Understanding Aggressive Driving and Ways to Reduce It – Phase 2

Report of Task 3: Message Development and Testing

Prepared by

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Acronyms and Abbreviations

ANOVA	analysis of variance
AR	adaptive response
c	contemplation
CR	cognitive reappraisal
M	mean
MANOVA	multiple analysis of variance
p	precontemplation
PD	prosocial driving
SD	standard deviation
U.S.	United States

1 Introduction

Traffic crashes are a major public health concern in the United States (U.S.), with an estimated 40,990 lives lost in traffic crashes in 2023 (National Center for Statistics and Analysis, 2024). While many factors contribute to traffic crashes, aggressive driving is considered a leading cause, with evidence suggesting aggressive driving is a cause in approximately 56% of fatal crashes (AAA Foundation for Traffic Safety, 2013). Aggressive driving is also a common behavior among drivers. Before the COVID-19 pandemic, nearly 80% of drivers reported expressing anger, aggression, or road rage while driving at least once in the past year (AAA Foundation for Traffic Safety, 2016). More recently, prevalence research finds that 96% of drivers in the U.S. reported engaging in aggressive driving behaviors at least once in the past year, with nearly all specific aggressive driving behaviors increasing from 2014 to 2025 (Steinbach et al., 2025). Furthermore, there is evidence to suggest that people's perceptions that others are driving more aggressively has increased in the past five years, especially during the COVID-19 pandemic (Stephens et al., 2022).

This research project expands on previous work sponsored by the Traffic Safety Culture Transportation Pooled Fund. Phase 1 of this project included a literature review to define aggressive driving, a contextual model to explain its occurrence, a survey of road users to further refine the definition and operationalization of aggressive driving behaviors and refine potential points of intervention as presented in the contextual model, and a resource created for traffic safety practitioners about ways to bolster their current traffic safety efforts to address aggressive driving. Based on the results of the survey, Phase 1 included recommendations and ideas for bolstering existing traffic safety efforts in order to reduce aggressive driving. Specifically, in Phase 1, a number of implications for interventions with drivers emerged. Directly with drivers, we recommended growing prosocial driving, supporting cognitive reappraisal and adaptive responses while driving, and challenging misperceptions; one likely avenue for reaching drivers directly is through media messaging. Phase 1 results also suggested that bystanders, especially spouses, partners, family members, and close friends can be influential in encouraging others to not drive aggressively. Therefore, we recommended engaging bystanders to address aggressive driving. While these ideas were based on the survey data collected in Phase 1, the specific strategies for engaging bystanders were not developed and strategies had not been tested. The final report and resources developed in Phase 1 can be found at https://www.mdt.mt.gov/research/projects/trafficsafety-ad.aspx.

In Phase 2, we proposed expanding on Phase 1 work by developing and testing one or more strategies to engage bystanders to discourage aggressive driving as well as

developing and testing media messages to reduce aggressive driving. In Task 1, we conducted key informant interviews with a sample of bystanders to understand their experience with someone important in their life driving aggressively to identify opportunities and potential avenues for intervention. Based on the results of those interviews, we identified key components of effective strategies to engage bystanders. In Task 2, we tested bystander intervention strategies with a sample of bystanders.

This report summarizes Task 3 of this project. The purpose of Task 3 is to develop and test media messages with a sample of drivers who engage in aggressive driving behavior. This report includes a summary of the methodology for message development and testing, a presentation of the results of the message testing, and recommendations for aggressive driving messaging.

2 Method

2.1 Message Development

Findings from Aggressive Phase 1 were used to identify opportunities to develop messages intended to reduce aggressive driving. Specifically, the Phase 1 survey results indicated that people were less likely to drive aggressively when they engaged in prosocial driving behaviors and there may be opportunities to reduce aggressive driving through messages about cognitive reappraisal and adaptive responses (Finley et al., 2024). Therefore, message development focused on utilizing three themes: prosocial driving, cognitive reappraisal, and adaptive response. Additionally, research indicates that behavior change is supported through alignment with the transtheoretical model (Prochaska, 2008; Rio Szupszynski & Ávila, 2021). That is, meeting people where they are in readiness and willingness to change is a powerful support for behavior change. Messages would reflect two categories of readiness – precontemplation and contemplation. Precontemplation messages are intended to raise the level of consciousness and concern for current driving behaviors and contemplation messages are intended to move people from awareness to considering change.

2.1.1 Message components and context

Using the three themes and two stages as the foundation for message development, a Messaging Workbook was created to clarify messaging goals from a broad and aspirational lens, including what the messaging should inspire drivers to think, feel, and do as a result of the message, and identify the primary audience and messaging context. As part of the Messaging Workbook, key elements were identified, which included the three themes, tailoring the message to the intended stage of change, and using a nonjudgmental, supportive frame to reduce psychological reactance (Otto et al., 2021). Example messages were drafted and included as part of the Messaging Workbook.

To better understand the context for messaging, we engaged with members of the Traffic Safety Culture Transportation Pooled Fund to gather the aggressive driving messages currently being used by their agencies/organizations as well as the communication channels being used to share those messages. Messages were reviewed and common components were incorporated into the key elements of the Messaging Workbook. Most members indicated that their agency/organization's traffic safety messaging about aggressive driving primarily targeted the general population; however, some participants selected specific demographic groups, including teens, young adults, adults, and older adults. Pooled Fund members indicated that they used a

variety of channels for distributing messages, including television, radio, social media, online ads (banner ads, search ads, display ads), variable message boards, billboards, and print media (newspapers, magazines) and many members shared that they believe television, radio, social media, online advertising (banner, search, display), variable message boards, and billboards to be the most effective.

2.1.2 Message content

Based on the information gathered from Pooled Fund members, we decided to develop messages with two parts. The first part was a longer message, such as the content that might be used for a radio commercial or a social media post. The second part was very brief, such as what might appear on a roadway message board. The two parts of each message set were complimentary.

After deciding on the basic framework of messages (i.e., two-part messages within three themes each with precontemplation and contemplation messages) and the key elements of the Messaging Workbook, artificial intelligence (AI) was utilized for a first draft of messages. Claude AI was used to generate an initial list of messages. Contents from the Aggressive Driving Phase 1 report, the Belief Change Task 1 Report, and the Messaging Workbook were uploaded into the generative tool and then prompted to generate message pairs for prosocial driving, cognitive reappraisal, and adaptive response messages for people in both the precontemplation and contemplation stages of behavior change. A total of 57 message sets were initially generated.

Prosocial driving messages include language to influence community building, courtesy, and considerate behavior among drivers. Cognitive reappraisal messages include language to reframe thoughts and assumptions about other drivers, whereas adaptive response messages include language to help drivers develop coping strategies and alternative responses while driving.

Within each theme, messages were categorized into two stages. Precontemplation stage messages utilized first person narrative focused on raising awareness without pressure to change. The precontemplation messages also included subtle questioning while avoiding direct calls to action. Contemplation stage messages were created to be more direct about behavior change and included specific strategies and techniques. The contemplation stage messages also appeal to values such as community responsibility and provide a clearer rational for why change matters when compared to precontemplation stage messages.

