.9%
Don't Know	5.0%	1.1%	1.9%	1.8%

Some results may not sum to 100% due to rounding error.

Table 3.3 Respondents' Opinions on Whether CMS Safety Messages Reduce Roadway Accidents.

	CLICK IT OR TICKET	DRUNK DRIVERS, CALL 911	
	Phone (N=503)	**Phone** (N=516)	**Total** (N=1018)
Yes	59.8%	62.8%	61.3%
No	22.5%	20.2%	21.3%
Don't Know	17.7%	17.1%	17.4%

Some results may not sum to 100% due to rounding error.

Respondents to the telephone survey were asked only their opinion of specific types of CMS public safety messages. Respondents were read the safety messages listed in Figure 3.1 and asked whether they "strongly agree," "agree," "neither agree nor disagree," "disagree", or "strongly disagree" that the message helps to improve public safety. The average score response was calculated with "strongly disagree" equaling one and up to "strongly agree" equaling five. The higher the score, the higher the message was rated. Any score over two indicates that respondents agreed that the message helps to improve public safety. On average, two messages were considered helpful to very helpful: "Report Drunk Drivers/Call 911" and "Don't Drink and Drive/Save Lives." Respondents tended to consider the "Don't Speed/Save Lives," "Click It or Ticket," and "Report Drunk Drivers/Call CHP [California Highway Patrol]" less helpful. Interestingly, "Report Drunk Drivers/Call CHP" was less helpful relative to the other messages; it appears that call 911 is preferable to CHP, perhaps because the provision of the number to call is considered more informative or individuals do not know what CHP stands for.

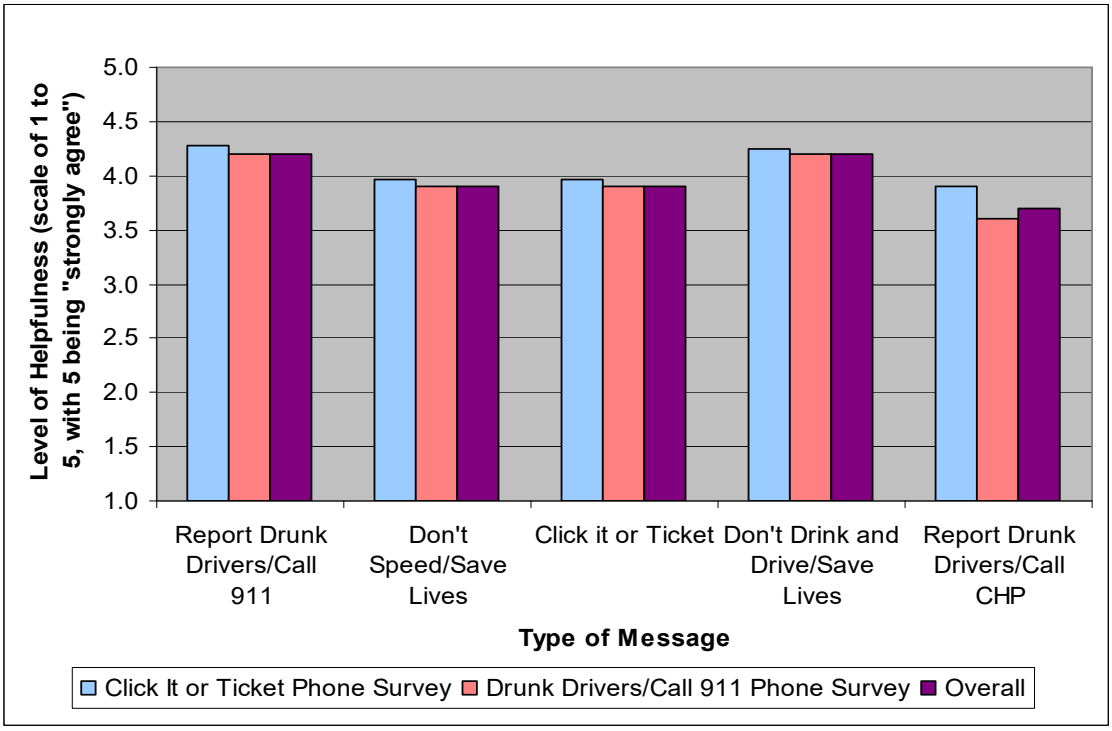

Figure 3.1 Helpfulness Ratings of CMS Safety Campaign Messages (Phone Survey).

Attitudes about Different CMS Message Topics

Respondents in both the intercept and the telephone survey were asked to rate different CMS messages topics (see Figure 3.2). Respondents were asked to indicate whether they considered the CMS message topic to be "very helpful," "helpful," "neutral," "unhelpful," or "very unhelpful." Again, the average scores were calculated with one equal to "very unhelpful" and five equal to "very helpful". A score greater than two is considered "helpful" to "very helpful." On average, across both campaigns and surveys (intercept and phone), messages considered to be "helpful" to "very helpful," included traffic advisories, advance notice messages, AMBER Alerts, severe weather notices, and travel time advisories. Safety messages, on average, were considered less helpful. These findings parallel the results in the literature that drivers prefer messages that help them shorten their commute times and consider other types of messages, such as safety, less useful.

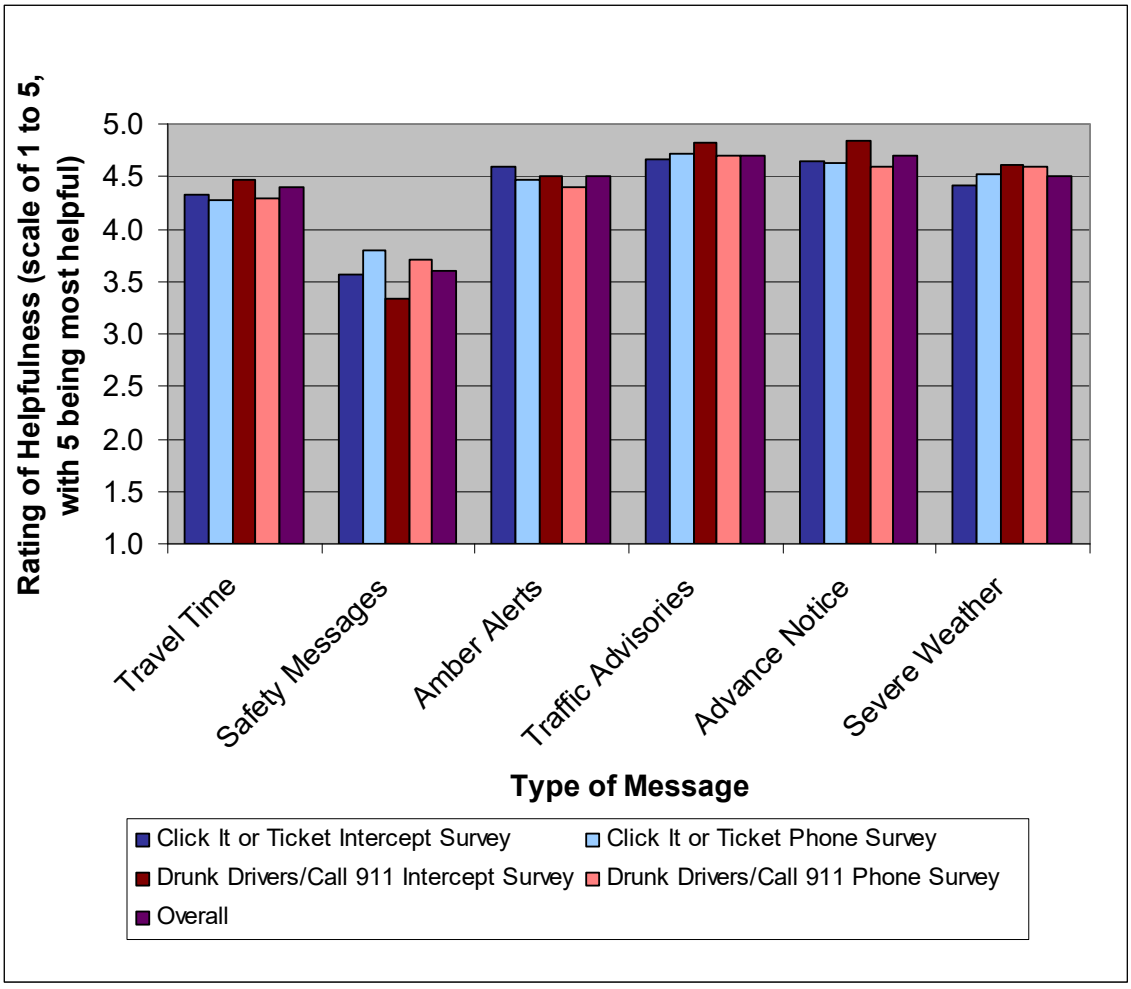

Figure 3.2 Helpfulness Ratings of CMS Message Topic (Phone and Intercept Surveys).

3.5 Conclusion

The use of CMSs to communicate important messages to drivers on the road is increasing. These messages have the potential to increase safety on roadways and highways and to decrease congestion by allowing motorists to immediately respond to pertinent information, such as messages about traffic rerouting and safety laws. The responses to surveys conducted in this study indicate that most drivers in California regularly view CMS messages, and actually read the messages the majority of the time. Respondents tended to agree that CMS safety campaign messages do improve public safety and reduce accidents. Respondents also indicated preferences for certain types of CMS safety messages: "Report Drunk Drivers/Call 911" and "Don't Drink and Drive/Save Lives" were considered to be most helpful, while "Don't Speed/Save Lives," "Click it or Ticket," and "Report Drunk Drivers/Call CHP [California Highway Patrol]" were considered less helpful. Overall, however, safety messages were considered to be less helpful than traffic advisories, advance notice messages, AMBER Alerts, severe weather notices, and travel time advisories. This last result is generally consistent with previous findings in the literature and with the results of the expert and stakeholder interviews and focus groups conducted as part of this research (see Appendices A and B).

Chapter 4: Effects on Vehicle Speeds

Summary

In this study, both reported survey data and revealed speed data from loop detectors on California highways were used to evaluate whether drivers slowed down to read CMSs with safety messages. The results of telephone and intercept surveys indicate fewer than 10% of respondents slowed down to read the safety messages, and fewer than 15% of respondents observed other drivers slowing down. A statistical evaluation of average speed data failed to establish that drivers slowed down to read CMSs with safety messages (p=0.24). However, a minority of drivers (15%) traveling 2.5 to 5 mph over the speed limit slowed an average of $1/7^{th}$ mph. Future research should employ a randomized controlled trial involving more CMS sites than in the current study.

4.1 Introduction

CMSs have the potential to increase safety on roadways by providing route-specific information to motorists about delays and road conditions; however, their expanded use to include safety campaign messages, has raised concerns about drivers possibly slowing to read CMS messages, which could increase collisions. In this chapter, both reported survey data and revealed speed data from loop detectors on California highways were evaluated to determine whether drivers slowed to read CMS safety messages. The authors begin with a review the literature on the relationship between CMSs and road speed. A discussion of the methodological approach follows. Next, research results are presented for both stated survey and observed speed data analysis. This is followed by a discussion of the results, including study limitations and opportunities for future study. Finally, the authors provide a summary of key findings in the conclusion.

4.2 Literature Review

In an online survey by Huey and Margulici (2007) of drivers in the Bay Area in 2005, respondents themselves raised concerns that CMSs could lead to decreases in speed on the road. For instance, one respondent reported: “signs are great but they cause traffic slowdowns…especially when the sign is used for messages other than traffic-related (e.g., Don’t Drink and Drive)” (p. 11).

Two studies in the published literature explore the relationship between CMS messages and driver travel speeds, but none of these studies examine safety campaign messages. In Harder *et al.*’s (2003) study of 120 drivers using a driving simulator, investigators calculated mean speeds within a half-mile range of the CMS message. A four-way analysis of variance (ANOVA) was conducted for four locations within the range adjusting for gender, age, and prior CMS exposure. In addition, the researchers explored interactions between gender, age, and CMS exposure. When drivers approached AMBER Alerts (i.e., messages containing specific details on a current abducted child), 21.7% decreased speeds by at least two miles per hour, and some drivers slowed down as much as 13.9 mph. Among drivers approaching a CMS at an exit, 13.3% slowed down

between two and 12.7 mph. Younger drivers drove the fastest, and women drove 2.3 mph more slowly than men (p=0.06). Speed differed little between prior CMS exposure groups.

In a study by Erke and Sagberg (2006) of CMS messages suggesting route changes in Norway, researchers used speed data and video recordings to assess whether or not drivers slowed to read CMS messages. They found that a greater proportion of drivers slowed at CMS locations when a message was shown. Further, no statistics on speed data were presented in the English summary.

The results of the published studies may have limited relevance to driver behavior in the presence of the relatively short, simple, and familiar safety campaign messages. Harder *et al.* focused on AMBER Alerts, which typically contain detailed content including vehicle descriptions and license plate numbers (2003). Messages that provide alternate route information due to road closures involve driver thought, decision, and action in a timely manner. For example, an alternate route may not take a driver past his or her ultimate destination or a secondary destination. A driver must weigh the consequences of weathering a delay on the main road or detouring and coping with a new set of unknowns. Drivers may be more likely to slow down for an AMBER Alert and route diversion messages that are loaded with complex information than for safety campaign messages.

4.3 Methods

See Chapter 2 (sections 2.31 and 2.32) for a description of the focus group, telephone survey, and intercept survey methodology.

4.31 Observed Travel Speed Data

Observed travel speed data were obtained from the California Freeway Performance Measurement System (PeMS) database (2007). A list of all CMSs in the San Francisco Bay Area was provided by the California Department of Transportation (Caltrans) with CMS message, location, and time of day. PeMS uses sets of loop detectors spanning a freeway in a single direction called Vehicle Detector Systems (VDS) to collect data such as speed, density, and flow in five-minute time intervals.

PeMS traffic data surrounding CMSs in the study were collected at times when the safety messages were shown as well as control days when the CMS messages were not shown. Control days were selected to best approximate the road conditions on the day the CMS message was shown. These days were usually one year before the message's display on the same day of the week and during the same time interval. If a message was shown over a holiday, an effort was made to choose a control day that would replicate the road conditions of the holiday.

Data were only collected for CMSs with VDS less than 2.5 miles in front of the CMS. In addition, the minimum observation percentage had to be greater or equal to 75% to use the VDS data. Most highways are four or five lanes wide in a single direction, and if one lane's loop detector fails, the observation percentages would respectively be 75% or 80%. The other three or four working loop detectors would continue recording data normally, while the non-working detector's data are imputed (by PeMS).

