Driver Attitudes and Behaviors at Intersections and Potential Effectiveness of Engineering Countermeasures

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FOREWORD

This report describes the results of a focus group study that explored driver attitudes and behaviors at intersections to assess the likely impacts of new or existing infrastructure-based technologies/countermeasures. The focus group study is part of a larger research project that will provide the Federal Highway Administration (FHWA) with information about roadway user attitudes and behaviors at intersections. Specifically, the information concerns driving performance, perceptual and cognitive bottlenecks, constraints that can negatively impact intersection safety, and engineering or educational countermeasures for intersection safety with the greatest likely impact on performance and safety.

Michael F. Trentacoste
Director, Office of Safety
Research and Development

Notice

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16. Abstract

The objective of this focus group study was to identify driver attitudes and behaviors related to intersection safety and to assess the likely impacts of new or existing infrastructure-based technologies/countermeasures. Four focus groups were conducted at each of three test sites: Washington, DC; Chicago, IL; and Seattle, WA. At each site, the four groups corresponded to the age/gender characteristics identified as important to this project. The four groups were:

- 18- to 35-year-old female drivers only.
- 18- to 35-year-old male drivers only.
- 35- to 55-year-old drivers of both genders.
- 65+-year-old drivers of both genders.

At each site, the focus groups took place over two separate evenings, with two focus groups conducted per evening. A total of 119 individuals participated in the focus groups. The effort focused on identifying driver attitudes and behaviors with respect to four intersection scenarios: (1) red-light running, (2) left turns at busy intersections, (3) turning left onto a major road with moderate traffic, and (4) rear-end crashes. For each of these four scenarios, results and conclusions relevant to the following key questions are developed and presented:

- What are drivers most likely to do in this scenario?
- Why do drivers engage in these behaviors?
- What engineering countermeasures have the most promise for improving traffic safety?

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Unclassified	Unclassified	174	

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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LIST OF ACRONYMS

FHWA.....Federal Highway Administration
GES.....General Estimates System
IDPE.....Identify, predict and execute
IBM..... Integrated behavioral model
LED..... Light-emitting diode
LTAP/LD ..... Left turn across path/lateral direction
LTAP/OD.....Left turn across path/opposite direction
LTIP ..... Left turn into path
MRI.....Midwest Research Institute
NCHRP ..... National Cooperative Highway Research Program
PSA .....Public service announcement
RTIP ..... Right turn into path
SCP/SI.....Straight crossing path/signalized intersection
SCP/UI .....Straight crossing path/unsignalized intersection
SUV.....Sport utility vehicle

CHAPTER 1. INTRODUCTION

The Federal Highway Administration (FHWA) is currently examining several general safety areas: driver behavior at intersections, the development of tools and procedures for intersection design, and human factors literature reviews for Safety R&D program areas, including Intersections, Pedestrians and Bicyclists, Speed Management, and Visibility. The goals for the safety research program are to gain a better understanding of driver behavior and attitudes about intersections, and available countermeasures.

As a part of this program, research was conducted to provide FHWA with information about key attitudes and behavioral influences in intersection driving performance, perceptual and cognitive bottlenecks and constraints that can negatively impact intersection safety, and engineering or educational countermeasures for intersection safety with the greatest likely impact on performance and safety.[1]

This research includes a task analysis of driver performance at intersections, a literature review on human factors research as it relates to highway infrastructure, and focus group discussions that explore driver attitudes and behaviors at intersections. Figure 1 summarizes the information flow and shows how activities, processes, and results will be combined to produce this knowledge.

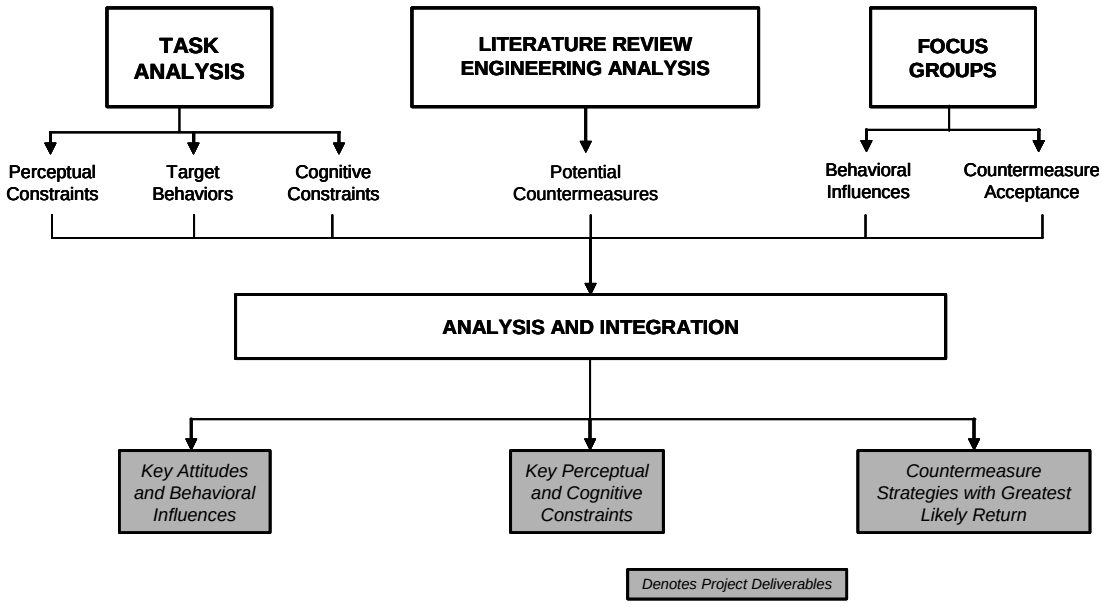

Figure 1. Flow of research inputs, activities, and deliverables.

This report describes the results of the focus group portion of this research. A primary goal of the focus group component was to provide qualitative information and insight to complement the analytical and quantitative information obtained in the other components of this research. There is a great deal of important qualitative information about driver intersection behavior including

[1] This research was conducted as task B.1 of the *Integrated Program for the Interactive Highway Safety Design Model and Safety Research* project for FHWA.

the different strategies and approaches to intersection driving that drivers can adopt; their attitudes, behaviors, and motivations; and their safety concerns.

Focus group discussions provide an established method to obtain this rich information. Such discussions allow researchers to probe responses and introduce new ideas in a flexible manner that cannot be achieved with quantitative research. Also focus groups provide continual feedback and exchange between the moderator and the respondents. Such an opportunity for self-correction more robust and accurate responses. For example, if an answer or response is unclear or ambiguous, the interviewer can rephrase the question and gather desired insights accordingly. If new ideas emerge during a focus group, the interviewer can investigate them further. Also, initial and nonrehearsed reactions to scenarios can shed light on participant decisionmaking processes and the relative importance of factors they consider.