After the initial list was developed, the 57 message sets were reuploaded into Claude AI to analyze each of the draft messages for psychological elements present in each message. These psychological elements included cognitive dissonance, social identity,

enhanced emotional benefits, and enhanced self-efficacy. Messages containing cognitive dissonance elements highlight contradictions between values or typical behavior and driving behavior. Social identity elements appeal to community belonging and representation. Enhanced emotional benefit elements emphasize how courteous driving makes the driver feel better, and enhanced self-efficacy elements build confidence that change is possible and achievable. A spreadsheet was generated that indicated what elements were present in each of the message sets. Messages that did not contain any psychological elements were removed from the initial list.

Then, researchers manually reviewed and edited each of the messages for meaning, clarity of language and consistency with each of the three themes, stage of change, and presence of psychological elements. Messages were prioritized based upon the presence of psychological elements to ensure elements were represented across the themes and stages. Researchers narrowed the list to three message sets within each theme and stage to ensure variety within each group and differentiation across groups. Within each theme and stage combination, one message included elements of cognitive dissonance.

The final collection of messages contained 18 message sets, with three for each theme and stage of change combination (3 themes: prosocial driving, cognitive reappraisal, adaptive response x 2 transtheoretical model stages: precontemplation and contemplation x 3 messages). Messages are presented in Appendix A.

2.2 Design and Sample

To assess satisfaction with messages intended to reduce aggressive driving as well as effectiveness in addressing aggressive driving, an experiment was designed to deliver messages, obtain immediate feedback, and follow up to assess recall and change. The protocol was reviewed and approved by the Montana State University Institutional Review Board prior to data collection. Participants provided informed consent before participation.

2.2.1 Participants

Verasight provided the participant panel. To be eligible to participate, participants needed to be 18 years old, living in the U.S., be a licensed driver, and report driving at least weekly over the past month. Participants also needed to endorse at least two aggressive driving behaviors over the past month. Of those who were invited and began the survey, 78% met inclusion criteria.

Two data collection activities (surveys) were conducted, separated by one week. The first survey was completed by 1,400 participants and 960 of those also completed the second survey. Data was reviewed for completeness, and participants were removed for

missingness in either survey exceeding 20%, with 152 responses removed from the first survey and 96 responses removed from survey two. The final sample consisted of 1,248 participants for the first survey (89.1%) and 864 participants who completed both surveys (90.0%).

Participant demographics are displayed in Table 1. Demographics did not differ between the sample of participants for the first survey and the sample that completed both surveys.

Table 1: Participant Demographics

	Survey 1 Sample		Survey 1 & 2 Sample	
	n	*%*	*n*	*%*
Age				
18-21 years	29	2.3	15	1.7
21-25 years	76	6.1	50	5.8
26-35 years	184	14.7	119	13.8
36-45 years	250	20.0	166	19.2
46-54 years	197	15.8	142	16.4
55-64 years	213	17.1	145	16.8
65 years or older	299	24.0	227	26.3
Gender				
Man	618	49.5	424	49.1
Woman	618	49.5	433	50.1
Transgender man	1	0.1	1	0.1
Transgender woman	0	0	0	0.0
Non-binary	10	1.2	6	0.7
Self-described	1	0.1	0	0.0
Race				
White or Caucasian	1002	80.3	703	81.4
Black or African American	121	9.7	74	8.6
American Indian/Native American or Alaska Native	42	3.4	28	3.2
Asian	81	6.5	58	6.7
Native Hawaiian or Other Pacific Islander	8	0.6	8	0.9
Other	55	4.4	33	3.8
Prefer not to say	7	0.6	7	0.8
Ethnicity				
Spanish, Hispanic, or Latino origin	184	14.7	124	14.4
State				
Alabama	20	1.6	14	1.6
Arizona	21	1.7	12	1.4
Arkansas	9	0.7	7	0.8
California	197	15.8	127	14.7
Colorado	16	1.3	9	1.0
Connecticut	15	1.2	12	1.4
Delaware	2	0.2	2	0.2
District of Columbia	1	0.1	1	0.1
Florida	69	5.5	51	5.9
Georgia	51	4.1	35	4.1

Hawaii	2	0.2	2	0.2
Idaho	7	0.6	6	0.7
Illinois	42	3.4	32	3.7
Indiana	37	3.0	26	3.0
Iowa	7	0.6	5	0.6
Kansas	6	0.5	4	0.5
Kentucky	10	0.8	6	0.7
Louisiana	36	2.9	22	2.5
Maine	4	0.3	3	0.3
Maryland	15	1.2	12	1.4
Massachusetts	20	1.6	13	1.5
Michigan	54	4.3	39	4.5
Minnesota	14	1.1	9	1.0
Mississippi	11	0.9	8	0.9
Missouri	15	1.2	13	1.5
Montana	3	0.2	1	0.1
Nebraska	4	0.3	2	0.2
Nevada	16	1.3	11	1.3
New Hampshire	1	0.1	1	0.1
New Jersey	55	4.4	44	5.1
New Mexico	6	0.5	4	0.5
New York	84	6.7	54	6.2
North Carolina	27	2.2	17	2.0
North Dakota	2	0.2	1	0.1
Ohio	33	2.6	18	2.1
Oklahoma	13	1.0	6	0.7
Oregon	8	0.6	6	0.7
Pennsylvania	46	3.7	32	3.7
Rhode Island	1	0.1	0	0.0
South Carolina	18	1.4	16	1.9
South Dakota	4	0.3	4	0.5
Tennessee	18	1.4	12	1.4
Texas	106	8.5	76	8.8
Utah	9	0.7	7	0.8
Virginia	62	5.0	41	4.7
Washington	21	1.7	17	2.0
West Virginia	6	0.5	5	0.6
Wisconsin	24	1.9	19	2.2

Participants reported engaging in a variety of aggressive driving behaviors. On average, participants reported 6 different aggressive driving behaviors over the past month. The most common behaviors were sped up when the traffic light was changing from yellow to red, honked or flashed headlights when another driver did something inappropriate, drove 15 miles per hour faster than the normal flow of traffic, and yelled or made an angry gesture at another driver. Participant endorsement of aggressive behaviors is presented in Table 2. Aggressive driving behaviors were similar for the sample of participants who completed the first survey and the sample that completed both surveys.