As speed limits at each CMS location are posted as 65 mph, all time intervals where the average speeds were less than 60 mph were eliminated from the dataset. These instances do not represent free-flow situations and may bias the modeling results.

Ultimately, only five sites met the inclusion criteria and contained valid VDS data. Some VDS had unrecorded data or a low percentage of working loop detectors (observation percentage).

All speed data analysis and modeling was done employing SPSS v15 (Chicago, IL), using generalized linear models that control for CMS location, time of day, and distance to CMS.

4.4 Results

4.41 Stated Survey Responses

Telephone and intercept surveys were administered for the two safety campaign messages. The "Click It or Ticket" in May 2007 and "Report Drunk Drivers, Call 911" campaign in December 2007 included questions that asked drivers: 1) if they slowed down to read the CMS message, and 2) if they observed other drivers slowing to read the message. For "Click It or Ticket," the intercept results indicated that 9% (41/455) stated that they slowed down to read the CMS message and 9% (41/455) reported that other drivers slowed down. In contrast, telephone results indicate that 8.6% (15/175) stated that they slowed down to read the CMS message, and 14.3% (25/175) reported that other drivers slowed down (see Figure 1). For "Report Drunk Drivers/Call 911," the in-person results indicated that 2.1% (11/520) stated that they slowed down to read the CMS message, and 4.2% (22/520) reported that other drivers slowed down. Telephone results revealed that 9.5% (21/222) stated that they slowed down to read the CMS message, and 11.3% (25/222) reported that other drivers slowed down. Interestingly, drivers thought others slowed down more often than they did themselves. Similarly, participants in focus groups for this study indicated that they did not slow down to read CMS messages; however, they thought that other drivers did (see Appendix B).

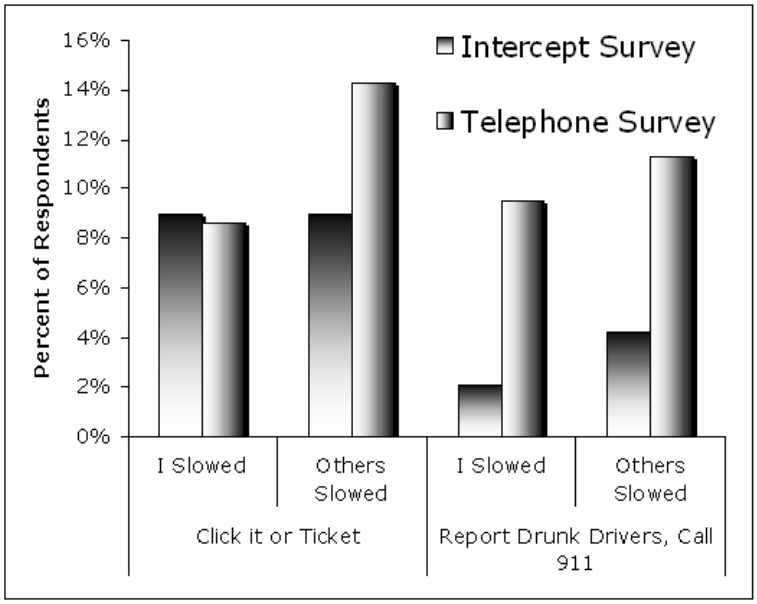

Figure 4.1 Percent of Respondents Indicating that They or Others Slowed Down to Read Safety Campaign Message by Message and Survey.

4.42 Observed Speed

Four safety messages were displayed on five CMS signs from May to December 2005 in the San Francisco Bay Area: "Arrive Alive – Don't Drink and Drive" (43.1% of sample), "Obey Speed Limit" (33.3%), "Click It or Ticket – Buckle Up" (13.5%), and "Save A life – Drive Safe" (10.1%). Data were accessed by PeMS in five-minute intervals producing a sample large enough to detect statistically significant effects of CMS messages on average highway speeds. The total sample size, the distribution of the samples among the sites, and a description of each CMS location appear in Table 4.1.

Table 4.1 Frequencies of CMS Locations with Description for PeMS Speed Data.

CMS Location	Total	%	Description (Highway, Direction of travel, Distance to nearest city, Distance from nearest on-ramp)
San Mateo	2,651	38.5	SR-101, North-bound, 1.6 miles northwest of Burlingame, 0.5 miles north of Broadway
Contra Costa I	2,009	29.2	SR-24, West-bound, in Lafayette, 0.4 miles west of Deer Hill Rd
San Francisco	1,141	16.6	I-280, North-bound, 1.6 miles North east of Ingleside, 0.5 miles north of Monterey Blvd.
Contra Costa II	715	10.4	I-80, West-bound, 0.8 miles east of Tara Hills, 0.9 mi west of Pinole Valley Rd.
Marin	362	5.3	SR-101, North-bound, 6 miles north of San Rafael, 0.1 miles north of Nave Dr.
Total	6,878	100.0	

The distance of the detectors (VDS) from the CMSs was expressed in negative values, and the distribution is shown in Figure 3.2. This distribution lends itself to four natural groups starting on

the far right, with three clearly defined groups (Very Close, Close, and Far), and the remainder in the last group (Very Far, indicated in black in Figure 4.2). The four groups of distances are equally represented by the data (see bottom row of Table 4.2).

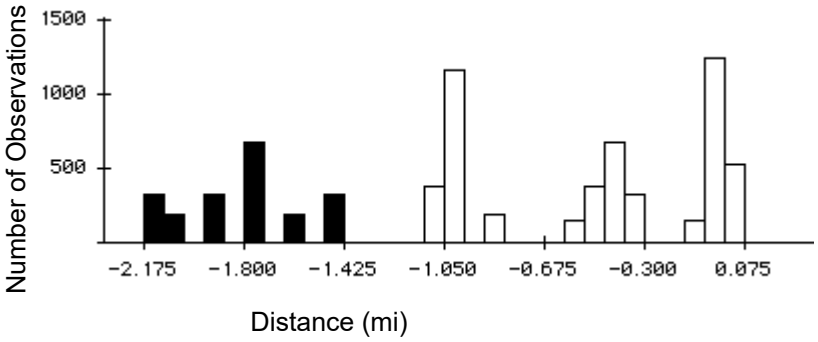

Figure 4.2 Histogram of Distance of VDS to CMS (group "very far" in black).

Table 4.2 Frequencies of Distances of VDS to CMS.

	Very Far	Far	Close	Very Close		
Location	**> 1.3 mi**	**1.3 - 0.6 mi**	**0.6 - 0.1 mi**	**<0.1 mi**	**Total**	**Percent**
San Mateo	670	671	656	654	2651	38.5
Contra Costa I	1001	336	336	336	2009	29.2
San Francisco	0	380	380	381	1141	16.6
Contra Costa II	240	192	0	283	715	10.4
Marin	0	156	156	50	362	5.3
Total	1911	1735	1528	1704	6878	100.0
Percent	27.8	25.2	22.2	24.8	100	

Driver average speeds for the entire sample is 69.2 ± 3.6 mph, with statistically different speeds at each location (p<0.0001, ANOVA). These differences are illustrated in Figure 3 and will have to be controlled for in models evaluating CMS influence on driver speeds. Notice that at the San Mateo location average speeds of 75 mph are within one standard deviation, while at Contra Costa II speeds within one standard deviation were as low as 56 mph.

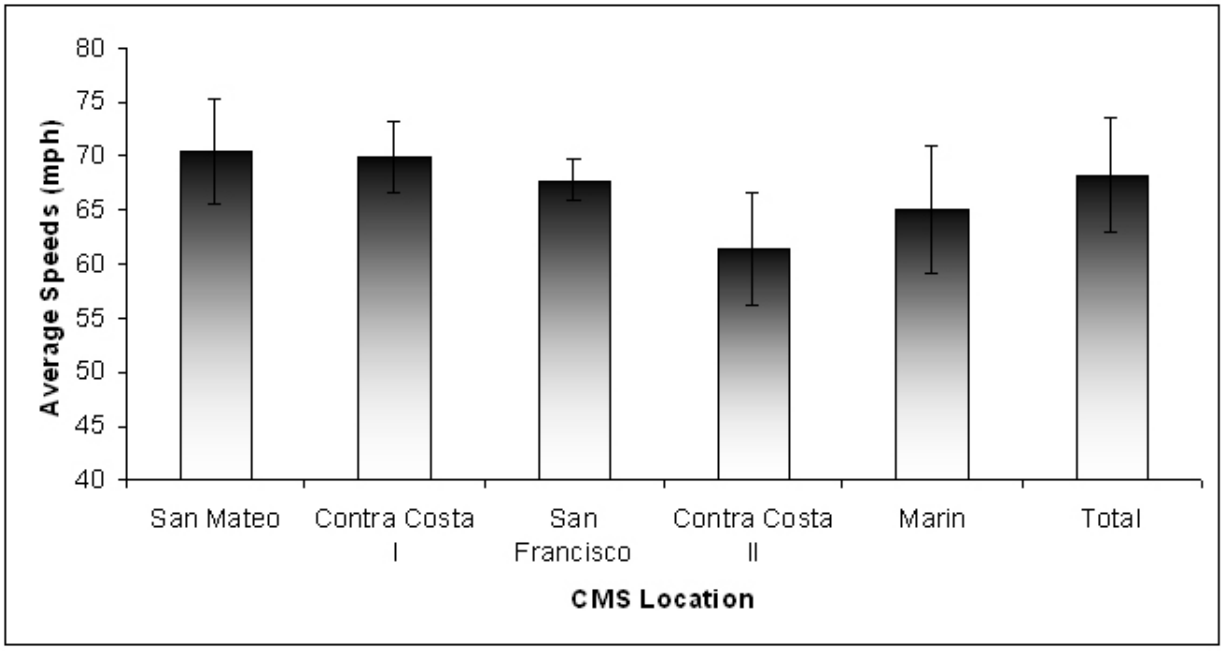

Figure 4.3 Driver Average Speeds at Each CMS Location and Total.

To test the hypothesis that drivers slow down to read CMS safety messages, a generalized linear model was employed where the response or dependent variable is driver average speed, and an indicator variable specifying when a CMS safety message is shown or not is the predictor or independent variable. If it is found that average driver speeds are less when a CMS safety message is shown versus when not shown, we can determine that drivers are indeed slowing to read the safety message.

All variables available in the dataset were used as control variables in the model. They are site location, distance from VDS to CMS, distance squared, and time of day. The number of characters in the message could not be included in the model, as times when no message was shown had no characters. Since the observed speed part of study is retrospective, different safety messages could not be controlled for since site location was concomitant with the different safety messages. The square of the distance was included in the model, as it is both significant and improved model residuals.

Model Results

Results of the model indicate that all the control variables in the model affect driver average speeds significantly (all $p<0.0001$), while the presence of a CMS safety message does not ($p=0.24$, see Table 4.3).

Table 4.3 Primary Model of Average Driver Speed.

Source	Degrees of Freedom	Sums of Squares	Mean Square	F-ratio	*p*-value
Constant	1	3.30E+07	3.30E+07	4.49E+06	< 0.0001
Distance	1	1277.63	1277.63	173.98	< 0.0001
Distance Squared	1	1132.56	1132.56	154.22	< 0.0001
Site Location	4	23752.6	5938.14	808.6	< 0.0001
Time of day	2	4440.55	2220.28	302.34	< 0.0001
CMS (on or off)	1	10.152	10.152	1.3824	0.2397
Error	6868	50436.6	7.34371		
Total	6877	88163.2			

Control Variables

The control variable—time of day—changed average speed very little, as indicated in Table 4.4. There is only a difference of about 1.5 mph from the late night drivers to the other time intervals. This is not surprising, as traffic patterns change with time of day.

Table 4.4 Summary of Average Speed (mph) by Time of Day.

Group	Count	Mean mph*	Standard Deviation
12-5am	708	70.8	2.7
5-10am	1011	72.0	2.7
10-2pm	5159	68.5	3.5
Total	6878	69.2	3.6

* 1 mph

It was expected that CMS location would be significant as discovered by the ANOVA analysis in the previous section, where each CMS location was shown to exhibit a different average speed.

The CMS distance effect does not reveal a clear trend as shown in Figure 4.4. From very far, drivers average almost 70 mph, then slow down one mph, then speed up again to 70 mph, only to slow down to the lowest speed of 68 mph right in front of the CMS (within 0.1 miles). However, this phenomenon occurs whether or not the CMS is actually showing a safety message or not. This suggests the possibility that drivers may slow down on average due to the mere presence of a CMS and not due to a message. However, the magnitude of the slowdown is less than two mph, and there is a possibility with only five locations that the slowdown is due to the physical characteristics of particular locations.

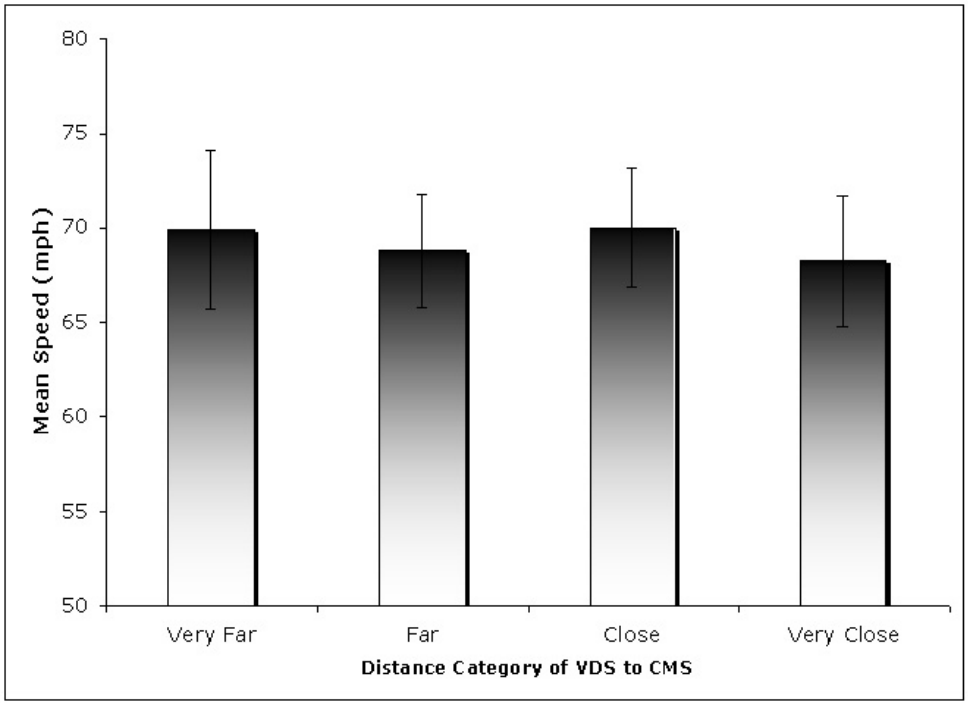

Figure 4.4 Average Driver Speeds (mph) by Categorical Distance from CMS.