Qualitative research is usually reported discursively, often in respondents' own words. This ensures reporting accuracy with minimal interpretive bias. The moderator and the observers also play key roles in interpreting and reporting information from the groups. The interviewer's role is to process information from respondents, interpreting both verbal and nonverbal responses and to probe for underlying motivations and emotions associated with what respondents say they believe and do. Sometimes, however, what participants may say is not what they actually do. These discrepancies are addressed in the analysis and report when the moderator contributes interpretations and inferences and points out contradictions or subtle differences that took place during the groups. Note, however, that these observations cannot correct for all differences between respondents' perceptions and their actual actions that are not inherently obvious.

Because the samples are small and not representative of the total population, and thus minimally generalizable, qualitative research cannot be a valid substitute for quantitative research. Since the research relies on nondirective, semistructured interviews, the stimulus situation is not the same for every respondent. Therefore, focus group studies should not be viewed as definitive; quantitative research is also necessary to arrive at indepth conclusions.

The body of this report contains three technical chapters and five appendixes:

- Chapter 2 describes the methods used to conduct the focus group interviews. It includes summaries of the participant screener and a Moderator Guide, in addition to a description of activities associated with:
  - Selecting test sites.
  - Refining recruitment screeners, Moderator Guides, and developing focus group materials.
  - Identifying, screening, and scheduling respondents.
  - Organizing and scheduling focus group facilities, including audiovisual capabilities.
  - Conducting the focus groups, including rescreening and take-home surveys.
  - Analyzing and providing a topline summary of the focus group discussion highlights.
- Chapter 3 provides the results from the focus groups.
- Chapter 4 provides the conclusions from the focus groups.
- Appendix A provides the participant screener that was used to identify and schedule potential focus group participants.
- Appendix B provides the moderator guide that was used to guide the focus group topics and discussions.

- Appendix C provides the take-home survey that was given to participants at the conclusion of each focus group session and then mailed back to the project team for analysis.
- Appendix D provides a tabular summary of the focus group results.

CHAPTER 2. METHODS FOR CONDUCTING THE FOCUS GROUPS

OVERVIEW

The objective of the focus groups was to identify driver attitudes and behaviors about intersection safety and to assess the likely impacts of new or existing infrastructure-based technologies/countermeasures.

Four focus groups were conducted at each of three test sites: Washington, DC; Chicago, IL; and Seattle, WA. At each site, the four groups corresponded to the age/gender characteristics identified as important to this project. The groups were:

- 18- to 35-year-old female drivers only.
- 18- to 35-year-old male drivers only.
- 35- to 55-year-old drivers of both genders.
- 65+-year-old drivers of both genders.

At each site, the focus groups took place over two separate evenings, with two focus groups conducted per evening. A total of 119 individuals participated in the focus groups.

Using the criteria described in appendix A, the project team screened focus group participants to ensure that relevant points of view were adequately represented in the groups (e.g., drivers who have difficulties making left turns, red-light runners, younger drivers, older drivers, etc.).[2] The content of the focus groups addressed issues related to driver attitudes and beliefs about safety in signalized and unsignalized intersections both in the general context of approaching intersections and in the specific context of high-risk intersection scenarios (e.g., stale yellow light, left turn into traffic, etc.). Also addressed in the focus groups were respondent opinions about the potential effectiveness of specific intersection countermeasures. Take-home surveys were distributed to focus group participants to get additional information not covered in the focus group discussions. Finally, the researchers analyzed and summarized the results of the focus groups presented in this report.

Key activities in conducting the focus groups included:

- Selecting focus group discussion scenarios.
- Selecting the test sites.
- Developing recruitment screeners, Moderator Guides, and focus group materials.
- Identifying, screening, and scheduling respondents.
- Organizing and scheduling focus group facilities, including audiovisual capabilities.
- Conducting the focus groups, including rescreening and take-home surveys.
- Analyzing and providing a topline summary of the focus group discussion highlights.

Each of these activities is described in more detail below.

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[2] The participant screener shown in appendix A reflects some minor changes from the screener guide presented in the original workplan for the focus groups.

Selection of Focus Group Discussion Scenarios

The first activity was to determine the scope of the intersection safety investigation. There are several different characteristics of intersections (e.g., signalized, unsignalized, urban, rural, traffic volume, etc.) that affect driver behaviors at intersections in addition to different types of unsafe activities that drivers can perform at various intersections (e.g., red-light running, failure to yield, left turns across traffic, etc.). It is not possible to investigate all of these combinations given the limited time available to conduct the focus groups, so the project team selected a subset of these aspects for discussion in the focus groups.

Selection criteria were based on crash data and the availability of infrastructure-based countermeasures. In particular, an analysis of crash types at intersections using 1998 GES data conducted by Najm et al. indicates that the most common crash types involve straight crossing path crashes in signalized (SCP/SI) and unsignalized (SCP/UI) intersections, in addition to left turn across path/opposite direction (LTAP/OD) crashes at signalized intersections, and left turn across path/lateral direction (LTAP/LD) crashes at unsignalized intersections (see table 1).[(1)] Three of these crash types were selected as scenarios, including SCP/SI, LTAP/OD (signalized intersection), and LTAP/LD (stop-controlled intersection), based on maximizing the diversity of situational factors and countermeasure types that could be presented to focus group participants. In addition to these crash types, a scenario based on rear-end crash situations was also added because of the high prevalence this type of crash at intersections. According to 1993 GES data, rear-end crashes at intersections comprise approximately 12 percent of all roadway crashes.[(2)]

Table 1. Relative frequency of intersection crossing-path crashes.[(1)]

Traffic Control Device	Crossing Path Precrash Scenarios (%)				
	LTAP/OD[1]	LTAP/LD[2]	LTIP[3]	RTIP[4]	SCP[5]
Signal	20.48	4.74	1.34	1.79	16.28
Stop Sign	1.43	11.45	3.04	2.59	21.11
No Control	8.41	2.33	0.89	0.98	3.13

[1] Left turn across path/opposite direction
[2] Left turn across path/lateral direction
[3] Left turn into path
[4] Right turn into path
[5] Straight crossing path

The specific situational factors for each scenario were also selected so that they took into account the most common causal factors for each crash type.[(2)] For example, because "tried to beat signal" and "violation of signal" were identified as major causal factors in SCP/SI crashes, the corresponding scenario involved a yellow light dilemma-zone situation. Similar attempts were made to incorporate the major causal factors into the other scenarios as well. Table 2 shows descriptions of the individual scenarios.

Table 2. Focus group discussion scenarios.