Table 2: Aggressive Driving Behaviors

	Survey 1 Sample		Survey 1 & 2 Sample	
	M	*SD*	*M*	*SD*
Total number of aggressive behaviors	6.2	3.3	6.1	3.1
	n	%	*n*	%
Sped up when the traffic light was changing from yellow to red	1135	90.9	791	63.4
Drove 15 miles per hour faster than the normal flow of traffic	826	66.2	559	44.8
Honked or flashed headlights when another driver did something inappropriate	809	64.8	566	45.4
Yelled or made an angry gesture at another driver	731	58.6	513	41.1
Overtook traffic by weaving in and out of lanes	435	34.9	298	23.9
Tailgated another driver	415	33.3	284	22.8
Slowed in front of another driver on purpose	374	30.0	247	19.8
Blocked another driver that was attempting to pass or change lanes	367	29.4	249	20
Cut off and/or braked hard in front of another driver	299	24.0	183	14.7
Ignored the right-of-way to "beat" another driver	272	21.8	178	14.3
Forced another driver onto the shoulder or off the road	81	6.49	45	3.6
Hit another vehicle on purpose	62	4.97	30	2.4

2.2.2 Experimental design

The experimental design consisted of nine conditions to which participants were randomly assigned. Each participant received messages from two of the three themes and were assigned to one of three transtheoretical model stage conditions – precontemplation, contemplation, or both. Participants each viewed four messages. Participants in the precontemplation and contemplation conditions received two of the three messages for each theme, randomly chosen. Participants in the precontemplation and contemplation paired condition received a precontemplation and a contemplation message for each theme, with the pair of messages randomly chosen.

2.2.3 Procedure

Data collection was conducted by Verasight using the Qualtrics platform for online survey administration. Participants were invited and randomly assigned to condition at the beginning of the survey. They provided informed consent, followed by screening questions to ensure age eligibility as well as having a driver's license, driving at least weekly, and engaging in two or more aggressive driving behaviors over the past month. Participants who met inclusion criteria continued to the survey, where they were asked questions about their perceptions of themselves as a driver as well as perceptions

about other drivers. Then participants were presented with message sets, with the messages presented based on the participant's condition. Each message was presented, and then after a four second delay, questions about the message set were shown (with the message still remaining on the screen). For each message, participants indicated whether they had seen it before and then they rated the message on 12 five-point semantic differentials to assess their satisfaction with each message (e.g., positive-negative; understandable-confusing; boring-interesting). This procedure was repeated for the four message sets presented to each participant. Then, participants were shown each message again and asked to indicate the extent to which the message made them think about their driving and motivated them to drive more safely.

One week later, participants were invited to complete the second survey. The second survey asked participants if they had thought about any of the driving messages over the past week and to indicate the extent to which the messages made them think about their driving. Then participants' recall of messages was assessed by showing, in random order, the messages they had seen as well as distractor messages that they had not been shown in the first survey. For each message, participants indicated whether they had seen it before or not. Participants also responded again to the perception questions (i.e., their perceptions about themselves as drivers and their perceptions of other drivers). See Appendix B for the screening survey, Survey 1, and Survey 2.

3 Results

Data were exported from Qualtrics and analyzed in IBM SPSS and R for descriptive and inferential statistics. Message reaction was assessed at Survey 1 and is therefore based on the Survey 1 sample (n = 1,248). Recall and change in perceptions are based on the sample of participants who also completed Survey 2 (n = 864). Many analyses included tests for differences based on characteristics of the messages participants viewed, specifically theme (i.e., adaptive response, cognitive reappraisal, or prosocial driving) and stage (i.e., precontemplation only, contemplation only, or pairs).

3.1 Message Reaction

Participants rated each message on 12 semantic differentials (e.g., positive-negative; understandable-confusing; boring-interesting). These ratings were reverse coded as needed and averaged into a composite score from 1 to 5, with higher scores indicating a more positive reaction and greater satisfaction with each message. Cronbach alphas for each message composite score ranged from .93 to .95. Overall participants had a positive, satisfied reaction to the messages, with average scores exceeding the scale midpoint of 3 (M range: 3.5 – 4.1). Across themes, prosocial driving messages were the most highly rated, with all prosocial driving precontemplation messages receiving an average rating of 4.0 and prosocial contemplation messages receiving average ratings of 3.9 and 4.0. The highest rated message was ARc3, an adaptive response contemplation stage message (M = 4.1, SD = 0.8). See Figure 1.
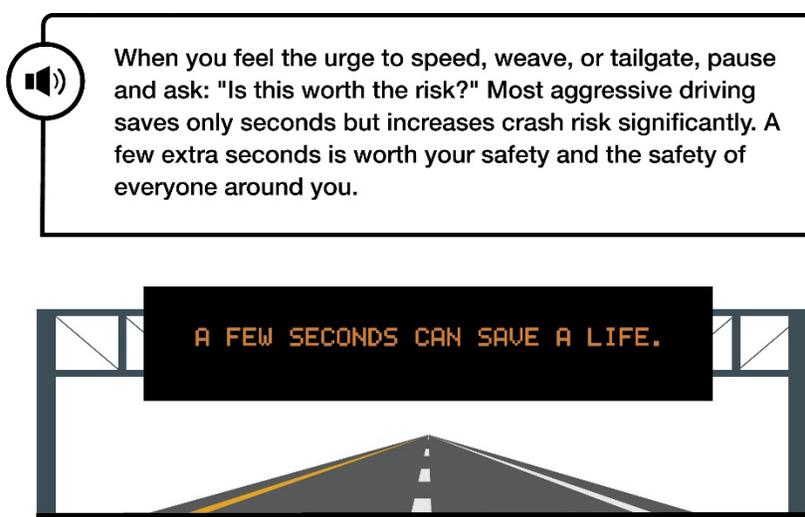

Figure 1. Highest Rated Message (ARc3 - Adaptive Response Contemplation)

At the first survey, after seeing each message for the second time, participants also indicated agreement with the statements "This message makes me think about my driving" and "This message motivates me to drive more safely," with responses ranging from 1 (strongly disagree) to 5 (strongly agree) for each. Participants' ratings averaged at or above the midpoint (3) for both statements across all messages (*M* ranges = 3.0 – 3.8 for think; 3.2 – 3.9 for motivate). Overall, the prosocial driving messages were consistently highly rated, with more than 60% of respondents agreeing or strongly agreeing that the messages made them think about their driving and more than 65% of respondents agreeing or strongly agreeing that the messages motivated them to drive more safely, except for PDc3, which had lower agreement (49.6% and 58.3%, respectively). Across the two statements, ARc3 again received the most agreement (*M* = 3.8, *SD* = 1.0; 69.2%).

See Appendix C for descriptives of reaction by message.

3.2 Message Follow Up

One week after completing Survey 1, including viewing the messages, participants completed Survey 2, which assessed whether participants had thought about the messages and their ability to recall the messages.

3.2.1 Thinking about and describing messages

Participants indicated whether they had thought about the messages over the past week. More than half of the participants had, with 32.9% indicating once or twice, 19.4% indicating a few times, and 3.8% reporting that they had thought about the messages "quite a bit." The remaining 43.9% reported that they had not thought about the messages. How much participants thought about the messages did not differ by theme or stage of messages viewed, $F(8, 855) = .55$, $p = .82$.