The issue of drivers slowing down within 0.1 miles of a CMS, regardless of whether a message is displayed, was investigated by running the model again but for each CMS location individually when a CMS message is not displayed. Investigating each location when CMS messages are not shown determines if drivers slowed down due to a CMS presence and not message content. Distance to a CMS statistically affects average speed in only three of five locations (see Table 4.5). Of these, one of them shows a strong quadratic effect (Marin), where drivers slow initially, speed up and then slow down again, suggesting that speed may be more a function of hills or turns known to be common in Marin. Another location that revealed a significance effect is San Francisco, where drivers appeared to speed up approaching the CMS, suggesting again that slowing down just prior to a CMS is not related to the presence of the sign but is an artifact of location characteristics. Only one of the five locations demonstrated a consistent slow down as drivers approached the CMS (Contra Costa I) and even this case amounted to only a 1.1 mph slow down. The overall conclusion, based on the analysis of the five locations, is that there is no consistent behavior exhibited, and the apparent slow downs are due to characteristics of each particular location and not the presence of a CMS.

Table 4.5 Summary of Average Driver Speeds (mph) by Distance at Each CMS Location when the CMS is Not Showing Any Message.

Distance	Contra Costa I	Contra Costa II	Marin	San Francisco	San Mateo
Very Far	70.8	63.1	-	-	70.6
Far	70.1	64.8	65.5	67.0	70.5
Close	68.7	-	70.6	67.7	71.9
Very Close	67.6	64.0	62.0	68.7	71.0
p-value	<0.0001	0.47	<0.0001	0.0001	0.29

"-" = no data

Various Speed Analyses

Researchers hypothesized that it is possible that a CMS message referring to a law enforcement action could cause drivers who are going over the speed limit to slow down to avoid a speeding ticket. Thus, the act of reading the message has nothing to do with slowing to read it. Interestingly, researchers found that those drivers with average speeds between 67.5 and 70.5 mph did, in fact, slow down when a CMS safety message was shown (p=0.0003). Although this special interval spans only three mph (see Figure 4.5), it does include 15% of the data and the most common speed of 68 mph, which is just over the speed limit of 65 mph. In the event this phenomenon is also an artifact of site physical characteristics (and not an overall trend), the model was repeated for those few cases (15%), where a slow down was observed but for each site individually. The overall speed reduction trend was replicated in the majority of sites with an adequate sample size. The finding that drivers traveling just over the speed limit may slow in the presence of a CMS safety message should be replicated in future research with a larger sample size.

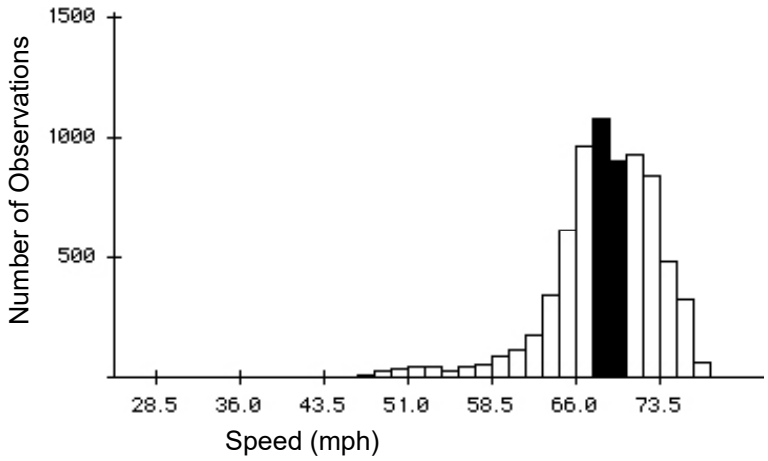

Figure 4.5 Histogram of All Average Speeds (mph) with the Interval of Speed Reduction due to CMS Shown in Black.

4.5 Discussion

The PeMS database system proved to be a fruitful resource for data analysis, and our model proved to be an effective method for detecting changes in driver speeds. Speed changes as little as $1/7^{th}$ mph were statistically significant. The results indicated that, on average, drivers are not slowing down for CMS safety messages. However, the analysis also showed that drivers traveling 2.5 to 5 mph over the speed limit (15% of sample) did in fact slow down an average of $1/7^{th}$ mph. It is possible that those traveling the slower speeds do not need to slow down in the presence of CMS messages; those traveling at very high speeds are not likely to be very concerned about a speeding ticket, and thus only those conscious of their speed, at just over the speed limit, responded to the CMS message and slowed slightly. As the motivation for slowing down cannot be separated from those trying to avoid a speeding ticket, we do not know for certain that drivers who slowed due to safety messages are doing so to read the message.

The minority of drivers who were found to slow down for CMS safety messages (15%), based on the observed speed data analysis, is consistent with the stated survey findings where 2.1% to 9.0% of respondents reported that they slowed down to read the signs, and 4.2% to 14.3% of respondents reported that others slowed down.

These results suggest that if all drivers were going the speed limit, none would slow down to read CMS safety messages. Further, those that slowed down are a minority, and they only slowed by a small fraction of one mph posing no threat to traffic safety or traffic delay.

4.6 Limitations

Availability of data was a limitation of the study. Only five CMS locations had sufficient data to be included in the study. The four types of safety messages could not be entered into the model and therefore controlled for, as message content was concomitant with site location. Traffic densities were not collected, so corrections for this could not be made in the model. Control data were gathered from the prior year, and other changes in traffic conditions were unknown. Further, it is unknown which messages were "two phase" (a message in which half the message appears separate from the second half). Drivers waiting to view the second phase of a message might respond differently. In addition, the model had no way to account for speeding, and some drivers may have slowed at safety messages to avoid speeding tickets rather than to read the CMS.

The survey data could be subject to the usual sample biases of telephone and intercept surveys. For example, for the intercept survey, not all drivers stop at rest stops but all stop at gas stations. Also, survey responses that indicated drivers slowed down could be overstated, as some respondents may have thought they were supposed to slow down for safety messages and simply replied as such. The survey results reveal a discrepancy between the distribution of those who think they did not slow down and believed that others did. Theoretically, these numbers should be equal, as the same percent of respondents who claim they slowed down should perfectly match those who thought others slowed down.

Finally, the observed speed analysis of the study was retrospective and should be done as a randomized controlled trial.

4.7 Future Study

Future research should include a randomized controlled trial using loop detector data obtained from both permanently installed and temporary CMSs at locations (randomized) throughout California in which a period of a week separates the display and non-display of safety messages. Using control data gathered from one year prior introduces an unknown number of other factors, and a true comparison is difficult. Data should be collected year round and holidays should be noted. Traffic density and flow in addition to speed data should be collected so that traffic conditions can be controlled. A more detailed CMS site analysis should be conducted indicating posted maximum speed limits, number of lanes, presence of an HOV lane (or other special type of lane), road slope at the site, and degree of turn at each distance from the CMS. Data should be collected one to two miles past the CMS as well so that traffic conditions (such as congestion) can be further reflected in the models.

4.8 Conclusions

CMSs have the potential to increase safety on roadways by providing route specific information to motorists about delays and road conditions; however, their expanded use to include safety campaign messages has raised concerns about drivers possibly slowing down to read CMS messages, which could increase collisions. In this study, both reported survey data and revealed speed data from loop detectors on California highways were evaluated to determine whether drivers slowed down to read CMS safety messages. The telephone and intercept survey results indicate that less than 10% of respondents slowed down to read the safety messages, and less than 15% of respondents observed other drivers doing so. A statistical evaluation of average speed data failed to establish that drivers slowed down to read CMS safety messages (p=0.24). This finding differs from those of previously published studies that indicate drivers may slow down to read CMS AMBER Alert and route guidance messages. Consistent with the other studies is our finding that a minority of drivers (15%) traveling 2.5 to 5 mph over the speed limit slowed an average of $1/7^{th}$ mph (p=0.0003). These results suggest that if all drivers were going the speed limit, none would slow down to read the CMS safety messages. Further, those that do slow down are a minority and only do so by a small fraction of one mph, posing no threat to traffic safety or traffic delay. Future research should employ a randomized controlled trial involving more CMS sites than were possible in the current study and with randomized messages and times shown.

Chapter 5: Conclusions

With respect to the three motivating questions of this study, the following can be concluded.

1. *How attentive is the public to messages displayed on CMSs?*

- The results of the literature review indicate that detailed messages (e.g., license plate numbers) and flashing messages are more difficult for drivers to recall. Fiber optic signs may improve drivers' attention to messages.

- The results of the statewide telephone and intercept survey administered while safety campaign messages were displayed on CMSs indicate *high levels of attention to CMS messages*: between 80% and 95% of respondents, many of whom view CMS messages daily, indicate that they read CMS messages 75% to 100% of the time.

2. *Is there a public safety benefit from displaying safety campaign messages on CMSs?*

- There is no published literature that evaluates the public safety benefit from safety campaign messages displayed on CMS. However, there are a limited number of studies that document positive behavioral changes resulting from road condition and route guidance messages displayed on CMS.

- The results of the telephone and the intercept survey undertaken in conjunction with the "Click It or Ticket" and the "Report Drunk Drivers, Call 911" safety message campaigns suggest that *positive safety effects may be derived from public safety campaigns messages on CMSs when the public is familiar with and understands the messages displayed*. The results for the "Report Drunk Drivers, Call 911" CMS messages indicate a high comprehension rate (92% to 98.5%); a low rate of drunk driver reporting (1.5% to 7.9% phone), which is consistent with the current reduced rate of drunk driving-related incidents in California; and a sizable effect on awareness of the risks and consequences of drunk driving (18.8% to 30.5%). In contrast, the survey results for the "Click it or Ticket" campaign indicate a much lower comprehension rate (53.1% to 64.6%). Only 33% of those not wearing their seat belt, put it on after viewing the message, and over half of those who did not did not put on their seat belt, did not fully comprehend the message.

- The survey results were echoed in the focus groups. Many participants indicated that they already practiced safe driving habits, and thus the messages would have no affect on their behavior. However, others did indicate a positive change in their behavior after seeing a safety campaign message. Some commented specifically on the "Call 911 to Report Drunk Driving" message, two indicated that they paid more attention to other drivers and one called 911 to report a suspected drunk driver. Another participant stated that, after seeing the "Don't Speed" message, she looked at her speedometer and slowed down. Participants tended to agree that safety messages served as a reminder to drivers about the rules of the road and stated, for example, that "any prevention is a good thing" and that "if the CMSs discouraged one person from driving drunk or reminded them to designate a driver, then the message was beneficial."

- On the other hand, the results of the telephone and intercept surveys indicated that safety messages were considered to be less helpful overall than traffic advisories, advance notice messages, AMBER Alerts, and severe weather notices. This last result is generally consistent with previous findings in the literature and with the results of the expert and stakeholder interviews and focus groups conducted as part of this research.

3. *Do travelers slow down to read CMS messages and, as a result, interrupt traffic flow?*

- Only two studies report on the effect of CMS messages (AMBER Alerts and route diversion) on driving speeds, and their results suggest that drivers may slow down to read messages. However, AMBER Alerts and route diversion messages are more cognitively demanding than the relatively short, simple, and familiar safety campaign messages, and thus their findings may have limited relevance to this study. AMBER Alerts typically contain detailed content including vehicle descriptions and license plate numbers. Alternate route information requires quick thought, decision, and action on the part of the driver.

- The results of telephone and intercept surveys indicate less than 10% of respondents slowed down to read the safety messages and less than 15% of respondents observed other drivers slowing down.

- Similarly, focus group participants indicated that they do not slow down in the presence of a CMS message; however, they have observed other drivers doing so.

- A statistical evaluation of observed speed data found that a minority of drivers (15%) traveling 2.5 to five mph over the speed limit slowed an average of $1/7^{th}$ mph (p=0.0003) in the presence of CMSs with safety messages; however, overall average driving speeds were not significantly reduced (p=0.24).[3]

Based on the findings of this study, researchers recommend the continued display of safety campaign messages on CMSs; however, the display of these messages should have a lower priority than messages related to traffic advisories, advance notices, AMBER Alerts, and severe weather notices. Safety messages should be evaluated to ensure a high level of public familiarity and understanding, and priority for display should be based on message evaluations.

Specific guidelines that prioritize messages for display on CMSs to optimize comprehension and positive behavioral change should be developed by relevant state agencies based on the best available evidence on CMS messaging. Research on CMS messaging should be monitored, and guidelines should be updated accordingly.

[3] Note that researchers attempted an analysis of how the presence of safety campaign messages on CMSs may have affected accidents; however, because of limitations in the available data, the analysis was inconclusive. The results are documented in Appendix D.

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APPENDIX A: SUMMARY OF EXPERT AND STAKEHOLDER INTERVIEWS

Introduction

In Appendix A, the results of interviews with experts and stakeholders involved in the implementation of CMSs and their messages in the U.S. are summarized. The topics explored in this summary include expert and stakeholder understanding of the importance, benefits, and limitations of different types of CMS messages; the effectiveness of safety campaign messages; and research needs.

Methods

Interviews were conducted with 21 experts and stakeholders (referred to collectively as respondents here) in California as well as throughout the U.S. during April, May, and June 2007. The majority of interviews were conducted by telephone, although a few were conducted in-person. Respondents were contacted for interviews at numerous agencies across the U.S., including representatives from U.S. Department of Transportations, California Department of Transportation District Offices, the California Highway Patrol, the National Highway Traffic Safety Administration, the California Office of Traffic Safety, the California State Automobile Association, and consulting firms. Respondents provided their opinions and these did not necessarily represent the perspective of their employers. Responses are reported in aggregate to protect the confidentiality of the respondents. The interview script is included at the end of this appendix.

The interviews began by exploring respondents' background and their work responsibilities in relation to CMSs and safety messages. Next, respondents were asked questions related to the use of CMSs to display safety messages, including the benefits and challenges of using CMSs to display safety messages. Questions were then asked that explored the overall use of CMSs and types of messages that might be displayed. Finally, respondents were asked questions about the delivery methods for safety messages and research needs.

Background

Each interview began by asking respondents how their work responsibilities related to CMSs. Ten respondents indicated that they worked in traffic management and had direct responsibility for, or participatory roles, in deciding which messages were displayed on CMSs. Five respondents were involved with the process of displaying messages, but were not involved in determining the content of the messages. Four respondents participated in decisions related to the use of CMSs and the types of messages displayed. Two did not work with CMSs and one worked with incident management, travel time, and data collection.