SCENARIO	DESCRIPTION
SCENARIO 1	SI/SCP (Red-light running): Approaching a signalized intersection at speed, the light turns yellow; driver is far enough away from the intersection that he/she can stop if he/she brakes hard, but is likely to enter the intersection on an early red if he/she accelerates.
SCENARIO 2	LTAP/OD (Left turn in traffic): Stopped in the middle of an intersection, waiting to make a left turn on a busy street; an oncoming car is also waiting to turn left and makes it difficult to see other vehicles approaching in the next lane. There is no dedicated turning lane and no dedicated turn signal; cars are waiting behind to also turn left (or go straight).
SCENARIO 3	LTAP/LD (Left turn at stop sign): A vehicle is stopped on a minor road with a stop sign, waiting to turn left onto a major road (that has no stop sign); a consistent flow of vehicles going at high speeds is crossing in both directions on the major road.
SCENARIO 4	Rear-end crash: Approaching an intersection at speed, the car in front stops suddenly when the light changes to yellow; the driver needs to slam on the brakes to avoid a rear-end collision.

SELECTING THE TEST SITES

As noted above, four focus group sessions were held at each of three test sites. The selected sites included Washington, DC, where the contractor has a state-of-the-art facility; Seattle, WA; and Chicago, IL. Site selection was based on criteria that considered access to required participant populations, varying market size and existence of relevant intersection features of interest (e.g., urban and rural intersections, etc.), and cost impact of conducting the focus groups. Another consideration was that the sites also provide a range of atmospheric and road-traction conditions. For example, respondents from Chicago, IL, were more likely to be familiar with driving in snow and ice conditions, while respondents from Seattle, WA, were more likely to be familiar with driving under a variety of precipitation and fog conditions.

The Washington, DC, site served as the first focus group location. This choice allowed FHWA personnel and project staff to observe the initial sessions in the contractor's facilities and to provide important feedback on the conduct and direction of the focus groups. Based on these initial sessions, the researchers made minor changes to the Moderator Guide used to conduct each focus group session. Appendix B provides the updated Moderator Guide.

REFINING RECRUITMENT SCREENERS, MODERATOR GUIDES, AND FOCUS GROUP MATERIALS

The core of any focus group project lies in: (1) developing and fine-tuning tools to most efficiently recruit participants with desired characteristics, and (2) implementing techniques to gather the best possible data. Appendices A and B are the final versions of the Participant Screener and Moderator Guide. These items are described below.

Participant Screener

The participant screener for this task used questions to identify drivers that reported either intentionally or unintentionally entering an intersection on a red, in addition to those who reported encountering left-turn situations where they had to engage in risky driving (see appendix A). Additionally, previous research indicates that factors such as driver age, gender, marital status, and having young children present affect driver intersection behaviors, such as red-light running and left-turn making. (See references 3, 4, 5, and 6.) These factors were also considered while developing the participant screener.

The participant screening process yielded four separate focus groups comprised of:

- 18- to 35-year-old female drivers only.
- 18- to 35-year-old male drivers only.
- 35- to 55-year-old drivers of both genders.
- 65+-year-old drivers of both genders.

Within each group, participants were mixed on certain criteria such as marital status, having children, and red-light running (e.g., at least four, but no more than six red-light runners per group). This mix ensured that the participants represented a sufficient diversity of opinions on the relevant topics. In addition, past focus group experience indicates that separating the focus groups this way is effective in creating enough homogeneity among age and sex to elicit participation from all respondents and ease the social pressures associated with focus group dynamics. This factor is particularly true for respondents under the age of 35, when men and women should be in separate groups whenever possible.

Moderator Guides

Appendix B shows the final Moderator Guide that provided a general sense of the focus groups' content including timing of various topics, information flow, planned scope, optimal external stimuli, and specific topic questions for the focus group discussions. The Moderator Guide covers four general discussion sections:

1. *Introduction*—Moderator and participant introductions (first name only) along with disclosures and a balanced and appropriate explanation of plans and expectations for the next 2 hours.

2. *Warmup*—The moderator directs the participants to discuss general issues about the topic and establishes a rapport with the group.

3. *Exercises*—A variety of easel exercises, including projective techniques, are used to gain respondents' input about the intersection scenarios and corresponding countermeasures.

4. *Closing*—The moderator provides the group members with an opportunity to share information about any topic that they may have previously omitted.

The "Exercises" portion of the Moderator Guide contained the key discussion topics. These covered red-light running, making left turns at signalized and unsignalized intersections, and

rear-end-crash situations. For each of these scenarios, the moderator's objective was to obtain participant opinions regarding:

- General views about specific intersection scenarios.
- What drivers see as the perceptual, decisionmaking, and psychomotor requirements in each scenario. Additionally, how do these requirements combine to produce highly demanding or highly difficult driving episodes?
- The potential effectiveness of various countermeasures in improving safety and the perceptual, decisionmaking, and psychomotor challenges identified in each scenario.

In addition, for red-light running behaviors, some of the beliefs, attitudes, knowledge, etc., underlying the risky actions were probed in further detail. The guide was designed with open-ended questions to gain optimal respondent input while maximizing objectivity and minimizing predictability. Probes and other information gathering techniques were altered in each scenario.

The countermeasures investigated in the Moderator Guide were drawn primarily from the National Cooperative Highway Research Program (NCHRP) guides for addressing signalized and unsignalized intersection collisions.[7,8] The emphasis was on selecting infrastructure-based countermeasures that could provide fruitful avenues for future research.

Other Materials (Countermeasures)

The focus group materials included written and graphic descriptions of the intersection scenarios and corresponding countermeasures. Table 3 shows a list of the countermeasures presented in each scenario. The graphics presented in the Results chapter below (figures 9 through 17) show how the countermeasures looked to drivers and include schematic layouts to coincide with each scenario that demonstrate how the countermeasures function and their layout in the roadway environment. Clearly written explanations of how the countermeasures worked in addition to any impacts they would have on the traffic flow accompanied the graphics. Key visual aspects (e.g., flashing lights) that may not be evident from the graphics were also explained to the focus group participants. Most countermeasures were selected for particular scenarios if they addressed one or more of the primary driver-related causal factors identified with each crash type.[2] If data were available, the potential effectiveness of individual countermeasures was also considered.[9]

Table 3. Scenario countermeasures for the focus groups.

Scenario 1: Red-Light Running
1. Red-light cameras
2. High-visibility traffic lights
3. Advance traffic light warning signs
4. Intersection collision warning systems
Scenario 2: Left Turns at Busy Intersections
1. Protected left-turn lights
Scenario 3: Turning Left on Major Road with Moderate Traffic
1. Automatic gap detection
2. Synchronized adjacent traffic signals
Scenario 4: Rear-End Crashes
1. Intersection rumble strips
2. Improved skid resistance

To reduce the chances of biasing the participants' evaluations of the relative potential effectiveness of individual countermeasures, the project team attempted to match the level of description and detail for all countermeasures, in addition to presenting the information in a common format where possible.

Take-Home Survey

The researchers developed a brief take-home survey (shown in appendix C) to obtain participant responses about relevant intersection activities that could not be addressed—because of time restrictions—during the actual focus groups. The questionnaire included 12 Likert scale and open-ended questions. All questions addressed the following scenario: *"These questions are about the driving situation discussed in the group where the light turns yellow just as you approach an intersection. Specifically, you have enough time to stop if you brake quickly; otherwise the light is likely to turn red while you are in the intersection unless you speed up quite a bit."*

A late-yellow/early-red scenario was selected rather than a clear red-light-running scenario because the project team anticipated that not enough of the participants recruited would be able to report running red lights with sufficient frequency to yield correlations to behavioral factors. Thus, the late-yellow/early-red scenario was used instead of red-light running.