Those who had thought about the messages ($n = 485$) were asked to describe, via an open-ended text box, the message as best as they could recall. Participants' responses were reviewed by two researchers. Unrelated or irrelevant comments not about driving were removed, and the remaining comments were categorized into groups based on how well they matched one of the four messages the participant had viewed. More than half of the participants (53.9%) described an aggressive driving-related message; 36.0% described a message that was coded as not an exact match (e.g., "How my driving affects other people"; "Focus on what you can control"; "Everyone makes mistakes") and 17.9% described a near or exact match (e.g., "We're all doing the best we can"; "You can be someone else's calm"; "Deep breaths help road rage"). In the match group, participants described all 18 messages, with 1 to 9 participants describing

each. The three most commonly described messages were CRc1 (12.7%), ARp3 (11.3%), and ARc3 (9.9%).

Some participants (20.9%) said they did not remember a particular message or said they remembered "all of them"; 10.8% of participants described a general message about "driving safe" or "driving nicer" and 14.4% described a driving message not about aggressive driving.

3.2.2 Recall

Participants' recall of messages at Survey 2 (one week after seeing the messages) ranged from 46.7% accurate (ARp3) to 62.8% (ARc3). However, Survey 2 accuracy recall is modified by participants' Survey 1 report of having seen the messages previously. Since messages were created for this study and were not previously disseminated, Survey 1 affirmative response for having seen the message previously is considered false recall. After adjusting for Survey 1 false recall, recall by message ranges from 34.3% (ARc3) to 55.5% (ARp1). See Appendix D for Survey 2 recall, Survey 1 false recall, and adjusted recall by message.

Collapsing messages into groups to test for differences in recall based on message theme and stage revealed no differences by theme, $F(2, 858) = 1.06$, $p = .35$, or stage, $F(2, 858) = .47$, $p = .62$.

3.2.3 Message effects

At Survey 2, participants responded to five items about the effect of the messages they had seen one week earlier, indicating their agreement that the messages made them think about their driving, motivated them to drive more safely, made them think about the safety or wellbeing of other people on the road, made them think about what they can control when driving, and made them think about reacting differently to other people on the road. Participants rated each statement from 1 (strongly disagree) to 5 (strongly agree). Participants' ratings averaged above the midpoint (3) for all statements, ranging from 3.6 to 3.8 and indicating agreement. See Figure 2. Agreement with the statements did not differ by theme or stage of messages viewed, $F(4, 859) = .69$, $p = .60$.
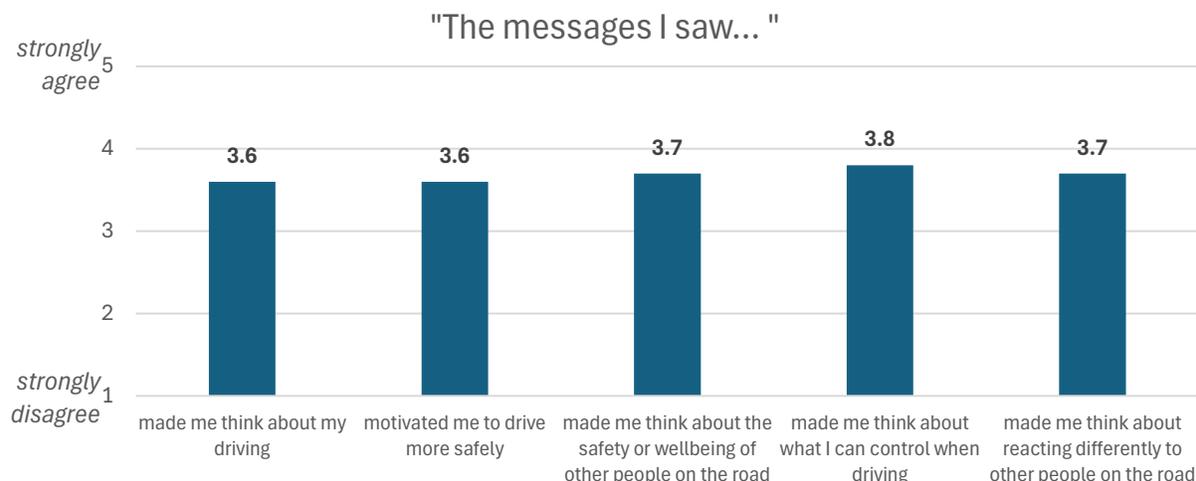
"The messages I saw... "

Figure 2. Participants' Agreement with Statements about Messages

3.3 Perceptions of Self and Others as Drivers

During both surveys, participants responded to a set of items to assess their perceptions of themselves as a driver (5 items) and their driving habits (3 items) as well as their perceptions of other drivers (5 items). Items were averaged for three composite scores. The five items assessing self perceptions included "I am a safe driver" and "I treat other people on the road with respect"; higher composite scores indicated greater perception that they are good and safe drivers. The three items assessing driving habits included "I am considering making changes to how I drive" and "I do not think my driving habits are a problem"; the latter was reversed, and, for the composite, higher scores indicated greater concern about their driving habits and consideration of making a change. For perception of others, the five items were similar to the self perception items and included "Most drivers are good drivers" and "Most drivers treat other people on the road with respect." Cronbach alphas for the composite scales are presented in Table 3.

Table 3. Cronbach Alphas for Perception Scales

Scale	Number of items	Cronbach alpha at Survey 1	Cronbach alpha at Survey 2
Self perceptions	5	.70	.73
Self driving habits	3	.67	.58
Other perceptions	5	.87	.87

A repeated measures multiple analysis of variance (MANOVA) was conducted to examine potential changes in the three perceptions scales over time (from Survey 1 to Survey 2). Message themes and stages were included as between-subjects factors and participant age and gender were included as covariates. The overall MANOVA was

significant, with a perceptions by time by age interaction, $F(2, 1706) = 7.31$, $p < .001$. There was no significant effect for message theme or stage, nor was the interaction significant.