Next, respondents were asked about their roles in the deployment of CMS safety campaigns messages. Many indicated that their responsibilities for CMSs were not specific to CMS safety campaign messages. Nine of the experts reviewed all CMS messages, including safety messages, to determine whether they met agency standards related to messages type, format, and length. Three were involved with the development of policy regarding the use of CMSs, including the

safety campaigns. Two had responsibility for broader safety campaigns, of which the use of CMSs was just one component. Four noted that safety messages were dictated by headquarters, and that they were responsible solely for message implementation. One of these individuals was responsible for displaying the correct message without creating a hazard. Three respondents were not involved with CMS safety messages.

Respondents were then asked about the types of CMS safety campaign messages with which they were familiar. The majority of respondents were familiar with CMS messages about drunk drivers. This was followed by messages about seat belts, work zone safety, and AMBER Alerts. Some also noted familiarity with maximum enforcement, weather advisories, and special event messages. One respondent was not familiar with safety campaign messages.

CMSs and Safety Messages

Next, respondents were asked a series of questions that explored their opinions about the use of CMSs to display safety campaign messages. The first question asked respondents what they thought were the benefits of using CMSs for safety campaigns. While most respondents noted various benefits, none felt certain that this practice improved safety. Seven thought safety messages on CMSs might encourage safer driving, but acknowledged a lack of empirical evidence supporting this. Four respondents simply noted that there was no data regarding the benefits of using CMS for safety messages. Six thought that one of the greatest benefits of using CMSs to display safety messages was the ability to reach many people and locations, and four noted the ability to target travelers while they were driving. Three respondents noted benefits including the dynamic nature of the CMSs and their ability to target different messages by time-of-day. Some noted the low cost, speed, and ease of displaying messages on CMSs. Three respondents thought there might be a benefit of displaying safety messages on CMSs when these messages were linked to a broader safety campaign. One respondent did not think there was any benefit of displaying safety messages on CMSs.

Next, respondents were asked what they thought were the greatest challenges of using CMSs for safety campaign messages. Respondents noted the greatest challenge was that drivers might begin to ignore CMSs due to their overuse. Respondents also had concerns about: ensuring that the information displayed CMSs was correct and relevant; drivers slowing to read the messages; and the possibility of confusing drivers with messages. Other challenges noted included the lack of data on the impact of using CMSs for safety campaigns and public complaints about using tax money for this purpose.

Respondents were then asked if they had any concerns about the use of CMSs for safety campaigns. The primary opinion expressed was that traffic management messages are more important (seven respondents) and that only traffic related messages should be displayed on the CMSs (two respondents). Two of the respondents felt that it is unclear that drivers change their behavior in the presence of messages that are not traffic related. The respondents also stated that it is unclear how to determine what non-traffic related messages are appropriate, that safety messages should be used in conjunction with maximum enforcement, and that CMSs become less effective with over-use. One respondent did not have information about the use of CMSs for

safety campaigns. Another did not have any concerns and felt that CMSs should be used for safety message campaigns.

The final question asked respondents whether they believed CMSs should be used for safety messages. Overall, respondents felt CMSs should be used to display safety messages. Most also noted that there should be guidelines. The CMSs should not be over-used and safety messages should only be displayed when there was nothing else to report to drivers. A few believed that CMSs should only be used for serious situations such as an AMBER Alert.

Types of Messages Displayed on CMS

After discussing the use of CMSs for safety message campaigns, the discussion shifted to general questions about the types of messages displayed on CMSs and the general benefits and challenges of CMSs. Respondents were asked how they thought the public would rank (low, medium, and high) different types of messages. Respondents believed that the public would find messages related to travel, such as traffic management and weather, to be the most important use of CMSs. They also thought that the public would find AMBER Alerts messages to be an important use of CMSs. Respondents thought the public would find less value in messages that were not directly relevant to their current trip, including safety messages. Figure A-1 illustrates respondents' ratings of the relative importance of CMS messages from the public perspective.

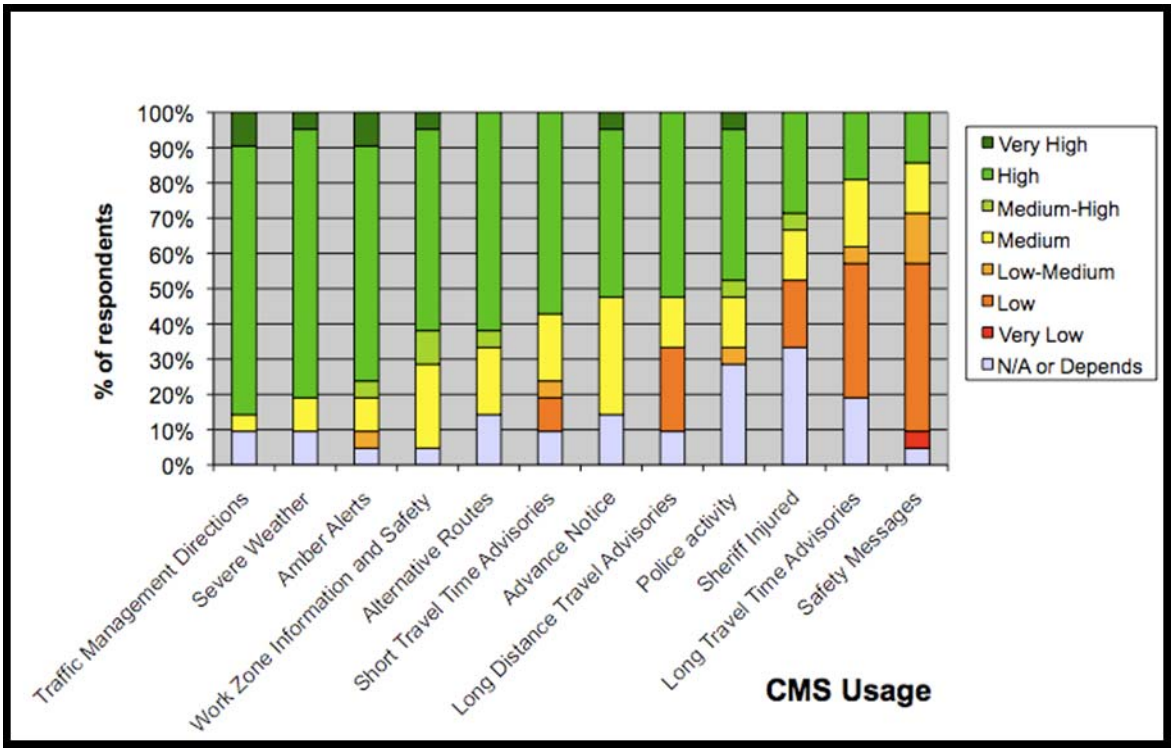

Figure A-1 Rankings, from Public's Perspective, the Importance of CMS Message Types.

After ranking the importance of CMS messages from the public's perspective, respondents were asked, to rank *how expert/stakeholders would rank (low, medium, high) the importance of the same set of messages*. From their expert/stakeholder perspective, the respondents also ranked

information related to the immediate trip as most important, such as traffic management directions and severe weather. Respondents also thought that police activity was also important. Respondents ranked safety messages as the least important use for CMSs. Figure A-2 shows the importance of different CMS messages from the expert and stakeholder perspective.

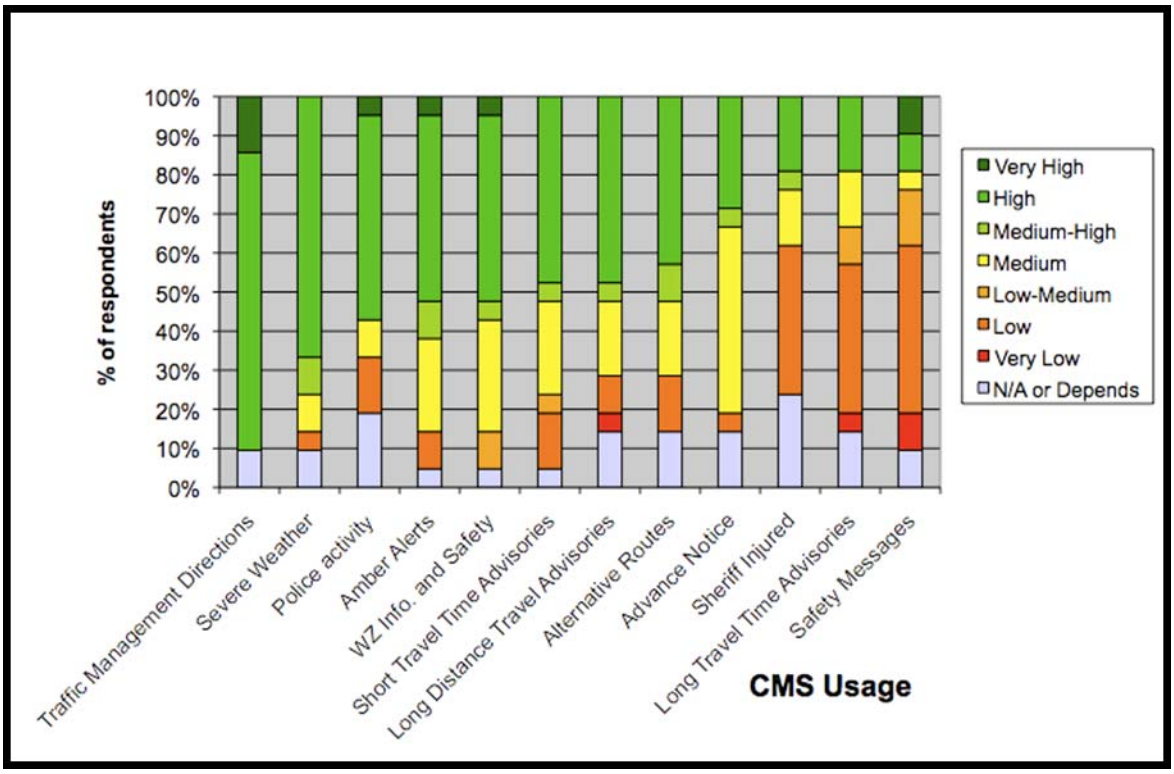

Figure A-2 Rankings, from Expert/Stakeholder Perspective, the Importance of CMS Messages Types.

Next, respondents were asked to discuss any concerns they might have about CMSs. This question was intended to explore overall concerns about CMSs, and not just concerns about safety messages. Respondents' primary concern was that drivers might begin to ignore the messages due to overuse of the CMSs. The respondents also expressed concern that drivers might slow to read the messages, resulting in additional congestion and unsafe conditions. Table A-1 shows the concerns expressed by respondents.

Table A-1 Concerns about CMS.

Concerns	Respondents
Drivers ignoring messages due to CMS overuse	13
Drivers slowing to read message create congestion and unsafe conditions	8
Accuracy of information	5
Public complaints about messages	3
Not changing or updating messages	2
Placement of the CMS to not block signals or traffic	2
Displaying messages that do not benefit drivers	2
Environmental impacts in sensitive areas	2
Extra maintenance due to CMS overuse	1
Not using the CMSs enough (tax money should be better utilized)	1
Drivers do not notice CMSs due to other flashier/larger signs	1
Limitations of CMSs	1
Distracting duel phase messages	1
Over-engineered and too costly for purpose	1

After discussing concerns about CMSs, respondents were asked about the benefits. This question probed the overall benefits of CMSs, and not just the safety messages. Table A-2 shows the benefits expressed by the respondents.

Table A-2 Benefits of CMSs.

Benefits	Respondents
Drivers are more tolerant of delays if they are informed in real time	10
Information improves traffic flow and enhances safety	9
Allow drivers to make alternative plans and/or take alternative routes	8
Alert drivers of unexpected and dangerous conditions or situations	4
Reach a large audience	4
Reach a targeted audience	3
Inform drivers of travel time	3
AMBER alerts help save children	2
Dynamic and thus get people’s attention	2
Ease of deployment for both portable and permanent	1

When respondents were asked to rank (low, medium, and high) the benefits of displaying different types of messages on CMSs, road conditions, hazards, and non-recurrent conditions were noted as the messages with the highest benefits. Respondents were mixed in their opinions about the value of displaying safety messages on CMSs and did not think that information about parking and public transportation was of high value. See Figure A-3 for the respondents' ranking of the relative benefits of various CMS messages.

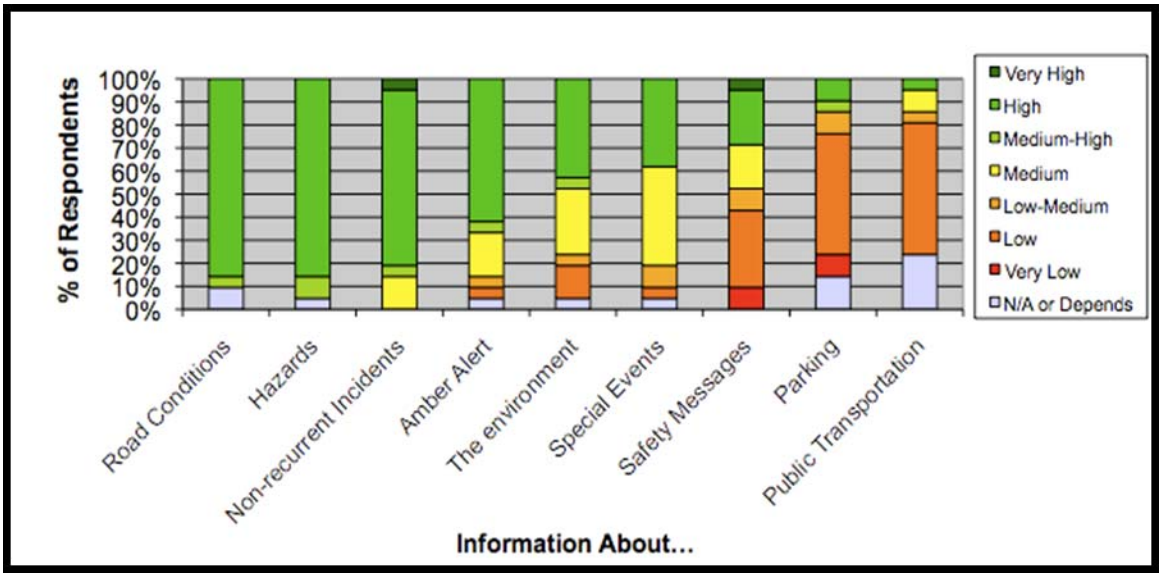

Figure A-3 Relative Importance of CMS Messages.