The moderator encouraged respondents to complete this questionnaire either before they left the focus group location or as soon as they returned home, while thoughts generated in the group were still fresh in their minds. As described in more detail in chapter 3, the return rate for the take-home surveys was 70 percent.

IDENTIFYING, SCREENING, AND SCHEDULING RESPONDENTS

Participant Sources/Pools

All participants were identified, screened, and scheduled using databank recruiting provided by local research organizations. In each of the three cities where focus groups were to take place, the project team paid research organizations to recruit and schedule focus group participants. Each of these organizations has in-house demographic information on individuals who have expressed a prior willingness to participate as respondents for various research topics. Research assistants at these organizations used the participant screener provided by the contractors to identify participants that meet the selection criteria for the specific focus group sessions.

Scheduling Respondents

Recruiting organizations contacted candidate participants by telephone, provided them with a general description of the task, offered stipends, screened according to the procedures detailed in the participant screener, and assigned them to a focus group session if appropriate. Identifying, screening, and scheduling respondents ran from September 20, 2004, to October 15, 2004.

With the exception of the first focus group, 12 respondents were scheduled for each group to ensure that 8 to 10 were present for the actual focus group. For the first focus group in Washington, DC, 14 respondents were recruited to ensure that the maximum number of 10 were present. This strategy was ultimately helpful because it provided the project team with an understanding of how the maximum number of participants as part of the initial group evaluation impacted the timing of the groups.

ORGANIZING AND SCHEDULING FOCUS GROUP FACILITIES, INCLUDING AUDIOVISUAL CAPABILITIES

State-of-the-art research facilities were used for the Washington, DC, and Seattle, WA, focus groups. Facilities included focus group rooms wired with the necessary audio and video recording capabilities and a one-way mirror that provided a life-size view of the focus groups from an adjacent room and allowed observation of facial expressions and other nonverbal responses. In addition, facilities had the necessary waiting rooms and other amenities to ensure the comfort of participants, observers, and moderator. An appropriate facility was also arranged for the Chicago, IL, focus groups.

CONDUCTING THE FOCUS GROUPS

As participants arrived for each focus group, they were briefly rescreened as a final quality control measure to ensure they met all participation criteria. The first focus group in Washington, DC, was scheduled in the early afternoon to debrief, clarify, and crystallize the meaning of what had transpired. In the debriefing, the project team assessed the flow, timing, countermeasure coverage after the scenarios, and whether the Moderator Guide met all technical objectives. The project team then made all necessary adjustments before the second focus group met. Appendix B reflects these adjustments to the Moderator Guide.

The focus groups were conducted using the content and flow presented in the Moderator Guide in appendix B and the countermeasure descriptions in figures 9 through 17. The researchers videotaped participant responses, and collected handwritten notes taken by both the moderator and the observer.

Across the 3 focus group locations, a total number of 119 individuals participated in the task B.1.2 focus groups. Table 4 below shows the number of participants by location and gender/age characteristics.

Table 4. Number of focus group participants as a function of location and age/gender characteristics.

AGE/GENDER CHARACTERISTICS	LOCATION		
	Washington, DC	Chicago, IL	Seattle, WA
18- to-35-year-old females	8	10	10
18- to 35-year-old males	10	10	10
35- to 55-year-old males and females	10	10	10
65+-year-old males and females	11	10	10

Once participants completed the focus group and were dismissed, they were paid $75 each and given the take-home survey to complete on their own time, along with a self-addressed stamped envelope to mail the survey back to the contractor.

ANALYZING AND SUMMARIZING THE HIGHLIGHTS OF THE FOCUS GROUP DISCUSSIONS

The raw data of the analyses were the words, phrases, sentences, and nonverbal responses of the focus group participants. Project staff looked at all data (tapes, notes, postsession summaries) for patterns emerging from the data. To analyze and summarize the focus group discussions, both the moderator and observer:

- Took notes during each of the focus group sessions.
- Independently developed summaries of each focus group session organized around the key questions/issues addressed during each session.
- Met together to review their individual summaries; compare impressions; discuss differences/discrepancies; and share comments about group interaction, peer pressure, respondent competition, contaminating influences, and subject sensitivity.
- Contributed interpretations and inferences; pointed out any possible biases and contradictions.
- Reviewed taped transcripts of the focus groups.
- Compiled key findings in a topline results summary.

The take-home surveys were entered into a Microsoft® Excel spreadsheet and any discrepancies resolved by visual inspection to ensure data-entry accuracy. Descriptive statistics and simple correlations were computed for responses to all Likert scale questions, and frequency-of-response was tabulated for all open-ended questions.

CHAPTER 3. RESULTS

INTRODUCTION

This subsection of our report presents the results from the actual focus group discussions. It is presented using the same flow and sequence of questions used in the actual focus groups (shown in more detail in the Moderator Guide provided in appendix B) and is organized by subpoints composed of the questions developed to meet the study objectives. Specifically, the discussion flow for each scenario presented below first addresses behaviors, then the decisionmaking factors that more or less directly influence these behaviors, and then complicating factors encountered in the four intersection scenarios presented to the respondents.

The four scenarios addressed in the focus groups and discussed below are:

- Scenario 1: Red-Light Running.
- Scenario 2: Left Turns at Busy Intersections.
- Scenario 3: Turning Left on Major Roads with Moderate Traffic.
- Scenario 4: Rear-End Crashes.

The Moderator Guide in appendix B gives a step-by-step overview of the discussion flow for the scenarios. In general, the discussion focused on describing each scenario, gaining an understanding of driver behavior in the scenarios (i.e., *How do drivers behave in this situation?*), and understanding the many primary and secondary factors (e.g., situations, attitudes, habits, beliefs, consequences, etc.) that influence their decisions and behaviors (i.e., *Why do drivers behave this way?*) during the scenario.

Next, we addressed the participants' opinions of and responses to the nine countermeasures presented during the focus groups. These are:[3]

- 1.1: Red-light cameras.
- 1.2: High-visibility traffic lights.
- 1.3: Advance traffic light warning signs.
- 1.4: Intersection collision warning systems.
- 2.1: Protected left-turn lights.
- 3.1: Automatic gap detection.
- 3.2: Synchronized adjacent traffic signals.
- 4.1: Intersection rumble strips.
- 4.2: Improved skid resistance.