Follow-up repeated measures analysis of variance (ANOVA) tests revealed a significant time by age interaction for self perceptions, $F(1, 853) = 5.12$, $p = .02$. For self driving habits, there was a significant main effect for time, $F(1, 853) = 8.96$, $p = .003$, which was modified by a time by age interaction, $F(1, 853) = 6.80$, $p = .009$. For other perceptions, there was a significant main effect for time, $F(1, 853) = 4.89$, $p = .03$. See Figure 3 for the overall composite perception scores by time. Additional analyses examined differences in time by age for self perceptions and self driving habits. For self perceptions, significant decreases from Survey 1 to Survey 2 were noted for participants over the age of 35. See Figure 4. For self driving habits, significant increases were noted for all age groups, with participants over the age of 45 experiencing the greatest increases. See Figure 5.
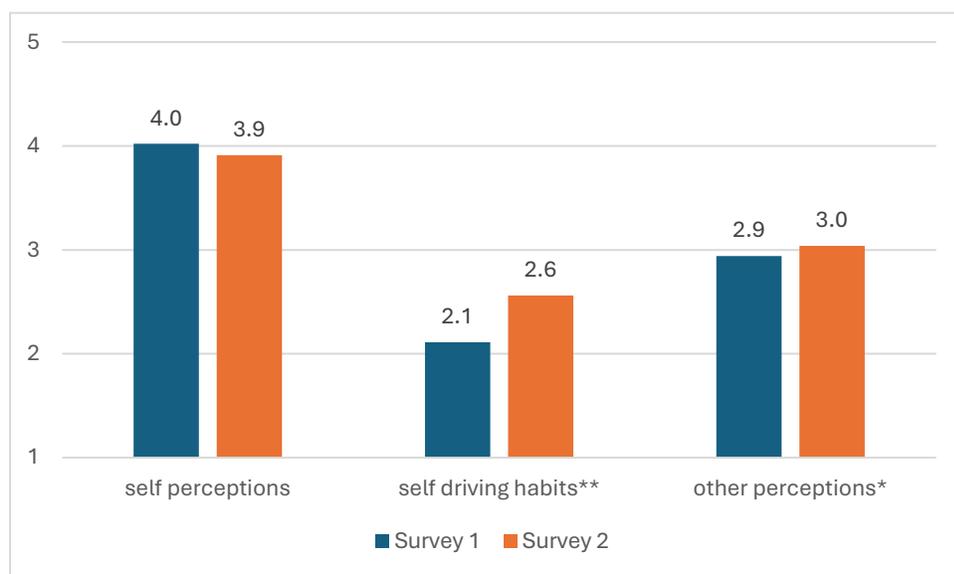

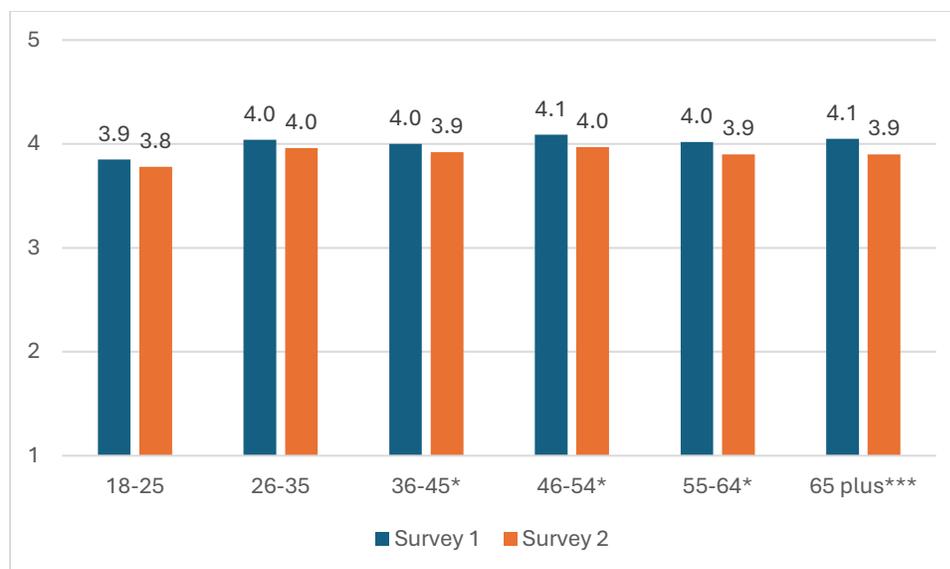*Figure 3. Composite Perception Scores by Time*

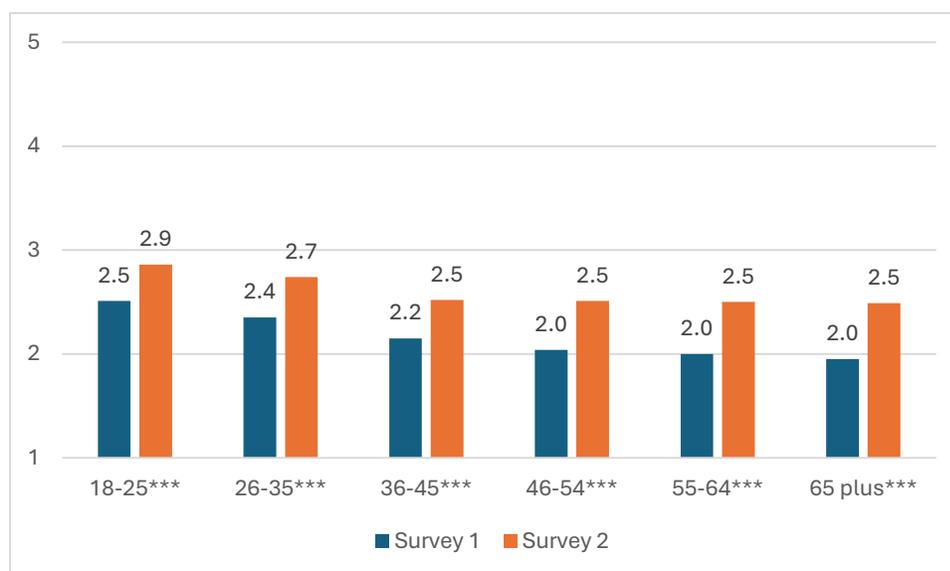*Figure 4. Self Perception Scores by Age and Time*

Figure 5. Self Driving Habits Perception by Age and Time

Taken together, perception results indicate that participants over the age of 35 perceived themselves as *less good and safe drivers* at Survey 2 compared to Survey 1. Participants across ages reported *increased concern* about their driving and *consideration of changing their driving habits* at Survey 2 compared to Survey 1, with the greatest increase among participants over the age of 45. Regardless of age, participants' perception of *other drivers as good and safe drivers increased* from Survey 1 to Survey 2. However, the theme or stage of messages participants viewed during Survey 1 did not affect their perceptions or change in perceptions over time.

4 Discussion

Aggressive driving is a persistent and concerning traffic safety issue. Traffic safety stakeholders often use messages to communicate information and encourage safer driving, but little information exists about effectiveness of, or recipients' reactions to, messages to address aggressive driving. In this study, novel messages to address aggressive driving were developed and tested with a sample of drivers who report engaging in aggressive driving behaviors in the past month. Findings suggest that messages to address aggressive driving are generally well-received by drivers and can support them in thinking differently about their driving and the driving of others.

Based on previous work, messages were designed to promote adaptive response, cognitive reappraisal, and prosocial driving. All messages were intended to encourage recipients to think about their own driving without a direct instruction about changing behavior or driving a specific way. Aligning with the transtheoretical model (Prochaska, 2008; Rio Szupszynski & Ávila, 2021), messages were constructed to support precontemplation or contemplation stages and the study tested whether precontemplation or contemplation alone was more effective than sequencing precontemplation and contemplation messages in pairs.

Participants had the most favorable reactions to the prosocial driving messages, though they had overall positive reactions for all messages.

One week after seeing the messages, approximately half of participants accurately recalled each message they had seen, though recall adjusted by initial false recall is less. During the initial survey, participants were presented with each message twice. Participant recall would be supported by multiple presentations of the messages over time.