Methods to Deliver Safety Messages and Research Needs

Next, respondents were asked what they (or their agency or organization) had found to be the best methods to deliver safety messages to the public. Many respondents were quick to point out that the best methods were often costly and some focused on free media, such as news stories. Some respondents made a distinction between messages targeting traffic safety and messages about general safety in their response to the question. Five respondents thought CMSs were the best method to deliver traffic safety messages. For general safety messages, television and radio were the preferred delivery methods. CMSs were also considered a good method to deliver safety messages, but only when there was no other message to display. Other media for delivering safety messages noted by the respondents included newspapers, billboards, static signs, mailers, the Internet, pamphlets, posters, and law enforcement.

Finally, the respondents were asked what research they would like to see conducted regarding CMS and safety campaigns. Many indicated that research was needed to determine the behavioral effects of CMS safety messages, public opinions about safety campaign messages, and whether drivers read the messages. One respondent indicated that no research was necessary because the effectiveness of safety messages were intuitively known. Responses are noted in Table A-3.

Table A-3 Research Needs Regarding CMS and Safety Messages.

Research Needs	Respondents
Do drivers change their behavior?	12
What is the public's opinion?	8
Do drivers read the messages?	7
Are the signs or the messages? distracting?	3
Do drivers understand the messages?	3
Do the messages cause or contribute to accidents?	2
Do drivers slow down to read messages?	1

Expert and Stakeholder Interview Instrument

Goal: To understand the range of concerns and expectations about the application of the CMS for public safety campaigns

Introductions

Introduce self and intent of interview
Introduce Project/Review consent text and get signed or verbal consent.
Get name, title of interviewee (if not already available)

1) Do your work responsibilities pertain to CMS in any way?
   a. If so, how?

2) What is your role in the deployment of CMS safety campaigns?

3) What CMS safety campaign messages are you familiar with?

4) What are the greatest benefits of using CMSs for safety campaigns?

5) What are the greatest challenges of using CMSs for safety campaigns?

6) Do you have concerns regarding the use of CMSs for safety campaigns?
   a. If so, what are your concerns?

7) Do you believe that CMSs should be used for safety messages?

8) Please order the highest, medium and lowest uses of CMSs from what you believe would represent the PUBLIC perspective.

   a. Short Distance Travel Time Advisories (30 minutes or less)
   b. Long Distance Travel Time Advisories (100-240 minutes)
   c. Long Distance Travel Advisories (carry chains 100+ miles from snow)
   d. Safety Messages (don't drink and drive, use seat belts, don't speed, save lives)
   e. Amber Alerts
   f. Sheriff Injured
   g. Traffic Management Directions (Incident Ahead, Lane Closure Ahead, Real Time Traffic Management, slow or stopped traffic ahead)
   h. Work Zone Information and Safety
   i. Alternative Routes (optional and required)
   j. Advance Notice (major closure, major special event)
   k. Police activity (bomb threat, terrorist attack, hostage/kidnap situation)
   l. Severe Weather (fog, dust, wind, snow, ice)
   m. Other Uses Not Noted Here?

9) Please order the highest, medium and lowest uses of CMSs from YOUR EXPERT/STAKEHOLDER perspective.

a. Short Distance Travel Time Advisories (30 minutes or less)
b. Long Distance Travel Time Advisories (100-240 minutes)
c. Long Distance Travel Advisories (carry chains 100+ miles from snow)
d. Safety Messages (don't drink and drive, use seat belts, don't speed, save lives)
e. Amber Alerts
f. Sheriff Injured
g. Traffic Management Directions (Incident Ahead, Lane Closure Ahead, Real Time Traffic Management, slow or stopped traffic ahead)
h. Work Zone Information and Safety
i. Alternative Routes (optional and required)
j. Advance Notice (major closure, major special event)
k. Police activity (bomb threat, terrorist attack, hostage/kidnap situation)
l. Severe Weather (fog, dust, wind, snow, ice)
m. Other Uses Not Noted Here?

10) Do you have any concerns regarding CMSs? (overall, not just safety messages)
   a. If so what are your concerns?

11a) In your opinion, what are the benefits of CMSs s?

(First ask this as an open question with no prompts)

11b) Same question as above, but now provide options (high, medium, low)
   a. Inform the traveler of road conditions
   b. Information related to hazards
   c. Information related to special events (immediate or advance notice)
   d. Information related to non-recurrent incidents (accidents, road work)
   e. Parking Information
   f. Public transport information
   g. The environment (weather)
   h. Amber alert
   i. Safety messages

12) What have you or your (state, agency, organization) found to be the best method to deliver safety messages to the public?

13) Please tell me what research you would like to see conducted regarding CMSs and safety campaign.

APPENDIX B: SUMMARY OF FOCUS GROUP RESULTS

Introduction

In Appendix B, the results of two focus groups, conducted to allow for an in-depth exploration of drivers' attitudes toward CMSs and safety messages and to assist researchers in developing a statewide public opinion survey on the same topic, are summarized. The focus groups were held on the evenings of April 18 and 19, 2007 in Walnut Creek, California. Participants were recruited via flyers distributed at local business parks. Potential participants were screened to ensure that participants included California residents who drove as their primary mode of travel, and were between the ages of 18 and 56 years old. Twenty-three persons participated in the two focus groups. The focus group instruments are provided at the end of this Appendix.

Background Survey Results

A brief questionnaire was administered at the beginning of each focus group to provide background demographic information about the participants.

- Eleven participants were female and twelve were male.

- Eleven participants were single, ten were married, one was divorced, and one declined to state.

- The focus groups included participants of all ages:
    - 18 and 25 (seven);
    - 26 and 30 (four);
    - 31 and 35 (two);
    - 41 and 55 (seven); and
    - 56 or older (three).

- A wide range of academic achievement was reported among the participants:
    - Some high school (one);
    - High school diplomas (three);
    - Associate Degree (one);
    - Some college (six);
    - Bachelor Degrees (six);
    - Some graduate school (two);
    - Master Degrees (two); and
    - Declined to state (two).

- Household income levels (2006 pre-tax) varied as well among participants:
    - $10,000 to $19,999 (three);
    - $20,000 to $49,999 (five);
    - $50,000 to 79,999 (four);
    - $80,000 to $109,999 (four);
    - Over $110,000 (three); and

- Declined to state (four).

- Participants reported living in cities throughout the East San Francisco Bay as well as the Central Valley and Sonoma County:
  - Walnut Creek (three);
  - Livermore (two);
  - Clayton (two);
  - Concord (two);
  - Elk Grove (two);
  - Danville (one);
  - Lafayette (one);
  - Concord (one);
  - Alamo (one);
  - Orinda (one);
  - Benicia (one);
  - Brentwood (one);
  - Rodeo (one);
  - Tracy (one);
  - Vallejo (one);
  - Merced (one); and
  - Rohnert Park (one).

- The majority of participants work in the East Bay (one in Oakland, Livermore, Alamo, Pleasanton, Tracey and two in Berkeley, Walnut Creek, Pleasant Hill), some worked further from the Bay Area (two in Sacramento and one in Merced), and six reported working throughout the Bay Area.

The questionnaire also asked participants a series of questions about the number of miles they drive for their commute to work, the highways they drive on, and their recollection of CMSs on their commute. The purpose of these questions was to provide researchers with a background understanding of the participant's exposure to CMSs.

- While the majority of participants drive between 10 and 30 miles during a typical one-way commute to work, quite a number drove less than ten miles, and a few had much longer daily commutes:
  - Less than 10 miles (seven);
  - 10 to 20 miles (nine);
  - 20 to 30 miles (three);
  - 30 to 40 miles (one);
  - 75 to 80 miles (one);
  - 70 miles (one); and
  - 10 to 150 miles (one).

- Participants reported driving on a variety of highways during their commutes (note that this question did not attempt to determine the stretch of highway driven or actual exposure to CMSs during the participant's commute to work):

- Highway 680: 22 miles daily average (eight);
- Highway 24: 20.5 miles daily average (six);
- Highway 580: 30 miles daily average (four);
- Interstate 5: 87.5 miles daily average (two);
- Highway 99: 27.5 miles daily average (four);
- Interstate 80: 44 miles daily average (one);
- Highway 120: 10 miles daily average (one);
- Highway 4: 10 miles daily average (one);
- Interstate 50: 10 miles daily average (one);
- Highway 101: 55 miles daily average (one);
- Highway 280: 20 miles daily average (one); and
- Highway 880: 5 miles daily average (one).

- All of the participants recalled seeing CMSs on freeways. The messages most clearly remembered by the participants were AMBER Alerts and messages related to the immediate trip, such as traffic advisory and travel time to destination. Fewer participants remembered public safety messages and messages that did not relate to the immediate trip:
  - AMBER Alert (16);
  - Traffic advisory (14);
  - Travel time to destination (13);
  - Weather advisories (eight);
  - Public safety message (five); and
  - Officer injured/down (two).

- Among the five participants who recalled seeing public safety messages on CMSs, the following messages were noted:
  - Slow for Cone Zone;
  - Construction Zone;
  - Call 911, Report Drunk Drivers; and
  - Bay Bridge Closure (Labor Day 2006).

- Participants recalled seeing CMSs on a variety of highways, which reflects the high number of highways the participants drive for their commutes to work:
  - Interstate 5 (four);
  - Highway 24 (four);
  - Interstate 80 (three);
  - Highway 99 (two);
  - Highway 680 (two);
  - Highway 4 (one);
  - Highway 140 (one); and
  - Interstate 880 (one).

  Participants also recalled seeing CMSs in Pleasant Hill, Pinole, San Mateo, and at the Sun Valley Mall exit. One participant recalled seeing a CMS while driving toward Santa

Rosa, and another while driving toward San Francisco. Three did not recall specific locations.

- While many of the participants recalled seeing CMSs every day, many reported seeing the CMSs less frequently and did not recall how often they saw CMSs:
    - Once a week (three);
    - Twice a week (four);
    - Five times a week (six);
    - More than five times a week (two); and
    - Did not recall (eight).

Focus Group Discussion

In both focus groups, the moderator followed a protocol developed to gain a stronger understanding of the participants' experience with CMSs and to elicit their opinions and perceptions regarding CMSs, particularly with respect to the use of CMSs for delivering safety messages to the driving public. The focus groups began with general questions and discussions about CMS messages and shifted to more specific discussions about CMS and safety messages.

Initially participants were asked where they drove on a regular basis, which freeways they typically drove on, if they noticed CMSs on these routes and, in which locations they remembered CMSs. All focus group participants recalled seeing CMSs while driving. As described previously above, a wide variety of locations were noted, indicating both the diverse driving patterns of the focus group participants as well as a fairly high deployment of CMSs in the San Francisco Bay Area:

- Highway 24 between Walnut Creek and Berkeley, near Central Lafayette and before the Caldecott Tunnel (three);
- Highway 680 near Orinda, Concord, and Red Bear (three);
- Highways, 99 and 140 between Turlock and Merced, and on Interstate 5 between Stockton and Sacramento (two);
- Interstate 80 in a number of locations including downtown Oakland, near University Avenue, between Vallejo and Pleasant Hill, and between Vallejo and El Cerrito (two),
- Interstate 5 between the East Bay and Los Angles (two);
- Highway 680 towards Dublin and another near Davis (two);
- Highway 99 and 50 and Interstate 5 near Sacramento and Elk Grove (two);
- Highway 4 near Martinez (one); and
- Highway 101 between Sonoma and San Francisco (one).

The two CMS messages that participants recalled seeing most frequently were messages to call 911 to report drunk drivers and AMBER Alerts. Between the two focus groups, six participants recalled each of these messages. One said she had called 911 when she saw an erratic driver because of this message. Four participants recalled seeing a message about a wanted fugitive and four remembered seeing messages related to weather conditions, including dust and wind advisories. Three noted seeing messages about an officer injured/killed, two had seen road closure signs related to the Bay Bridge, and two recalled a CMS posting traffic conditions ahead. Just one participant mentioned seeing a road closure/construction message.

The participants were asked what they thought was the primary purpose of CMSs. The majority thought CMSs were used to ease congestion, make traffic flow better, manage traffic flow, and divert congestion. However, one participant stated that the CMSs "jam traffic up." Many of the participants felt that CMSs are supposed to increase driver awareness and make drivers pay attention to road conditions, but an equal number felt the primary purpose of CMSs was to promote roadway safety. One noted that the purpose was to reach a large number of people with one sign.

When the participants were asked to rank the importance of the various messages displayed on the CMSs, the most important messages were thought to be about road conditions, traffic delay, and AMBER Alerts. The least important messages to display on CMSs included "Call 911 to Report Drunk Driving", fugitive or wanted person, and advanced notice regarding weather or road conditions.

None of the participants thought they slowed to read messages posted on the CMSs. However, most thought that other drivers did slow to read the messages.

When participants were asked to recall specific safety messages, nine remembered seeing the "click-it or ticket" message, six noted seeing messages encouraging them to call 911 to report drunk drivers, and four recalled seeing "don't drink and drive" messages. Other messages that the participants recalled included reducing driving speeds to save lives and to slow for construction.

Many participants thought that public safety messages were beneficial and considered CMSs to be an effective method for broadcasting messages. Participants stated that safety messages served as a reminder to drivers about the rules of the road. One thought that the messages about not drinking and driving might encourage motorists to designate a sober driver during the holidays. Messages to drivers not to speed were considered helpful reminders. Participants also thought that the signs caught drivers' attention, and one stated that "any prevention is a good thing." Two persons had suggestions to make the safety messages more effective, including placing them in locations where people have time to respond to the message, and displaying messages at night when they are easier to see and read.

Other participants did not think CMS safety messages were effective or beneficial. Two participants stated that motorists would not change their behavior (e.g., not drinking and driving) based on CMS messages. One thought that the safety messages were not needed and would be ignored. One suggested that if drivers were paying attention to a CMS, then they would not be paying attention to driving. Finally, an older focus group participant stated that older drivers needed more time to react to the messages.

When participants were asked if the safety messages have had an impact on *their behavior*, a majority (15 participants) felt that CMS safety messages provided information that most drivers already know, and that they would not cause a change in behavior. However, some respondents did report changes in behavior in response to safety messages. Four reported that, when they saw an AMBER Alert message, they became more aware of vehicles around them and two mentioned

that after seeing a CMS with a "Call 911 to Report Drunk Driving" message that they paid more attention to how other motorists were driving. One participant reported that she called 911 to report a driver she suspected was drunk after seeing a CMS message encouraging her to do so. One stated that, after seeing a CMS with a message alerting her to traffic congestion ahead, she was prepared to stop when she saw the traffic back up. Another participant stated that, after seeing the "don't speed" message, she looked at her speedometer and slowed down.