The Moderator Guide in appendix B provides a step-by-step overview of the discussion flow for the countermeasures. In general, the discussion focused on describing each countermeasure, determining if drivers believed that the countermeasure would improve safety, and then gaining

[3] All of the countermeasures are labeled using an "X.Y" designation, where "X" refers to the scenario and "Y" refers to the relevant countermeasure associated with that scenario. For example, "1.1" refers to the first countermeasure discussed within Scenario 1, and "1.2" refers to the second countermeasure discussed within Scenario 1.

an understanding of the perceived implementation issues, advantages, and disadvantages associated with that countermeasure.

Below both the discussion of scenarios and countermeasures include anecdotal quotes from the study respondents.

PARTICIPANT RESPONSES TO THE FOUR DRIVING SCENARIOS

Scenario 1: Red-Light Running

Scenario 1 was described to the focus group participants using the graphics shown below in figures 2 and 3 with the following verbal description: "*Approaching a signalized intersection at speed, the light turns yellow. The driver is far enough away from the intersection that he/she can stop if he/she brakes hard, but is likely to enter the intersection on an early red if he/she accelerates.*"

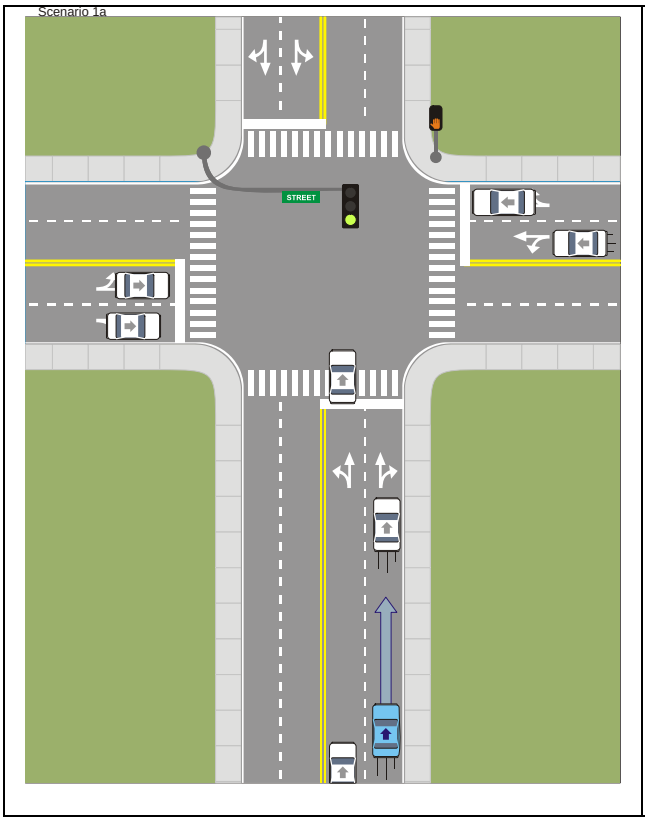

Figure 2. Graphic 1 used to describe scenario 1: Red-light running.

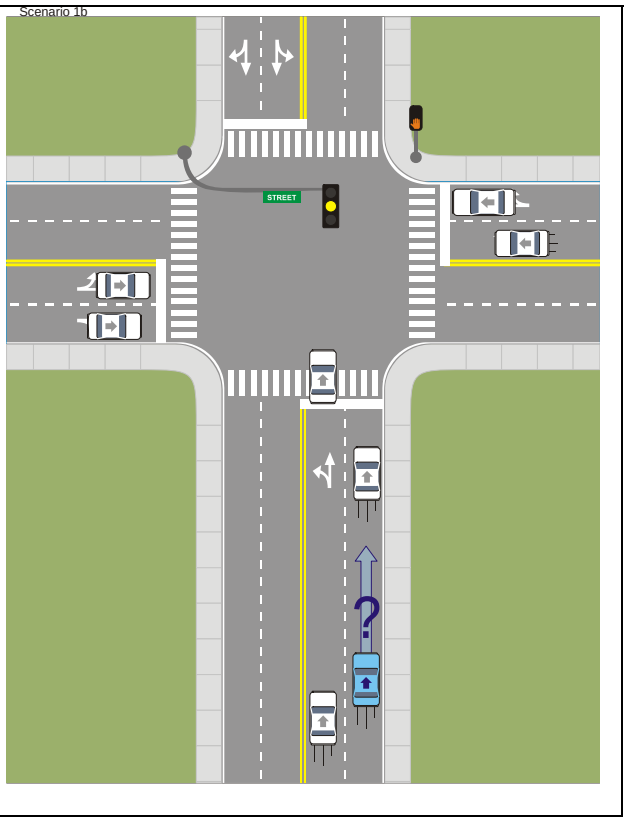

Figure 3. Graphic 2 used to describe scenario 1: Red-light running.

Cognitive/Decisionmaking Aspects of Decisions to Go or Stop on Late Yellow/Early Red Light

1. Are drivers more likely to go through or stop at the intersection?

There was a distinct difference in the approach to this scenario based upon the age of the drivers.

Older drivers were the most cautious. Almost all of the older drivers would not go through the intersection if they were the blue (shaded/gray) car and many of them would try to stop even if they were the white car in front. They were the most defensive drivers and spent a great deal more time checking the whole situation around them. They were also much more concerned about younger drivers and being cut off. These and other factors beyond their control increased their level of caution.

- *"When the light changes (to yellow), I don't speed up, I look everywhere first." —Washington, DC*
- *"The book says when the light turns yellow, it means to stop, not accelerate."—Seattle, WA*
- *"You have to be careful if the first guy decides to wait for the light. I always see (drivers) especially young guys cut you off because they want to go around."—Chicago, IL*

Middle-aged drivers were more likely to go through or slow down based on a quick decision characterized by taking in all of the factors. There was an equal balance of those that would go through the light if they were the blue (shaded/gray) car and those that would stop.

- *"After driving a while, you know when you can go. Over the years you get a feel for it." —Chicago, IL*
- *"I'd stop because of the car in front. Also the car on the right is either going to go forward or turn right. If those cars weren't there, I might go, but in this scenario, I'd stop." —Seattle, WA*

Young female drivers, like the middle-aged drivers, were fairly balanced about whether they would go through the light or stop. Many were very cautious, but just as many were aggressive. Others would go into the left lane to get around the car in front to go through the light or just to "be first" in line.

- *"You have to stop in this situation."—Seattle, WA*
- *"I want to be the first car. If that car is slowing down or speeding up, that's when I make a decision. I want to be ready when the light turns green."—Chicago, IL*
- *"There is no way I'd stop with 2 feet of space. I'd honk and keep going."—Washington, DC*

About three-quarters of the young males would go through the light or approach the intersection with the intent to do so. Some of the young males would go through even if the light was just turning red (as opposed to yellow). A few noted that as long as they could get the front of their car through the intersection before the light turned red they would go through.