Participants agreed that the messages made them think about their driving and motivated them to drive more safely. Participants also agreed that the messages met their intended goals, specifically to have recipients think about the safety or wellbeing of other people on the road, think about what they can control when driving, and to react differently to other people on the road. Further, one week after receiving the messages, participants indicated greater concern about their driving and increased consideration of changing their driving habits, reflecting message effectiveness at increasing awareness and motivating recipients to consider behavior change. Some participants (ages greater than 35) also rated themselves as less good and safe drivers one week after viewing the messages, similarly suggesting increased awareness of opportunities to improve driving.

Participants' perceptions of other drivers also changed after viewing messages. One week later, participants' ratings of most other drivers as good and safe increased, suggesting message effectiveness in reducing hostile attributions of other drivers that are common in aggressive driving. Messaging that shifts assumptions about others' intentions may therefore be a promising pathway for reducing escalation during driving interactions.

However, there were no differences based on message type. Message theme or stage of change did not impact participants' recall of messages nor their change in perceptions of themselves or others. Results from this study suggest that messages were similarly effective regardless of theme or stage. Participants' stage of change was not assessed in this study, as message recipients' stage of change is generally unknown in real-life application. Results indicate no differences if participants received precontemplation messages only, contemplation messages only, or paired messages. Therefore, traffic safety stakeholders may consider messages of all types – adaptive response, cognitive reappraisal, and prosocial driving – as well as messages aligned with different stages of change (precontemplation and contemplation). The lack of differences across themes and stages suggests flexibility for practitioners, allowing agencies to select messages based on context, audience, and communication channels without concern that one specific approach is required.

This study's findings must be considered in light of its limitations. First, participants were recruited from an online panel and may not be representative of the general aggressive driving population. While the sample was diverse, older adults were overrepresented in the sample compared to most estimates of aggressive drivers (Finley et al., 2024). Additionally, the sample was relatively evenly split by gender, while aggressive driving is generally more common in men than women. However, since messages are often distributed to the entire population of a state or community, feedback from a diverse sample is useful. A second limitation relates to behavior change. The goal of this study was to assess participants' reactions to messages and message effectiveness in changing participants' perceptions related to driving. However, actual aggressive driving behavior change was not expected during this study due to limited message dosage and the short time frame of one week. Findings suggest effectiveness in changes in beliefs and perceptions, which is an important step toward behavior change, but increased dosage and additional strategies are likely necessary to support consistent safer driving behaviors.

Despite these limitations, the current study demonstrates that people who drive aggressively have favorable reactions to messages that encourage adaptive response, cognitive reappraisal, and prosocial driving and that such messages can be effective in supporting changes in beliefs and perceptions. These findings suggest that messaging

may influence proximal determinants of behavior, including risk perception, self-reflection, and attributions about other drivers, which are important precursors to behavior change. Results can inform messages created and disseminated by traffic safety stakeholders. In real-world campaigns, repeated exposure across channels may amplify effects observed here, particularly given evidence that message recall is strengthened through repetition.

5 Conclusion and Next Steps

This study provides evidence to inform the use of messages to address aggressive driving. Traffic safety stakeholders could use these or similar messages as part of a portfolio of traffic safety culture strategies to reduce aggressive driving and support safer driving behaviors.

This report presents Task 3 for the Understanding Aggressive Driving and Ways to Reduce It, Phase 2 project. Tools and resources based on these findings will be developed in Task 4 and included in the final report.

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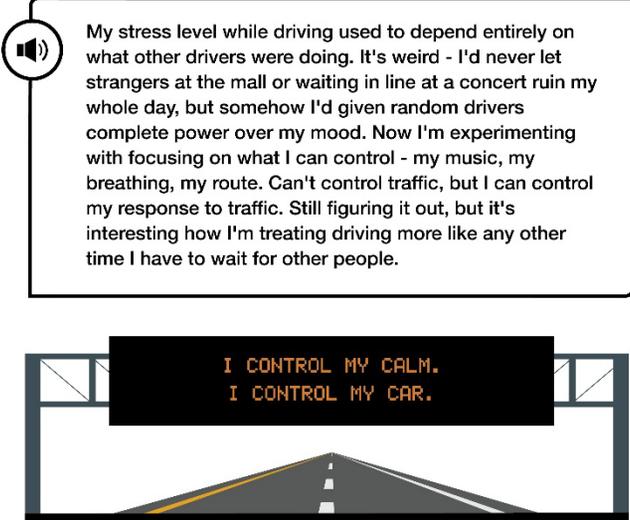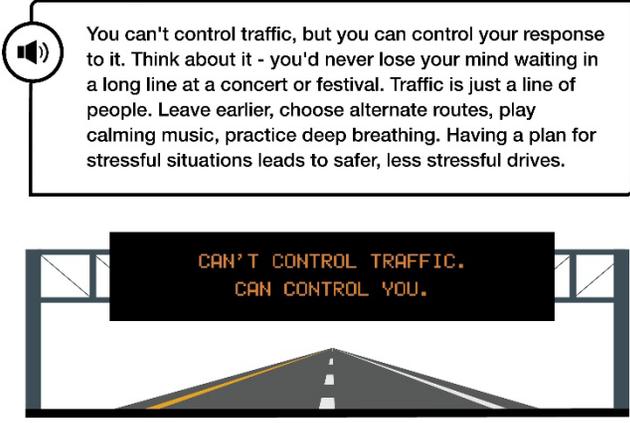https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813670

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Appendix A: Messages

Messages are coded by theme and stage. Themes are adaptive response (AR), cognitive reappraisal (CR), prosocial driving (PD). Stages are precontemplation (p) and contemplation (c).

Code	Message Set	Code	Message Set
ARp1	My stress level while driving used to depend entirely on what other drivers were doing. It's weird - I'd never let strangers at the mall or waiting in line at a concert ruin my whole day, but somehow I'd given random drivers complete power over my mood. Now I'm experimenting with focusing on what I can control - my music, my breathing, my route. Can't control traffic, but I can control my response to traffic. Still figuring it out, but it's interesting how I'm treating driving more like any other time I have to wait for other people. I CONTROL MY CALM. I CONTROL MY CAR.	ARc1	You can't control traffic, but you can control your response to it. Think about it - you'd never lose your mind waiting in a long line at a concert or festival. Traffic is just a line of people. Leave earlier, choose alternate routes, play calming music, practice deep breathing. Having a plan for stressful situations leads to safer, less stressful drives. CAN'T CONTROL TRAFFIC. CAN CONTROL YOU.