Next, participants were asked if they thought *other motorists* modified their driving behavior after seeing a CMS. Many participants felt that drivers would pay attention to the safety messages, if they were linked to enforcement (e.g., radar enforcement, driving under the influence [DUI] check points, and information about fines for speeding through work zones).

Participants had varied responses to messages about not drinking and driving. Two suggested that DUI checkpoint messages and anti-drinking and driving messages might be effective during holidays. One thought that if the CMSs discourage one person from driving drunk or reminded them to designate a driver, then the message was beneficial. Another participant thought message to not drink and drive were "ridiculous," because people would not change their behavior. Moreover, if they were already driving drunk when they saw the message, they would not stop.

Once the discussion shifted away from the drunk driving messages, one participant reported seeing other drivers take detours that were suggested on CMSs. Another thought the safety messages caused drivers to be more aware in general and might encourage the use of seat belts.

Some of the participants' comments related to other driver responses to the presence of the message rather than the content, six noted that other drivers slow to read the signs. Four of the six thought that drivers slow significantly to read AMBER Alerts.

The participants had suggestions to make CMSs more effective, but also noted some concerns regarding the messages. Two of the participants liked the idea of posting messages in Spanish and one suggested an easy to remember phone number, such as "1-800-CALL-CHP" might be effective. Another participant thought posting a "joke of the day" would help catch drivers' attention and two noted that displaying the same type of message every day might cause drivers to ignore the CMSs. Another suggested that CMSs should not display too much information or text.

A number of participants noted concerns about messages instructing drivers to use their cell phones, such as "Call 911 to Report Drunk Drivers." Some participants thought that encouraging motorists to call 911 would clog up the emergency call centers and that the wait time to report a crime would be too long. Others stated that dialing and cell phone use while driving was difficult.

After discussing safety messages, the discussion shifted to other types of public service messages that motorists might see on a CMS. Participants were asked if they recalled seeing general public messages that did not relate to road safety, such as "Flex Your Power." Four participants remembered "fire hazard" messages on Highways 50 and 80 towards Tahoe and three mentioned seeing messages encouraging motorists to use Bay Area Rapid Transit (BART) during spare the

air days. One participant recalled seeing a "Flex Your Power" message in Southern California during the rolling brownouts, and another remembered a "spare the air day" message near the Caldecott Tunnel in the San Francisco Bay Area.

Not all of the participants supported the use of CMS for general public messages. Three noted that they felt this use of CMSs was for advertisement purposes and they did not want to be told to do something on a public display. Another added: "I'm really concerned that this becomes a slippery slope; once you start moving away from traffic and public safety messages, where does it stop?" One respondent objected to the use of CMSs for non-traffic: "If my commute was slowed to read a sign about Flex Your Power, I would be ticked off because I would be late to work." Another simply stated that these types of messages were a "waste of time and waste of space on a sign."

Finally, the focus group participants were asked about other ways to deliver public safety messages. Overall participants supported the use of CMSs to deliver public safety messages. However, participants had many suggestions, including commercial radio, television, flyers, utility bill inserts, private billboards, signs on public transit such as busses and BART, junk mail, bumper stickers, and a blimp. One of the younger participants suggested a program called "Every 16 Minutes," which is conducted in high schools to combat teen drunk driving.

There was a wide divergence in opinion regarding the effectiveness of these mechanisms to deliver public safety messages and some mechanisms fell into both the most and least effective categories. The most effective methods for delivering public safety messages were thought to be television and radio followed by newspaper, CMSs, Internet, signs on overpasses, signs at public events, and advertisements on transit. The least effective mechanisms for delivering public safety messages were thought to be utility bills, junk mail, newspapers, flyers, bumper stickers, Internet, blimps, and CMSs.

Focus Group Questionnaire

Thank you for completing this questionnaire. All answers are completely confidential.

First Name:_____

1. On a typical day, how far is your one-way commute?

   ⑥ Under 10 miles per day
   ⑥ 10 - 20 miles per day
   ⑥ 20 -30 – 15 miles per day
   ⑥ 30 – 40 miles per day
   ⑥ Over 40 miles per day, please specify distance: _____ miles per day

2. In what city do you live? _____

3. In what city do you work? _____

4. What highway(s) do you drive on your typical commute? Approximately how many miles on each highway?:

   ⑥ 680 North Miles/day_____
   ⑥ 680 South Miles/day_____
   ⑥ 24 East Miles/day_____
   ⑥ 24 West Miles/day_____
   ⑥ Other (Please list highway)_____Miles/day_____
   ⑥ Other (Please list highway)_____Miles/day_____
   ⑥ Other (Please list highway)_____Miles/day_____
   ⑥ Other (Please list highway)_____Miles/day_____

5. On your commute have you ever noticed a Changeable Message Sign on the freeway?

   □ Yes
   □ No

6. If yes, what messages did the sign display?

   ⑥ Don't recall
   ⑥ Amber Alerts
   ⑥ Weather Advisory
   ⑥ Traffic Advisory
   ⑥ Travel Time to Destinations
   ⑥ Officer Injured/Down
   ⑥ Public safety messages
   ⑥ Other, Please specify_____

7. If you have noticed a Changeable Message Sign, can you recall the location?

   Please list:_____

8. How often do you typically see a message displayed on a changeable message sign during your commute?

   ⑥ Don't recall
   ⑥ Once a week
   ⑥ 2 times a week
   ⑥ 3 times a week
   ⑥ 4 times a week
   ⑥ 5 times a week
   ⑥ More than 5 times a week

9. Are you... ⑥ female ⑥ male

10. What is your current marital status?

    ⑥ Single ⑥ Married ⑥ Separated ⑥ Divorced ⑥ Widowed

11. What is your age?

    ⑥ 18 - 25 ⑥ 26 - 30 ⑥ 31 – 35 ⑥ 36 - 40 ⑥ 41 - 55 ⑥ 56 or older

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

    ⑥ Grade school ⑥ Bachelor's degree
    ⑥ Some high school ⑥ Some graduate school
    ⑥ Graduated high school ⑥ Master's degree
    ⑥ Associate's degree ⑥ Ph.D. or higher
    ⑥ Some college ⑥ Other, please specify:_____

13. What was your household's 2005, pre-tax income?

    ⑥ Under $10K
    ⑥ $10K - $19.9K
    ⑥ $20K - $49.9K
    ⑥ $50K - $79.9K
    ⑥ $80K - $109.9K
    ⑥ More than $110K
    ⑥ Decline to respond

Focus Group Protocol

6:30-6:40 Pre- Focus Group with Participants:

- Consent forms
- Intake questionnaire

6:40-6:50 Introduction:

- Moderator introduction and focus group purpose/overview
- Participant introductions

6:50-7:10 CMS Awareness:

- Tell us about your commute route and where are the changeable message signs that you see along the way (if any). (around the table with everyone)

- What messages do you recall seeing posted on a CMS? How often do you see messages posted on the CMS? (list on the easel)

- What do you believe is the primary purpose of CMS? (list answers on the easel)

- What do you think of CMS as a mechanism to deliver information to the public? (negative, positive, indifferent)

- What information messages do you consider most important and what are least important? (list most and least on easel)

7:10-7:30 CMS and Safety Campaigns

- Do you recall seeing any messages on CMSs about general safety….such as drinking and driving, speeding, or using seat belts?

- Messages associated with a safety campaign include: (list on easel)

    1) REPORT DRUNK DRIVERS / CALL 911
    2) REPORT DRUNK DRIVERS / CALL CHP
    3) DON'T SPEED / SAVE LIVES
    4) CLICK IT OR TICKET
    5) DON'T DRINK AND DRIVE / SAVE LIVES
    6) DON'T SPEED / SAVE LIVES

  Which do you recall seeing? (show of hands and count)

- Have any of these messages had an impact on your behavior (immediate or delayed)?

- Do you believe these messages have an impact on other driver's behavior?

- What information do you think should be included on the CMS to promote roadway safety?

- Do you think CMS can be an effective method of communicating public safety messages and improving roadway safety? Why or why not?

- Under what circumstances might CMS for public safety messages be effective?

- Under what circumstanced might CMS for public safety messages be less effective?

7:30-7:40 Break

7:40-7:50 CMS Impact on Travel:

- Do think reading CMS messages impacts your driving?

- If, so how do you think this impacted your driving?

- Do you think reading CMS impacts other people's driving?

- How do you think CMS impacts other peoples driving? (list on easel)

- By a show of hands, how many of you would say that motorists slow down to read the messages?

7:50-8:10 CMS Effectiveness:

- Can you recall a time when you changed your behavior in response to the information in a CMS?

- What was the message and what did you do?

- Do you think other motorists are likely to modify their driving behaviors after reading a message posted on a CMS? Why or why not?

- Do you think a message posted on a CMS warning you of an upcoming accident would cause you to use an alternative route? Why or why not?

- Do you think a CMS can affect other driving behaviors such as speeding, wearing a seat belt, or more serious behaviors such as drinking and driving? Why or why not?

8:10-8:20 Public Safety Messages Overall:

- Do you think that public safety messages (don't drink and drive, use child restraints, use seat-belt) are beneficial?

- What types of public messages can you recall?

- How have these messages been dispensed?
  --Utility bill inserts
  --billboards
  --CMS
  --radio messages
  --TV messages
  --other?
  (List on easel)

- Vote on effectiveness of these mechanisms to delivery public safety messages

8:20-8:30 Dispense Incentives and Adjourn

Appendix C: Telephone and Intercept Survey

Telephone Survey

First Screen

1. PROCEED TO NEXT QUESTION
2. No answer
3. Normal busy
4. Answering machine
5. Non-Working Number
6. Business Number
7. Fax/Modem/Data Line
8. Disconnected Number

Introduction

Hello. My name is _____ and I am calling on behalf of the University of California and the California Department of Transportation. We are conducting a study about Changeable Message Signs (or CMS) that show safety information to drivers on highways in California. Your participation in the survey will help Caltrans improve roadway safety in California. To see if you are eligible for the study, I have a few quick questions for you.

Screening

SC1. Are you at least eighteen years old with a valid driver's license?

1. Yes [SKPTO SC4]
2. No [SKPTO SC2]
88. Don't know [SKPTO SC2]
99. Refused [THANK AND TERMINATE]

SC2. Is someone else over 18 with a valid driver's license available?

1. IF YES "May I please speak to that person?" [CONTINUE INTERVIEW WITH NEW PERSON. RE-READ THE INTRODUCTION]
2. IF NO: "What would be a better time for me to call [RECORD TIME AND SET CALL BACK]
88. Don't know [THANK AND TERMINATE]
99. Refused [THANK AND TERMINATE]

SC4. Have you been driving on a major highway in California **within the last few days?**

1. Yes
2. No [THANK AND TERMINATE]
88. Don't know [THANK AND TERMINATE]
99. Refused [THANK AND TERMINATE]

(Program note – we need to recruit a R who says "yes" to SC1 and SC4, and want to exhaust all possible adults in the household)

SC5. Consent

Great – You are eligible to participate in this study and it will take about 10 minutes. The results of the study will provide researchers at the University of California and Caltrans with an understanding of the effectiveness of CMS for public safety campaigns. If you volunteer to be in

this study, you may withdraw at any time without consequences of any kind. Any information that is obtained in connection with this study will not be linked to you in any way. Your participation is strictly anonymous.

May I proceed now?

1. Yes
2. No – refused to participate [TERMINATE]
3. When will be a good time to call back? [RECORD TIME/SET CALL BACK]

CMS. Questions (All who qualify)

The first questions ask about Changeable Message Signs or CMS. A CMS is a large electronic sign along a freeway that is either permanent or portable. They are turned on to provide information to motorists.

NOTE: IF RESPONDENT DOES NOT UNDERSTAND – The CMS is the "display" that shows messages like "Amber Alert" and "Travel time to destination."

C1. Do you recall ever seeing a message displayed on a Changeable Message Sign?

1. Yes
2. No
88. Don't know
99. Refused

If ANS >1, (skpto GS Intro)

C2. (If C1 = 1) What did the message say?

1. "Click it or Ticket" or other seat belt message [skpto CT1]
2. Other message: enter verbatim: _____ [skpto OC1]
88. Don't remember (Interviewer – probe for any part of the message they recall) [skpto OC1]
99. Refused [Terminate]

(Program note for interviewers - If there is any mention of Click it or ticket, or any reference to a seat belt, R will go to CT1.)

(Program note -If the verbatim responses in C2 do **NOT** have **ANY** mention of Click it or Ticket, then skip to **OC1)**

Click it or Ticket Questions (All who say something related to Click it or Ticket)

CT1. What do you think the "Click it or Ticket" message means? DO NOT READ

1. Put on a Seat belt – adult
2. Put on a Seat belt – child
3. Put on seat belt or get a ticket
4. Drive slower
5. Drive faster
6. Tolls
7. FastTrak
8. Other (specify) _____
88. Don't know
99. Refused

CT2. Did you slow down in your car to read the “Click it or Ticket” message?

1. Yes
2. No
88. Don’t know
99. Refused

CT3. Did you notice other cars slowing down to read the “Click it or Ticket” message?

1. Yes
2. No
88. Don’t know
99. Refused

CT4. Did you put on your seat belt after seeing the “Click it or Ticket” message?

1. I already had my seat belt on
2. Yes
3. No
88. Don’t know
99. Refused

CT4a. Did anyone else in your car put on a seat belt after seeing the “Click it or Ticket” message?

1. They already had their seat belts on
2. Yes
3. No
4. No other passenger in car
88. Don’t know
99. Refused

CT5. Is there anything else **you** did differently after seeing the “Click it or Ticket” message? (DO NOT READ) (Select all that apply)

1. Put my (a) child’s seat belt on
2. Was more cautious
3. Told other people about it
4. Thought about safety (Been a safer driver)
5. Thought about not wanting a ticket (Avoided ticket)
6. Have not done anything differently
7. Other (specify) _____
88. Don’t know
99. Refused

CT6. What do you think **other drivers** do differently after seeing the “Click it or Ticket” message? (DO NOT READ) (Select all that apply)

1. Wear seat belts more - adults
2. Wear seat belts more - kids
3. Tell people about it
4. Avoid getting tickets
5. Wear seat belts less
6. Complain to Transit authority
7. They do not do anything differently
8. Other (specify) _____
88. Don’t know
99. Refused

CT7. Did you think the “Click it or Ticket” message increased **your awareness** of safety?

1. Yes
2. No
88. Don’t know
99. Refused

Other CMS Messages (Those who **have** seen messages, but have **NOT** seen “Click it or Ticket”, or any version of those words)

OC1. Do you recall seeing **other** messages displayed on the CMS?