- *"If I can get the front of the car into the intersection before the light changes (red), I will go."—Seattle*
- *"If I'm past the white line before the light turns red, I made it.—Chicago, IL*
- *"If the light is just turning red, you will go through."—Seattle, WA*
- *"I don't blindly go through, but probably would go through."—Washington, DC*

2. What factors influence your decision to go through or stop at the intersection?

In all groups, the decision was primarily centered on the drivers' focus on both the traffic light and the car in front of them. The key decision point was the change in the light from green to yellow. A secondary decision point was whether the car in front of them would go through the light. At this point the groups diverged in their situational evaluations and motivations (see discussion below). Additionally, drivers in all groups were concerned about following vehicles that could potentially crash into them from behind.

Many of the respondents in the older groups focused on the dilemma of wanting to stop when the light was yellow, versus wanting to be sure to: (1) not get stuck encroaching into the intersection when the light changed, and (2) not get hit from behind if they did stop. Many drivers readily noted that they would be looking behind them to determine how close the car behind them was, and several said that they might go through if the following car was too close.

- *"If the person where the light turned green is in a hurry, he could hit you."—Washington, DC*
- *"Sometimes you are caught. I'd be concerned that you don't have room to stop, but don't want to be in the intersection when the light changes."—Seattle, WA*
- *"I check my mirror to see who's behind me. I try to look ahead. If I see the hand is flashing I would stop if no one is on my rear end. If there was, I would try to make it through." —Chicago, IL*

Across the board, older drivers were inclined to approach intersections more slowly and operated under the assumption that the white car in front of them would stop. They continued to think this way, even when they were reminded that the white car was most definitely going to go through the light. Similarly, they frequently said that they would be slowing down and preparing to stop in advance of the yellow. Also, the longer the light was yellow, the more certain they were to stop.

- *"I first look at the traffic light and pay attention to when it turned yellow. Then I look in front of and behind me. If the guy in the front is slowing down, I will too."—Washington, DC*
- *"If you were already slowing down at the intersection, you could stop on time." —Seattle, WA*
- *"I am worried about what the vehicle ahead is going to do and want to stay behind him." —Chicago, IL*

For the middle-aged drivers the decision was more about whether they had enough time or would "make it," as opposed to wanting to stop. A separate, frequently cited factor was concern about hitting the lead car if that driver suddenly changed his/her mind and stopped short. Most felt they would probably hit the lead vehicle in that case. A number of middle-aged and younger drivers also noted that they might go into the left lane to get around the white car in the front. A few middle-aged and younger respondents mentioned that they would be more cautious if they were aware that there was a red-light camera there or if they knew there were often police cars in the area.

- *"The decision is: Do I have enough time? Am I going to make it?"—Washington, DC*

- *"If you've got speed you will go for it."—Chicago, IL*
- *"I would already be slowing down. I would be also watching the car on the other side because I might try to get over to get around the (white) car."—Chicago, IL*

Unlike the older groups, both the middle-aged and younger drivers were more inclined to assume the white car in front of them would go through the light, but they still anticipated that it might stop. Many of the middle-aged drivers would have sped up to go through the yellow light if the white car wasn't there, but since it was, they were more likely to be cautious.

- *"If the light is yellow, you have to stop, just in case the white car didn't go through." —Seattle, WA*

Many of the young females had predetermined criteria for when they would go through the light and when they would be more likely to stop, including whether they were driving in rural, suburban, or urban areas. The time of day was also frequently introduced in relation to congestion and the density of pedestrians during rush hour. Their criteria were often overruled as a result of their perceived level of frustration or being in a rush. When they are late, many younger female drivers are more likely to run a yellow/red light. In the evening or early morning when there are fewer cars around they are also much more likely to "go for it."

- *"It depends on the day and time. Before rush hour I would probably go through, but not after 3 p.m."—Chicago, IL*
- *"In the daytime I am looking at people downtown, and at night I am looking behind me." —Washington, DC*
- *"Downtown if I see yellow I stop. In my own neighborhood, I go."—Seattle, WA*

Most of the young females said they would be watching to see if the car in front of them was speeding up to go through or slowing down to stop or make a right turn. Also, they were likely to go through if the car behind them was too close, even if they would have preferred to stop.

- *"Half of the time the person in front is going to turn right. I would watch for that." —Chicago, IL*
- *"If you are that far from the intersection, you don't know what the white car is going to do."—Washington, DC*
- *"If cars are behind me, I won't stop short."—Seattle, WA*

A large number of the young males assumed that the car in front of them was going to go through, and they would speed up to follow it. Many of the young males that didn't speed up would still go through as opposed to slamming on their brakes, and many others would go into the left lane to get around the car in front. Also, many younger male drivers indicated that they were more likely to run a yellow/red light if they were in a hurry.

- *"At that distance if I hit the brakes I would go through anyway."—Chicago, IL*
- *"If the white car is speeding up, I would go through."—Chicago, IL*

The young males that would not go through had a rationale similar to that of the young females. Many were cautious based upon the potential of the vehicle in front to stop or turn at the last minute. Some were more concerned about whether they would get caught trying to run a red light, if there were red-light cameras or cops around, and whether they could get through without speeding too much.

- *"You're kind of screwed. I wouldn't put it past this white car to stop. If the left lane was open it would be a different story."—Seattle, WA*
- *"It depends on the area, whether a red-light camera is there and if there is traffic coming." —Washington, DC*

Some young male and middle-aged respondents noted how missing one light might make you miss the timing for several others. This situation would cause them to speed up and go through the light. A few said they would slow down because it wouldn't help to run one yellow since they would have to stop at the next one.

- *"If the lights are timed and you don't make that light, you also would miss the others, so you'd go through, especially if I am that close and can speed up and make it."—Chicago, IL*
- *"If the lights are timed and you don't make that light you would also miss the others, so you go through."—Washington, DC*
- *"It doesn't help to run one yellow because you'd have to stop at the next one."—Chicago, IL*

3. What are some additional external factors that influence driver decisions?

Many of the middle-aged and younger drivers noted that having passengers in the car was a complicating factor. Children had the largest impact on whether these drivers were more cautious, and a few also mentioned the importance of being a good role model in front of older children. Conversely, many of these drivers noted that they would be more likely to go through a yellow/ red light if they were by themselves.

- *"If I'm in danger, they're in danger. I am also modeling for them. When I'm alone I'm drinking coffee and playing the radio."—Chicago, IL*
- *"It makes a difference if kids are in the car more than friends."—Seattle, WA*
- *"Passengers matter."—Seattle, WA*

A large proportion of the older drivers was not as concerned with the presence of passengers and felt they would do the same thing with or without them in the car. When they did note passengers, they introduced them as distractions (e.g., "backseat drivers") as opposed to a reason for caution.

- *"I tell my passengers not to talk to or distract me. I don't want to kill one."—Washington, DC*
- *"My daughter has three children, and she is always talking in the car and turning her head, and she's been in a few accidents."—Chicago, IL*
- *"Passengers are a distraction including backseat drivers."—Washington, DC*

Respondents in just about all of the groups noted that the type of driver and vehicle in front or behind them sometimes made a difference. Some respondents were concerned about the age, type, and/or cost of the car being driven, in addition to whether the drivers looked like people who would stop or go on a yellow light. A few respondents noted that having their dog in the car would prevent them from stopping.