ARp2	Started keeping a stress ball in my car for when I feel road rage building up. Sounds silly, but having something to grip instead of honking the horn has actually helped. Sometimes the simplest solutions work best. Who knew? TRY SQUEEZING A STRESS BALL INSTEAD OF TAKING IT OUT ON THE HORN.	ARc2	The next time you feel anger rising while driving, try this: take three deep breaths and ask yourself, "How do I want to handle this?" That pause before reacting is where your power lies. You have the skills to choose patience over aggression, safety over speed, calm over chaos - it just takes practice. PAUSE BEFORE REACTING.
ARp3	Had a revelation during a traffic jam - I was getting worked up about something completely out of my control. So I tried focusing on my breathing instead of the brake lights ahead. Three deep breaths, and suddenly driving felt like a shared experience instead of me versus everyone else. Simple but effective. We're all together on the road. THREE BREATHS BEAT ROAD RAGE.	ARc3	When you feel the urge to speed, weave, or tailgate, pause and ask: "Is this worth the risk?" Most aggressive driving saves only seconds but increases crash risk significantly. A few extra seconds is worth your safety and the safety of everyone around you. A FEW SECONDS CAN SAVE A LIFE.

CRp1

Someone cut me off today and I instantly thought, 'what a jerk.' Then I caught myself, what if they just got bad news and were rushing to help someone. Thinking that way instantly calmed me down. But five minutes later, another driver merged slowly and I was honking again. I usually try to give people the benefit of the doubt. Remembering that applies in the car too helps me stay calm and the whole drive feels easier.

WHAT IF THEY'RE JUST HUMAN?

CRc1

That "aggressive" driver might be rushing to the hospital. That "slow" driver might be 16 and just learning. That person who cut you off might have just received devastating news. You don't know their story. Assume the best rather than getting furious when someone cuts you off. It'll make your drive more peaceful and keep you focused on what really matters - getting home safely.

YOU DON'T KNOW THEIR STORY.

CRp2

You know that driver who's going "too slow" in front of you? Yesterday I realized that person might be elderly, or learning to drive, or just being extra careful because they have precious cargo. Same situation, totally different feeling when I think about it that way.

SAME ROAD.
DIFFERENT STORIES.

CRc2

What if traffic jams weren't obstacles but opportunities? Time to listen to music, practice patience, or just breathe. When you stop fighting what you can't control and start finding value in the pause, even the worst traffic becomes more bearable. Your stress levels will thank you.

TRAFFIC JAMS = PATIENCE PRACTICE.

CRp3

I realized I was attributing bad driving to bad character - "they're rude," "they're selfish." But what if most driving mistakes are just that - mistakes? What if we're all doing our best with whatever's on our minds that day? Changes everything about how I see other drivers, and myself.

WE'RE ALL DOING OUR BEST OUT HERE.

CRc3

Before you assume that driver is inconsiderate, consider: maybe they didn't see you, maybe they're distracted by something serious, maybe they made an honest mistake. We all have bad driving moments. Giving others the benefit of the doubt keeps us all calmer and safer behind the wheel.

GIVE BENEFIT OF THE DOUBT.

PDp1

Yesterday, I was running late and weaving through traffic when someone actually slowed down to let me merge. Just a simple wave, but it instantly made me feel calmer. Then it hit me: when's the last time I did that for someone else? I like to think of myself as a decent person, but on the road I'm not sure I always am. The truth is, pushing through traffic doesn't just stress me out, it makes me the very driver I complain about. I can do better.

SOMEONE LET YOU MERGE TODAY.
WHEN WILL YOU RETURN THE FAVOR?

PDc1

The driver who cut you off isn't your enemy - they're your neighbor, your coworker, someone's parent or child. We'd never shove past someone in line at the store or curse at them in the hallway, but put us behind a wheel and suddenly we're different people. When we remember we're all part of the same community, driving becomes less about competition and more about cooperation. You're kind and patient in other parts of your life - bring that same person to your commute. How do you want to show up for your community?

WE ARE ALL PART OF THE SAME COMMUNITY.
DRIVE LIKE IT MATTERS.

PDp2	I was stuck in traffic yesterday, getting more and more frustrated, when I noticed the driver next to me wasn't honking or trying to speed around. Just patient. And somehow that calmness was contagious. Made me realize maybe there's a different way to handle these stressful drives. YOUR CALM CAN BE SOMEONE ELSE'S PEACE.	**PDc2**	Think about the drivers you appreciate most - the ones who signal, who let you in, who don't tailgate. They make your drive better just by being considerate. You have that same power to improve someone else's day. Every trip is an opportunity to be that appreciated driver. EVERY DRIVE IS A CHANCE TO BE KIND.
PDp3	Been noticing something lately - when I let someone merge or use my turn signal consistently, other drivers seem more chill around me too. It's like kindness spreads. Makes me wonder if the way I drive affects more than just me getting from A to B. Small acts of courtesy actually make the drive better for everyone. Made me realize we're all part of this driving community, and I want to be the kind of driver I'd want to share the road with. KINDNESS IS CONTAGIOUS. START A CHAIN REACTION.	**PDc3**	Every time you let someone merge or choose patience over aggression, you're showing the kind of driving community you want to be part of. Your actions influence others more than you realize. Be the kind of driver you want to share the road with. YOUR COURTESY CREATES COMMUNITY.

Appendix B: Surveys

Screening Questions

Demos.

1. How old are you?
   a. Under 18 years   *(exclude)*
   b. 18-21 years
   c. 21-25 years
   c. 26-35 years
   d. 36-45 years
   e. 46-54 years
   f. 55-64 years
   g. 65 years or older
2. Do you currently have a valid driver's license?
   a. Yes
   b. No   *(exclude)*
3. How do you describe your gender?
   a. Man
   b. Woman
   c. Transgender man
   d. Transgender woman
   e. Non-binary
   f. Prefer to self-describe: _____
3. Choose one or more races that you consider yourself to be
   a. White or Caucasian
   b. Black or African American
   c. American Indian/Native American or Alaska Native
   d. Asian
   e. Native Hawaiian or Other Pacific Islander
   f. Other
   g. Prefer not to say
4. Are you of Spanish, Hispanic, or Latino origin?
   a. Yes
   b. No
5. In what state do you currently reside?
   a. List of 50 states, D.C., and Puerto Rico

Driving Behaviors.

6. On average over the past month, how often have you driven a motor vehicle?
   a. Never   *(exclude)*
   b. Less than once a week   *(exclude)*
   c. About once a week
   d. A few days a week
   e. Most days each week
   f. Every day or nearly every day

7. Over the past month, how often have you done each of the following while driving?

	Never	Just once or twice	A few times	Regularly	Often
Tailgated another driver					
Yelled or made an angry gesture at another driver					
Overtook traffic by weaving in and out of lanes					
Cut off and/or braked hard in front of another driver					
Ignored the right-of-way to "beat" another driver					
Honked or flashed headlights when another driver did something inappropriate					
Driven 15 miles per hour faster than the normal flow of traffic					
Slowed in front of another driver on purpose					
Blocked another driver that was attempting to pass or change lanes					
Forced another driver onto the shoulder or off the road					
Sped up when the traffic light was changing from yellow to red					
Hit another vehicle on purpose					
Driven too fast for weather conditions					
Driven within 2 hours of consuming alcohol					
Driven within 2 hours of using cannabis/ marijuana					
Used your phone while driving					
Worn your seat belt					
Used mirrors and checked blind spots when changing lanes					
Obeyed posted speed limits in a school zone					
Driven with extra care around pedestrians					
Came to a complete stop at a stop sign					
Used turn signals ("blinkers") to notify other drivers of my intention to turn					

{Items are randomized. Must endorse two or more of the bold items to satisfy inclusion criteria.}

Survey 1

Please indicate the extent to which you disagree or agree with each of the following statements.
{Strongly Disagree, Disagree, Neither Disagree nor Agree, Agree, Strongly Agree}

Randomize 1-8.
1. I am a good driver
2. I am a safe driver.
3. I am a polite driver.
4. I treat other people on the road with respect.
5. Even when other drivers drive poorly, I don't let it bother me.
6. I do not think my driving habits are a problem.
7. Sometimes I think my driving could put myself or others at risk.
8. I am considering making changes to how I drive.