1. Yes
2. No **(skpto GS Intro)**
88. Don’t know **(skpto GS Intro)**
99. Refused **(skpto GS Intro)**

OC2. (If OCMS1 = 1) What did the message say?

Enter Verbatim: _____

88. Don’t remember (Interviewer – probe for any part of the message they recall) **(skpto GS Intro)**
99. Refused **(skpto GS Intro)**

(Program note for interviewers - If there is any mention of Click it or ticket, or any reference to a seat belt, R will go to CT1. These R will go from CT1 to GS Intro)

General Safety (For All)

GS Intro. Okay – thank you. Now I am going to read you some actual safety messages shown on CMS signs. Even if you have never seen these signs, we want to know if you think these messages help to **improve** public safety. Please respond with your opinions about these safety messages.

Do you Strongly agree, Agree, Neither agree nor disagree, Disagree or Strongly disagree that the following message **helps to improve public safety**…

GS1. **“Report Drunk Drivers/Call 911”**
Do you….

1. Strongly agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree
88. Don’t know
99. Refused

And this message…

GS2. **“Don’t Speed/Save Lives”**

1. Strongly agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree

88. Don't know
99. Refused

What about…

GS3**. "Click it or Ticket"**
1. Strongly agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree
88. Don't know
99. Refused

And…

GS4**. "Don't Drink and Drive/Save Lives"**
1. Strongly agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree
88. Don't know
99. Refused

Finally, what about this message

GS5**. "Report Drunk Drivers/Call CHP"**
1. Strongly agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly Disagree
88. Don't know
99. Refused

GS6. In general, do you think CMS with safety messages result in **less accidents on the roadways**?
1. Yes
2. No
88. Don't know
99. Refused

Program note: If C1. ANS >1 skp to OP Intro

GS7. About how often do you see a Changeable Message Sign on the freeway?
1. Every day
2. Every few days
3. Once per week
4. Once every 2 weeks
5. Once every month

6. I never see the signs
7. Other (Specify):
88. Don't know
99. Refused

GS8. What percentage of the time that you see the Changeable Message Sign, do you think you actually *read* the sign?

1. less than 25% of the time
2. 26 – 50% of the time
3. 51 – 75% of the time
4. 76 – 100% of the time
5. Other (Specify):
88. Don't know
99. Refused

Opinions of CMS and suggestions

OP Intro: Okay great. Now, I am going to ask you for a rating of how helpful the following CMS messages are to you as a driver and to the public in general. Please give a rating between 1 and 5 about the following **six safety topics** with**being Very helpful** and **5 being Very UNHELPFUL**.

Okay, the first topic is…

O1. Travel Time Advisories (or travel time to destination)

1. Very Helpful
2.
3.
4.
5. Very Unhelpful
88. Don't know
99. Refused

The next topic is…

O2. Safety Messages (such as don't drink and drive, use seat belts, don't speed)

1. Very Helpful
2.
3.
4.
5. Very Unhelpful
88. Don't know
99. Refused

And the next topic is…

O3. Amber Alerts (or child abduction alerts)

1. Very Helpful
2.
3.
4.
5. Very Unhelpful
88. Don't know
99. Refused

Next is...

O4. Traffic Advisories (such as Incident Ahead, Lane Closure, slow or stopped traffic ahead)

1. Very Helpful
2.
3.
4.
5. Very Unhelpful
88. Don't know
99. Refused

O5. Advance Notice (such as major closure, major special event)

1. Very Helpful
2.
3.
4.
5. Very Unhelpful
88. Don't know
99. Refused

O6. Severe Weather (such as fog, dust, wind, snow, ice)

1. Very Helpful
2.
3.
4.
5. Very Unhelpful
88. Don't know
99. Refused

Great, thank you.

O7. Do you have any additional comments about Changeable Message Signs in general?

Enter Verbatim: _____
88. Don't know
99. Refused

Household/Demographics (ALL)

We're almost done; I only have a few more questions for you for statistical purposes. Again, all of your responses are anonymous.

H1. What is your age range? Are you between…?

1. 18-24
2. 25-34
3. 35-44
4. 45-54
5. 55-70
6. 70 or older
88. Don't know
99. Refused

H2. Which of the following best describes your marital status?

1. Never married (including engaged)
2. Married
3. Partnered with someone
4. Divorced
5. Widowed
6. Other (Specify) _____
88. Don't know
99. Refused

H3. What is the number of children in your household under 16 years old?

Enter number:
88. Don't know
99. Refused

H3a. What is the number of people in your household between 16 and 24 years old?

Enter number:
88. Don't know
99. Refused

H3b. What is the number of adults in your household between 25 and 64 years old?

Enter number:
88. Don't know
99. Refused

H5. What is the number of adults in your household over 65 years old?

Enter number:
88. Don't know
99. Refused

H6. Altogether, how many motor vehicles are registered at this address? Please count motorcycles if you have them.

1. Enter number
88. Don't know
99. Refused

H7. What is the highway that you typically drive when leaving from your home?

NOTE: Do Not Accept Streets, Only Highways.

1. Enter highway
2. I do not use highways
88. Don't know
99. Refused_____

H8. What is the highest level of education or schooling you received?

1. No formal schooling
2. Eighth grade or less
3. Some high school but no diploma
4. High school diploma or GED
5. Some college, but no degree

6. Associate's or technical school degree
7. Bachelor's degree
8. Graduate or professional degree
9. Other (specify) _____
88. Don't know
99. Refused

H9. What race or races do you consider yourself to be? You may choose more than one.
1. White or Caucasian
2. Black or African American
3. Indian (American), Alaskan Native or Native Hawaiian
4. Middle-Eastern
5. Hispanic, Latino or Chicano
6. Indian (Asian)
7. Chinese
8. Filipino
9. Japanese
10. Korean
11. Vietnamese
12. Pacific Islander
13. Other Asian (specify) _____
14. Some Other Race (specify) _____
88. Don't know
99. Refused

H10. Which of the following best describes your 2006 total household income, before taxes, in thousands of dollars?
1. Less than 25
2. 25 to below 40
3. 40 to below 55
4. 55 to below 70
5. 70 to below 85
6. 85 to below 100
7. 100 to below 125
8. More than 125 thousand
88. Don't know
99. Refused

H11. Finally, what is your zip code??
Enter Verbatim: _____
88. Don't know
99. Refused

Those are all the questions I have for you. Thank you for helping with this important survey about public safety!

Record respondent's gender
1. Female
2. Male

Enter interviewer ID ___

Intercept Survey

Hi, my name is _____ and I am doing a brief survey with drivers on behalf of the University of California and the California Department of Transportation. The study is about Changeable Message Signs (CMS) that show safety information to drivers on highways in California. The results of the study will provide researchers at the University of California & Caltrans with an understanding of the helpfulness of the CMS signs for public safety campaigns. The survey is completely anonymous and you can skip any question you do not wish to answer. It should take about 3 minutes. Okay?

1. First, are you over 18 and have a valid driver's license?

- ❒₁ Yes
- ❒₂ No **(great - thank you for your time)**
- ❒₃ Don't know **(great - thank you for your time)**

2. Are you driving a commercial vehicle today?

- ❒₁ Yes (**great - thank you for your time)**
- ❒₂ No

3. Have you been driving on the Freeway today for at least 10 miles?

- ❒₁ Yes
- ❒₂ No
- ❒₃ Don't know

4. Do you remember seeing a Changeable Message Sign (CMS) on the freeway today? A CMS is a large electronic sign along a freeway that is either permanent or portable. They are turned on to provide information to motorists.

- ❒₁ Yes
- ❒₂ No **(Go to Q.6)**
- ❒₃ Don't know **(Go to Q.6)**

5. Can you tell me what was displayed on the sign?
(Record exact account of what is said)

- ❒₂ Can't remember (Probe for memory of any part of message seen)

6. Have you noticed any other CMS signs over the last few days?

- ❒₁ Yes
- ❒₂ No **(If no response to Q4, thank you and end)**
  (If response to Q4 is yes, continue to Q8 or Q15, based on if they qualify)
- ❒₃ Don't know **(Same as above)**

7. What was the message on *that* sign?
(Record exact account of what is said)

❒₂ Can't remember (Probe for memory of any part of message seen)

→If they <u>qualify</u>, continue to Q8	**→All others, go to Q15**

8. What do you think the "Click it or Ticket" message means? <u>Do not read– select all</u>

❒₁ Seat belt – adult
❒₂ Seat belt– child
❒₃ Put on seat belt or get a ticket
❒₄ Drive slower
❒₅ Drive faster
❒₆ Tolls
❒₇ FastTrak
❒₈ I Don't Know
❒₉ Other (specify)

9. Did you slow down in <u>your car</u> to read the "Click it or Ticket" message?

❒₁ Yes
❒₂ No
❒₃ Don't know

10. Did you notice <u>other cars</u> slowing down to read the "Click it or Ticket" message?

❒₁ Yes
❒₂ No
❒₃ Don't know

11. Did <u>you</u> or <u>anyone in your car</u> put on your seat belt after seeing the "Click it or Ticket" message?

❒₁ I already had my seat belt on
❒₂ Yes
❒₃ No
❒₄ Don't know

12. Is there anything else <u>you</u> did differently after seeing the "Click it or Ticket" message? <u>Do not read– select all</u>

- ❒1 Put my (a) child's seat belt on
- ❒2 Was more cautious
- ❒3 Told other people about it
- ❒4 Thought about safety (Been a safer driver)
- ❒5 Thought about not wanting a ticket (avoided ticket)
- ❒6 Have not done anything differently
- ❒7 Other (specify)

- ❒8 Don't know

13. What do you think <u>other drivers</u> do differently after seeing the "Click it or Ticket" message? <u>Do not read– select all</u>

- ❒1 Wear seat belts more - adults
- ❒2 Wear seat belts more - kids
- ❒3 Tell people about it
- ❒4 Avoid getting tickets
- ❒5 Wear seat belts less
- ❒6 Complain to Transit authority
- ❒7 Have not done anything differently
- ❒8 Other (specify)

- ❒9 Don't know

14. Did you think the "Click it or Ticket" message increased your awareness of safety?

- ❒1 Yes
- ❒2 No
- ❒3 Don't know

Q15. Now, I am going to ask you for a rating of how helpful the following CMS messages are to <u>you as a driver</u> and to the <u>public in general</u>. Please give a rating between 1 and 5 about the following **6 safety topics** with **1 being Very Helpful** and **5 being Very Unhelpful**.

15. Travel Time Advisories (or travel time to destination)

1----------2----------3----------4----------5

Very Helpful Very Unhelpful ❒ Don't know

16. Safety Messages (such as don't drink and drive, use seat belts, don't speed)

1----------2----------3----------4----------5

Very Helpful Very Unhelpful ❒ Don't know

17. Amber Alerts (or child abduction alerts)

1----------2----------3----------4----------5

Very Helpful Very Unhelpful ❒ Don't know

18. Traffic Advisories (such as Incident Ahead, Lane Closure, slow or stopped traffic ahead)

1----------2----------3----------4----------5

Very Helpful Very Unhelpful ❒ Don't know

19. Advance Notice (such as major closure, major special event)

1----------2----------3----------4----------5

Very Helpful Very Unhelpful ❒ Don't know

20. Severe Weather (such as fog, dust, wind, snow, ice)

1----------2----------3----------4----------5

Very Helpful Very Unhelpful ❒ Don't know

21. About how often do you see a Changeable Message Sign on the freeway? Do not read

- ❒1 Every day
- ❒2 Every few days
- ❒3 Once per week
- ❒4 Once every 2 weeks
- ❒5 Once every month
- ❒6 I never see the signs
- ❒7 Other (specify)

- ❒8 Don't know

22. What percentage of the time that you see the Changeable Message Sign, do you think you actually *read* the sign? Do not read

- ❒1 Less than 25% of the time
- ❒2 26 – 50% of the time
- ❒3 51 – 75% of the time
- ❒4 76 – 100% of the time
- ❒5 Other (specify)

- ❒6 Don't know

23. Do you have any additional comments about Changeable Message Signs in general?

❒2 No comments

We're almost done; I only have a few more questions for you for statistical purposes. Again, all of your responses are anonymous.

24. What is the number of children in your household under 16 years old?

Enter number: _____

❒8 Don't know

❒9 Refused

25. What is the number of people in your household between 16 and 24 years old?

Enter number: _____

❒8 Don't know

❒9 Refused

26. What is the number of adults in your household between 25 and 64 years old?

Enter number: _____

❒8 Don't know

❒9 Refused

27. What is the number of adults in your household over 65 years old?

Enter number: _____

❒8 Don't know

❒9 Refused

28. What is the highest level of education or schooling you received?

- ❒1 No formal schooling
- ❒2 Eighth grade or less
- ❒3 Some high school but no diploma
- ❒4 High school diploma or GED
- ❒5 Some college, but no degree
- ❒6 Associate's or technical school degree
- ❒7 Bachelor's degree
- ❒8 Graduate or professional degree
- ❒9 Other (specify) _____
- ❒10 Don't know
- ❒11 Refused

29. Which of the following best describes your 2006 total household income?

- ❒1 Less than 25,000
- ❒2 25,000 to below 40,000
- ❒3 40,000 to below 55,000
- ❒4 55,000 to below 70,000
- ❒5 70,000 to below 85,000
- ❒6 85,000 to below 100,000
- ❒7 100,000 to below 125,000
- ❒8 More than 125,000
- ❒9 Don't know
- ❒10 Refused

30. Finally, what is your zip code?

Enter Verbatim: _____

- ❒8 Don't know
- ❒9 Refused

Those were all my questions. Thank you for helping with this important survey about public safety!

Interviewer:_____ Date:_____

Time: _____ Location:_____

33. Respondent's gender *(DO NOT ASK)* ❒1 M ❒2 F

34. Respondent's age *(DO NOT ASK)*

- ❒1 18-24
- ❒2 25-34
- ❒3 35-44
- ❒4 45-54
- ❒5 55-70
- ❒6 70 or older

35. Respondent's Race *(DO NOT ASK)*

- ❒1 White or Caucasian
- ❒2 Black or African American
- ❒3 Indian (American), Alaskan Native or Native Hawaiian
- ❒4 Middle-Eastern
- ❒5 Hispanic, Latino or Chicano
- ❒6 Indian (Asian)
- ❒7 Chinese
- ❒8 Filipino
- ❒9 Japanese
- ❒10 Korean
- ❒11 Vietnamese
- ❒12 Pacific Islander
- ❒13 Other (specify) _____

NOTES OR COMMENTS

APPENDIX D: ANALYSIS OF ACCIDENT DATA

Introduction

Available accident data, obtained from CHP's Statewide Integrated Traffic Records System was examined in an attempt to evaluate the effect of CMS safety messages on accidents. The results of analysis are summarized in this report.