- *"I am concerned about people who realize they are in the wrong lane and suddenly change lanes."—Washington, DC*
- *"The type of car you and the person in front of you is driving would have an impact" —Chicago, IL*
- *"I'd also check the other guy (in front) – both the driver and the kind of car they are driving. If it was a kid I would slow down, over twenty-seven I would go."—Washington, DC*
- *"The dog does not get to wear a seatbelt. If I were to stop short he would go through the windshield."—Seattle, WA*

5. Do drivers anticipate and plan a response for a dilemma-zone situation as they approach an intersection, or do they react on the fly to the yellow light and the corresponding driving conditions?

A large number of the older drivers planned ahead and anticipated their response for entering a challenging intersection scenario such as this one.

- *"I'm looking at the whole traffic pattern."—Washington, DC*
- *"When coming up to the intersection I look at that signal (pedestrian). When it's flashing the light's gonna turn. It tells me to be ready to stop."—Seattle, WA*
- *"With that car making a left I wouldn't have an escape route."—Seattle, WA*
- *"If you were already slowing down, you could stop.—Seattle, WA*

A majority of the middle-aged drivers were inclined to introduce the idea of a gut or instant decision without any prompting. This reaction was typically described as "going with their gut," "getting a feel for it," "taking it all in based on experience," or other similar phrase. Some younger drivers also brought up the concept of gut decisions, and a few described them as "auto thinking." However, the majority of younger drivers were more likely to anticipate the situation instead.

- *"I look at what others are doing. You're gauging in seconds whether you're going based on experience. You take that in."—Chicago, IL*
- *"At certain intersections you run the red because you just do it and you know that you can."—Seattle, WA*
- *"It's a bit of a gut decision based upon a bunch of factors."—Washington, DC*

6. What other information do drivers use when make decisions regarding going through or stopping?

Some drivers in all groups mentioned that they would be watching the pedestrian signal and noting how long it had been flashing or watching the countdown timer (if such information were

available). Some young males would use this information to get them through the light. For example, a few mentioned that if the timer is counting down they would speed up on specific timer values to make the light.

- *"I check my mirrors to see who is behind me. I try to look ahead. If I see the hand is flashing I would stop if no one is on my rear end."—Chicago, IL*
- *"You know the light will turn yellow when it is on one."—Washington, DC*
- *"It depends where you are on the count. If it's above eight I will speed up."—Washington, DC*

A large number of the middle-aged and younger drivers noted that intersection familiarity is a big factor. If they know they have to wait a long time at the light, as is often the case in suburban areas, they would be more likely to go through. Many drivers also said that they go through because they know the light has a long yellow duration. On the other hand, many noted that they would be more cautious if they did not know the intersection.

- *"If there is a long wait and you know it, you'll be late so you go through."—Chicago, IL*
- *"The intersection by my house is yellow for :08 seconds and ten cars can get through it. In that case it doesn't matter if it's yellow and you know it."—Chicago, IL*
- *"If you're familiar with the intersection and you know it's a long light, I might go through it."—Seattle, WA*
- *"In the city I will stop but in the suburbs I would go because the yellow is really long." —Chicago, IL*

One older driver sometimes based his decision to go through the light on whether or not the white lane markings by his car had become solid. He believed that these markings were deliberately designed to indicate the cutoff point for making it through on a yellow light.

- *"Based upon the speed limit, if you are within the solid white line you can proceed. I use that cautiously as a guide."—Washington DC*

7. Is going through the light ever a deliberate act?

About half of the young males, a quarter of young females and a few older drivers would go through the light as a deliberate act to try to "gun it" or "make it." They sometimes ran the light if they were pressed for time, but they also did it if they were in an "aggressive" mood, or feeling frustrated or impatient.

- *"It depends on which road it is, traffic and level of road rage."—Chicago, IL*
- *"I am making a conscious decision as I'm approaching the intersection."—Chicago, IL*
- *"Whether I am in a rush doesn't matter as much as my mood."—Washington, DC*
- *"Frustration might make me drive through when I shouldn't.—Washington, DC*

Not being able to stop on time is another big reason for deliberately going through intersections in all categories with the exception of the older groups. Many also noted the loss of control that

comes from slamming on the brakes as a reason for deliberately going through. Yet another stated reason is whether or not drivers think they might get rear-ended.

- *"When you slam on the brakes you often don't have control of the car."—Seattle, WA*
- *"I don't want to stop because I can get hit by the car behind me." —Washington, DC*
- *"If cars are behind me, I won't stop short."—Washington, DC*
- *"I would go through because I would not want to get hit from behind."—Chicago, IL*

Most older drivers specifically emphasized that they do not intentionally enter an intersection during a late yellow/early red light just because they want to get through. If they do enter the intersection, it tends to be because they believe they have no other options.

- *"If it's yellow when you are hitting an intersection it is different than if the light is yellow when you are approaching the intersection.—Chicago, IL*
- *"Sometimes you get caught. You are concerned that you don't have room to stop, but don't want to be in intersection when the light changes."—Seattle, WA*
- *"Even if it is wet, you should leave enough room to be able to stop."—Seattle, WA*

While many middle-aged respondents run yellow and red lights and do view it as a deliberate choice, they do not view themselves like those they would describe as red-light runners. There was a real difference for them about going through the light as it was changing versus going through when it was red. However, their beliefs were somewhat contradictory as they readily attributed others' red-light running, but not their own, to irresponsible, criminal, or habitual intent.

- *"The person who will run the light will go through anyway."—Washington, DC*
- *"This won't work for habitual red-light runners."—Washington, DC*
- *"At certain intersections people just run red (lights). I know I can but I don't, unless it's a long yellow."—Seattle, WA*

8. Is it ever the case that drivers do not notice the signal until it is too late to do anything but continue through the red? Do drivers ever try to stop in this case?

During the focus group sessions, this subject rarely came up without prompting from the moderator. Some young males mentioned that if this does happen, they would go through when they were not paying attention or were distracted. A few young males mentioned that this can happen while on your cell phone. A few older and middle-aged drivers mentioned daydreaming and not paying attention as additional sources of problems. Drivers other than the young males indicated that, when this does occur, their decision to stop or go depends on the point when they notice the situation and whether or not it would be safe to stop.

- *"If you are not paying attention, you are going through."—Seattle, WA*
- *"Driving with cell phones are a distraction, and you might not see the light change. —Washington, DC*
- *"You can be daydreaming and misjudge the situation."—Chicago, IL*

Complicating Factors

1. The presence of other drivers.

About a quarter of all drivers were concerned about oncoming vehicles turning left across their path. With the exception of the young male drivers, many were concerned about cross traffic ready to enter the intersection at speed as soon as the light for cross traffic turned green.