Randomize 9-13.
9. Most drivers are good drivers.
10. Most drivers are safe drivers.
11. Most drivers are polite drivers.
12. Most drivers treat other people on the road with respect.
13. When drivers do things that seem rude, it is usually just a mistake.

Next we have some messages about driving that we'd like you to view. For each, please read the first message and imagine hearing it on the radio. Imagine seeing the second message on a roadway sign.
Messages appear. After each…

14. Have you seen this message before?   Y/N

15. I found that message to be…

Positive	Negative
Likeable	Unlikeable
Understandable	Confusing
Irritating	Pleasant
Appealing	Unappealing
Weak	Strong
Useful	Not Useful
Boring	Interesting
Convincing	Unconvincing
Motivating	Not motivating
Informative	Not informative
Relevant to me and my driving	Not relevant to me and my driving

Now we're going to show you the same messages again and ask two final questions about each.
each message appears, followed by a matrix.
{Strongly Disagree, Disagree, Neither Disagree nor Agree, Agree, Strongly Agree}
16. This message makes me think about my driving.
17. This message motivates me to drive more safely.

Survey 2

About a week ago, we showed you some messages about driving.

1. Have you thought about any of those messages over the past week?
   a. No, not at all
   b. Once or twice
   c. A few times
   d. Quite a bit

{if 1 = b, c, or d....}
1A. What message did you think about most often? Please provide the message or describe it as best as you can remember. {open-ended}

The messages I saw…
{Strongly Disagree, Disagree, Neither Disagree nor Agree, Agree, Strongly Agree}

2. made me think about my driving.
3. motivated me to drive more safely.
4. made me think about the safety or wellbeing of other people on the road.
5. made me think about what I can control when driving.
6. made me think about reacting differently to other people on the road.

Show messages and distractors. For each:
7. Have you seen this message before? Yes/No

{Strongly Disagree, Disagree, Neither Disagree nor Agree, Agree, Strongly Agree}
   Randomize 8-15.
8. I am a good driver
9. I am a safe driver.
10. I am a polite driver.
11. I treat other people on the road with respect.
12. Even when other drivers drive poorly, I don't let it bother me.
13. I do not think my driving habits are a problem.
14. Sometimes I think my driving could put myself or others at risk.
15. I am considering making changes to how I drive.

   Randomize 16-20.
16. Most drivers are good drivers.
17. Most drivers are safe drivers.
18. Most drivers are polite drivers.
19. Most drivers treat other people on the road with respect.
20. When drivers do things that seem rude, it is usually just a mistake.

Appendix C: Reaction by Message

Code	n	Semantic Differential Ratings			Think About Driving		Motivate to Drive More Safely	
		Composite Cronbach alpha	Composite *M (SD)*	% Items Positive Reaction	*M (SD)*	% Agree or Strongly Agree	*M (SD)*	% Agree or Strongly Agree
ARp1	302	0.94	3.8 (0.9)	62.8	3.7 (1.1)	64.6	3.8 (1.0)	64.2
ARp2	293	0.94	3.5 (1.0)	50.1	3.0 (1.2)	39.6	3.2 (1.2)	43.0
ARp3	250	0.94	3.8 (0.9)	62.6	3.4 (1.1)	55.6	3.5 (1.0)	56.4
ARc1	291	0.95	3.7 (1.0)	60.0	3.6 (1.0)	61.9	3.6 (1.0)	58.1
ARc2	279	0.94	3.8 (0.9)	63.2	3.6 (1.0)	60.6	3.7 (1.0)	67.7
ARc3	245	0.93	4.1 (0.8)	71.6	3.7 (1.1)	65.3	3.9 (1.0)	73.1
CRp1	297	0.95	3.5 (0.9)	51.2	3.2 (1.2)	49.5	3.4 (1.2)	52.5
CRp2	308	0.95	3.8 (0.9)	61.0	3.5 (1.1)	58.1	3.6 (1.1)	59.4
CRp3	246	0.94	3.6 (1.0)	54.3	3.3 (1.1)	48.4	3.5 (1.1)	52.8
CRc1	305	0.95	3.7 (1.0)	59.2	3.4 (1.1)	56.7	3.5 (1.1)	58.0
CRc2	289	0.95	3.7 (1.0)	58.4	3.4 (1.1)	53.6	3.5 (1.1)	52.6
CRc3	237	0.95	3.7 (1.0)	58.3	3.5 (1.1)	54.9	3.6 (1.1)	56.5
PDp1	283	0.93	4.0 (0.8)	69.6	3.6 (1.1)	66.4	3.8 (1.0)	68.9
PDp2	292	0.93	4.0 (0.8)	68.7	3.7 (1.1)	65.1	3.8 (1.0)	67.5
PDp3	257	0.94	4.0 (0.8)	68.8	3.6 (1.0)	64.2	3.8 (1.0)	68.5
PDc1	268	0.94	3.9 (0.9)	65.2	3.7 (1.1)	64.6	3.8 (1.0)	67.9
PDc2	286	0.94	4.0 (0.8)	68.9	3.8 (0.9)	67.1	3.8 (0.9)	67.5
PDc3	264	0.94	3.9 (0.9)	64.3	3.4 (1.1)	49.6	3.6 (1.1)	58.3

Appendix D: Recall by Message

Code	Accurate Recall % (Survey 2)	False Recall % (Survey 1)	Adjusted Recall %
ARp1	60.8	5.3	55.5
ARp2	52.3	5.0	47.3
ARp3	46.7	3.5	43.2
ARc1	61.3	7.6	53.7
ARc2	46.9	9.3	37.6
ARc3	62.8	28.5	34.3
CRp1	51.5	6.7	44.8
CRp2	54.4	7.2	47.2
CRp3	54.2	8.3	45.9
CRc1	52.4	6.6	45.8
CRc2	53.3	4.5	48.8
CRc3	51.6	3.8	47.8
PDp1	51.8	5.6	46.2
PDp2	55.0	8.1	46.9
PDp3	57.2	11.2	46.0
PDc1	47.9	7.7	40.2
PDc2	50.7	4.4	46.3
PDc3	50.0	7.0	43.0