Methods

Researchers conferred with Caltrans Headquarters and District offices to determine holiday weekends when safety campaign messages were displayed and not displayed on CMSs. Memorial and Labor Day weekends were selected because these holidays always fall on the same day of the week (Monday) during the summer months, when there is less chance that weather would impact road conditions. The goal was to find two years as close as possible with and without the safety messages displayed. Researchers were not able to control for changes in the number of CMSs over the years, changes in vehicle miles traveled (VMT), or for changes in roadway configuration that might impact roadway safety.

For Memorial weekend in 2004, no safety messages were displayed on CMSs. In 2007, CMSs displayed the "Click-it-or-Ticket" safety message. For Labor Day weekend in 2006, CMSs displayed "Report Drunk Drivers, Call 911" and did not display any safety message in 2007. The CHP provided accident data for these holiday weekends from the Statewide Integrated Traffic Records System. Data were provided for following CHP Divisions (which are roughly comparable to Caltrans Districts): Golden Gate (San Francisco Bay Area), Southern (Los Angeles Area), and the Inland (Bridgeport and Bishop).

An observation in the database consists of the number of accidents for a given jurisdiction within a CHP Division for the entire holiday weekend. For example, the Golden Gate Division has 12 jurisdictions and thus has 24 data "observations" (half with safety message showing and half without). The entire holiday weekend was included in the study, including the Friday preceding the holiday, Saturday, Sunday, and the holiday on Monday.

Counts of accidents types were first transformed with the square root function to create normal distributions. Then ANOVA was performed comparing transformed accident counts for when the safety messages were shown and not shown. If there were not enough cases of accidents to transform using the square root function (such as with deaths), then an indictor variable was created for death involved or no death involved. Next, the Fisher's Exact test was used to compare when safety messages were shown versus not. All of the descriptive statistics reported are either in indicator variable form or in their original non-square-root form for ease of interpretation.

All data processing was done in MS Excel 2004 (Seattle WA), and all transformations and analysis were done using Data Desk version 6.2 by Data Description (Ithaca NY, www.datadesk.com).

Results

The database has 132 total observations corresponding to the total number of jurisdictions in the three Divisions each appearing twice (once for CMS safety messages shown and once for not shown). Thus there are 66 jurisdictions, of which 24 are in the Golden Gate Division, 22 are in the Inland Division, and 20 are in the Southern Division (see Table D-1). Note that the number of jurisdictions does not reflect the number of collisions because the Southern Division has both the least number of jurisdictions and the most total collisions. Further, note that this does not indicate that the Southern Division has a higher collision rate because these numbers are not adjusted by VMT, number of registered vehicles, or any other such normalizing variable. As the subsequent analysis is focused on comparing collision rates for when a CMS safety message is shown versus not shown, comparisons between Divisions are not performed (and are not meaningful). Of interest, is the large difference between the mean and median values for the Inland Division indicating a skewed distribution to the right expected with count data. Thus, it is more informative and better justified by statistical theory to observe and compare medians and inter-quartile ranges rather than means and standard deviations (which are dependent on symmetric distributions for accuracy).

Table D-1 Number of Collisions by Division.

Division	Count	Sum	Mean	Median	Standard Deviation	InterQRange	75th percentile
Golden Gate	48	741	15.4	14.5	6.9	10.0	20.0
Inland	44	545	12.4	6.0	12.1	19.5	22.5
Southern	40	1146	28.7	26.0	14.8	16.5	37.0
Total	132	2432	18.4	18.0	13.3	19.0	26.0

InterQRange = Inter-quartile Range

There is no statistical difference overall for the average number of collisions between when CMS Safety messages were shown or not shown (p=0.62, see Table D-2). Subsets of the dataset reflecting each Division and each holiday were also analyzed with similar results. Labor Day coincides with the safety message, “Report Drunk Drivers, Call 911”, while Memorial Day coincides with the safety message, “Click-It or Ticket”.

TABLE D-2: Number of Total Collisions by CMS Safety Message Shown versus Not Shown

CMS Safety	Count	Sum	Mean	Median	Standard Deviation	InterQ-Range	75th Percentile	*p*-value**
OVERALL								0.62
Not Shown	66	1173	17.8	18.0	12.6	19.0	26.0	
Shown	66	1259	19.1	18.5	14.1	20.0	27.0	
Total	132	2432	18.4	18.0	13.3	19.0	26.0	
GOLDEN GATE								0.84
Not Shown	24	369	15.4	13.0	7.4	10.0	20.0	
Shown	24	372	15.5	15.5	6.4	8.5	19.5	
Total	48	741	15.4	14.5	6.9	10.0	20.0	
INLAND								0.87
Not Shown	22	269	12.2	6.0	12.0	22.0	26.0	
Shown	22	276	12.5	6.0	12.6	19.0	22.0	
Total	44	545	12.4	6.0	12.1	19.5	22.5	
SOUTHERN								0.50
Not Shown	20	535	26.8	22.5	13.9	7.5	27.5	
Shown	20	611	30.6	28.5	15.8	18.5	40.5	
Total	40	1146	28.7	26.0	14.8	16.5	37.0	
LABOR DAY *								0.63
Not Shown	33	572	17.3	19.0	12.3	15.8	23.3	
Shown	33	639	19.4	15.0	14.7	19.5	26.5	
Total	66	1211	18.3	17.0	13.5	18.0	25.0	
MEMORIAL DAY *								0.84
Not Shown	33	601	18.2	18.0	13.0	19.0	26.0	
Shown	33	620	18.8	19.0	13.7	19.5	27.0	
Total	66	1221	18.5	18.0	13.3	19.0	26.0	

InterQRange = Inter-quartile Range

* Labor Day coincides with the safety message, “Report Drunk Drivers, Call 911”, while Memorial Day coincides with the safety message, “Click-It or Ticket”.

** ANOVA Test

Provided in the database are totals for various types of collisions. The detailed analysis of these subsets follows with similar results to those of total collisions. Two of these variables had to be collapsed to indicator variables due to low numbers of occurrences. They are number of collisions involving deaths and number of victim deaths. While counting slightly different things

(number of victims killed may be larger than number of collisions with a death), when collapsed into an indictor variable, they become identical and so only one of the variables is reported.

The number of collisions overall involving death is not statistically significant (p=0.82, Fisher's Exact). The death involved collision analysis detail is shown in Table D-3. Note in all cases where the percent of collisions with a death is higher for CMS safety message shown versus not shown, the shown column has the larger percentage value. This reflects results of the overall collisions as well. However, as the differences are not significant, the percentages are essentially equal and it cannot be determined which is higher than the other.

Table D-3 Percent of Collisions Involving a Death for When CMS Safety Messages are Shown versus Not Shown.

	Not Shown	Shown	Total	*p*-value *
Overall	15.2	18.2	16.7	0.82
Golden Gate Division	16.7	20.8	18.8	1.00
Inland Division	18.2	18.2	18.2	1.00
Southern Division	10.0	15.0	12.5	1.00
Labory Day **	18.2	18.2	18.2	1.00
Memorial Day **	12.1	18.2	15.2	0.73

* Fisher's Exact Test

** Labor Day coincides with the safety message, "Report Drunk Drivers, Call 911", while Memorial Day coincides with the safety message, "Click-It or Ticket".

As with other outcomes, the overall number of collisions with injuries is not statistically significant by CMS safety message shown or not shown (p=0.93). For all subgroups such as Golden Gate Division, the results are similar (see Table D-4).

Table D-4 Number of Injuries Due to Collision by CMS Safety Message Shown versus Not Shown.

CMS Safety	Count	Sum	Mean	Median	Standard Deviation	InterQ-Range	75th percentile	*p*-value**
OVERALL								0.93
Not Shown	66	738	11.2	9.5	8.3	10.0	15.0	
Shown	66	759	11.5	10.0	8.9	10.0	15.0	
Total	132	1497	11.3	10.0	8.6	10.0	15.0	
GOLDEN GATE								0.56
Not Shown	24	198	8.3	8.5	5.1	6.5	10.5	
Shown	24	217	9.0	8.0	5.0	7.0	12.5	
Total	48	415	8.6	8.0	5.0	6.5	11.5	
INLAND								0.65
Not Shown	22	218	9.9	5.5	10.1	14.0	16.0	
Shown	22	186	8.5	5.0	8.8	9.0	11.0	
Total	44	404	9.2	5.0	9.4	11.0	13.0	
SOUTHERN								0.68
Not Shown	20	322	16.1	14.5	7.5	10.5	21.0	
Shown	20	356	17.8	14.0	9.9	15.5	25.5	
Total	40	678	17.0	14.5	8.7	14.0	24.0	
LABOR DAY *								0.82
Not Shown	33	365	11.1	9.0	9.0	11.8	15.5	
Shown	33	387	11.7	9.0	10.1	9.3	14.3	
Total	66	752	11.4	9.0	9.5	10.0	15.0	
MEMORIAL DAY *								0.90
Not Shown	33	373	11.3	10.0	7.8	9.3	15.0	
Shown	33	372	11.3	11.0	7.8	10.3	15.0	
Total	66	745	11.3	10.0	7.7	10.0	15.0	

InterQRange = Inter-quartile Range
* Labor Day coincides with the safety message, "Report Drunk Drivers, Call 911", while Memorial Day coincides with the safety message, "Click-It or Ticket".
** ANOVA Test

Table D-5 shows the results for the number of collisions that involved property damage only (no injuries or deaths). Overall there are no statistical differences between when CMS Safety messages were shown versus not shown (p=0.57).

Table D-5 Number of Collisions with Property Damage Only (no injuries/death) by CMS Safety Message Shown versus Not Shown.

CMS Safety	Count	Sum	Mean	Median	Standard Deviation	InterQ-Range	75th Percentile	*p*-value**
OVERALL								0.57
Not Shown	66	735	11.1	10.5	9.3	13.0	16.0	
Shown	66	778	11.8	10.0	9.3	14.0	17.0	
Total	132	1513	11.5	10.0	9.3	14.0	17.0	
GOLDEN GATE								0.87
Not Shown	24	241	10.0	9.0	6.2	10.5	15.5	
Shown	24	222	9.3	8.5	5.0	6.5	12.0	
Total	48	463	9.6	9.0	5.6	8.5	13.5	
INLAND								0.53
Not Shown	22	152	6.9	3.0	7.8	10.0	12.0	
Shown	22	169	7.7	3.0	7.9	11.0	13.0	
Total	44	321	7.3	3.0	7.8	10.5	12.5	
SOUTHERN								0.52
Not Shown	20	342	17.1	14.5	11.1	8.0	19.0	
Shown	20	387	19.4	19.5	10.6	10.0	24.0	
Total	40	729	18.2	16.5	10.7	11.0	22.5	
LABOR DAY *								0.64
Not Shown	33	353	10.7	10.0	8.1	11.5	15.3	
Shown	33	401	12.2	8.0	9.6	16.3	19.3	
Total	66	754	11.4	10.0	8.9	14.0	17.0	
MEMORIAL DAY *								0.75
Not Shown	33	382	11.6	11.0	10.4	14.0	17.0	
Shown	33	377	11.4	10.0	9.2	11.3	15.0	
Total	66	759	11.5	10.0	9.8	13.0	16.0	

InterQRange = Inter-quartile Range

* Labor Day coincides with the safety message, "Report Drunk Drivers, Call 911", while Memorial Day coincides with the safety message, "Click-It or Ticket".

** ANOVA Test

The last variable supplied in the CHP dataset is number of victims with injuries. Note that this is slightly different from the number of collisions with injuries analyzed prior (See D-6). Again, there are overall no significant differences in number of victims with injuries between when CMS Safety messages were shown versus not shown (p=0.93).

Table D-6 Number of Victim Injuries by CMS Safety Message Shown versus Not Shown

CMS Safety	Count	Sum	Mean	Median	Standard Deviation	InterQ-Range	75th percentile	*p*-value**
OVERALL								0.93
Not Shown	66	738	11.2	9.5	8.3	10.0	15.0	
Shown	66	759	11.5	10.0	8.9	10.0	15.0	
Total	132	1497	11.3	10.0	8.6	10.0	15.0	
GOLDEN GATE								0.56
Not Shown	24	198	8.3	8.5	5.1	6.5	10.5	
Shown	24	217	9.0	8.0	5.0	7.0	12.5	
Total	48	415	8.6	8.0	5.0	6.5	11.5	
INLAND								0.65
Not Shown	22	218	9.9	5.5	10.1	14.0	16.0	
Shown	22	186	8.5	5.0	8.8	9.0	11.0	
Total	44	404	9.2	5.0	9.4	11.0	13.0	
SOUTHERN								0.68
Not Shown	20	322	16.1	14.5	7.5	10.5	21.0	
Shown	20	356	17.8	14.0	9.9	15.5	25.5	
Total	40	678	17.0	14.5	8.7	14.0	24.0	
LABOR DAY *								0.82
Not Shown	33	365	11.1	9.0	9.0	11.8	15.5	
Shown	33	387	11.7	9.0	10.1	9.3	14.3	
Total	66	752	11.4	9.0	9.5	10.0	15.0	
MEMORIAL DAY *								0.90
Not Shown	33	373	11.3	10.0	7.8	9.3	15.0	
Shown	33	372	11.3	11.0	7.8	10.3	15.0	
Total	66	745	11.3	10.0	7.7	10.0	15.0	

StdDev = Standard Deviation
InterQRange = Inter-quartile Range
* Labor Day coincides with the safety message, "Report Drunk Drivers, Call 911", while Memorial Day coincides with the safety message, "Click-It or Ticket".
** ANOVA Test

Limitations

The first limitation with the study design is that the "control" dates are not in the same year as the "treatment" dates (CMS safety messages not shown versus shown). Therefore, completely different volumes of traffic may have been present contributing more to the collision rates than any other factor.

In the Labor Day comparison, the dates are one year apart, but for the Memorial Day comparison, the dates are three years apart. Also, the messages themselves are different and concomitant with the different holidays. So, there is no way to determine if there are differences due to the message or the holiday. The analysis was done by holiday, but the reader is cautioned that this delineation is also by safety message shown.

Finally, the results are not normalized by VMT, traffic density, traffic speeds, or sign location, or percent sign coverage because these data were not available. Therefore, it cannot be determined if the results gained comparing when CMS Safety Messages were shown versus not shown are in fact due to the CMS Safety Messages and not changes in traffic volume, speed, density, CMS location, or percent of CMS coverage in the division.