2. Heavy traffic congestion and long delays at intersections.

Heavy congestion was mentioned by many drivers as a big reason for not running lights. But long intersection delays were a primary justification for many drivers in all categories to go through lights.

3. Weather conditions.

For Chicago, IL, and Seattle, WA, groups, weather conditions came up much more quickly in the discussion than in Washington, DC—often as part of their initial reactions to the scenario. Not wanting to stop for fear of sliding on ice and snow was considered more in Chicago, IL, and slick oil with rain on top was introduced early in three of the four Seattle, WA, groups. Drivers in both cities were divided about whether they would stop or go through under these conditions. Some noted that they would stop even if they were going to skid, while others said it is safer to go through because of not wanting to skid or lose control.

- *"I would go through if I thought I would skid otherwise."—Chicago, IL*
- *"If it was raining, I would keep going or skid."—Seattle, WA*
- *"I am more likely to go through if it is raining."—Seattle, WA*
- *"If the white car is going to blow the light, I would stop even if I am going to skid." —Chicago, IL*
- *"If you are going 45 miles per hour (mi/h) (72 kilometers per hour (km/h)) and you are that close, you would be more likely to gun it than slam and slide."—Chicago, IL*

4. Poor visibility conditions (e.g., fog, nighttime).

A large proportion of the older drivers and some of the middle-aged drivers are far more cautious about driving at night; a few do not drive at all at night. Respondents in all groups also agreed that when there is poor visibility from weather, they are more likely to be cautious and slow down, and they are assuming (or hoping) other drivers are doing the same.

Field of vision obstructions were also noted as a factor by many of the respondents in all groups. Many noted that intersections are not usually as perfectly laid out as they were in the scenario diagrams discussed in the focus groups. Others mentioned the presence of trees, buildings, large vehicles, and anything else obstructing their view to make them more cautious.

5. Glare from oncoming vehicles.

Few drivers in the middle-aged groups brought up the topic of glare. The older groups were the most concerned about glare at night. Some noted that they do not like certain types of headlamps

(i.e., halogen). These drivers also discussed having difficulty seeing and problems driving in the presence of glare, especially if the roadway markings were faded. A few older drivers had coping strategies such as following the white lane markings instead of looking at the lights. Younger drivers brought up difficulties caused by glare from the sun during the day. This factor was most often introduced in the Seattle, WA, groups.

6. Poor roadway traction conditions (e.g., rain, ice, snow.)

Poor roadway conditions, especially rain in Seattle, WA, and snow and rain in Chicago, IL, were by far the most frequently cited complicating factor in all of the groups. The most common impact of poor traction conditions was that many drivers in all groups were more likely to go through the intersection rather than risk skidding or losing control of their vehicle.

7. Intersection terrain (uphill, downhill, flat).

Terrain was frequently mentioned as a factor in the Seattle, WA, groups. Big hills caused concern because they totally obstructed the view from intersections looking downhill. A few drivers also noted that they would go through if they were driving a stick shift because they would not want to stop on the hill.

8. Other complicating factors.

Another factor often introduced by all of the groups was the presence of pedestrians, which caused many drivers to be more cautious. Also, many of the respondents in the older and young female groups noted that pedestrians are much harder to see at night. Others mentioned that they try to determine whether pedestrians are about to jump into the crosswalk before they decide to go through the light.

Some middle-aged and younger drivers noted the presence of cameras and police cars as complicating factors. Young male drivers were also likely to be more cautious at night and in the suburbs because there are more police out.

Many young drivers noted that they are extremely cautious in school zones and that they would not go through a yellow light under those circumstances.

The type of vehicle that respondents were driving and the type of vehicle in front of them were frequently introduced as a factor among all drivers. It made a difference whether a vehicle was old or new/expensive, or heavy like a sports utility vehicle (SUV), truck, or large car because that made it slower to stop and more likely to obstruct their view. A few noted that they had small cars and so would be more likely to stop. Others mentioned that it mattered whether they had good brakes.

Cell phones and other distractions were also noted as complicating factors in many situations, but drivers usually mentioned them with respect to others on the road, not themselves. Respondents said that often people talking on phones don't see the light change. Many older drivers said that this situation was one of the problems with younger drivers and cited examples of accidents that can happen when people are not paying attention.

Attitudes, Beliefs, Behaviors, and Other Motivating Factors Related to Decisions to Go or Stop on Late Yellow/Early Red Light

1. What are driver attitudes regarding red-light running?

In all categories, those drivers who have had experience with a critical event (where, if they had gone through a yellow light they would have been hit, or if they actually had been hit by drivers that jumped yellow lights) viewed red-light running as much more dangerous than those that have not. These incidents almost always had an impact on their attitudes about red-light running and whether it was a serious problem.

Otherwise, attitudes of many of the respondents were most influenced by age, although there were exceptions in every category. Most older drivers were more inclined to view red-light running as a serious problem than were respondents of other ages. They described it as something that too many people do without regard to consequences.

Many middle-aged drivers typically go through yellow lights and sometimes through red lights, but do not view that as contributing to the problem of true red-light running. They do not intend to run red lights but it can happen when they go through yellow lights.

Most younger drivers that have not been involved in a red-light-running critical event are more concerned about getting a ticket than getting into a crash when they a run a red light. Many even consider it a bit of a game and like to find ways to avoid intersections where they have an increased likelihood of getting tickets.

2. What do drivers believe are the consequences of running red lights?

About half of all respondents in all groups mentioned getting tickets and paying expensive fines as a consequence of red-light running. This concern was slightly higher among younger and middle-aged drivers than older drivers.

Almost as many drivers in all groups were concerned about the potential for crashes or injuries involving pedestrians, passengers, themselves, and other drivers. Younger females and middle-aged drivers were more concerned about passengers than the other groups. Older drivers were more concerned about their own safety. Older drivers also mentioned being "at fault" and liability for hitting others as a consequence more often than the other groups—although all groups mentioned it.

3. Do drivers' beliefs about the consequences come into play in their decision process at all?

Although drivers most often mentioned getting tickets as a consequence of red-light running, the consequences that had the most lasting effect on their behavior was their safety and the safety of others. Many drivers from all groups acknowledged being more cautious and altering their driving behaviors because of the potential for crashes, hitting pedestrians, or getting hit by other drivers. In many cases, these views were based on their own experiences.

Some older drivers felt that the role of the police was important to other (especially young) drivers, but that the threat of getting a ticket did not have as much of a direct impact on their own behavior.

Many middle-aged drivers and young drivers (both males and females) said the presence of police cars and red-light cameras would cause them to change their behavior—specifically, that they might slow down and be more careful when going through an intersection. Yet when most of the young males and females actually got tickets, it only had a transient effect on their behavior. In particular, they mentioned that getting a ticket made them more careful for a while, but that it did not take long before they returned to their old habits. Similarly, getting a ticket might simply encourage them to avoid intersections where they knew the police would be while they continued to go through lights at other intersections. A few young drivers, while they would try to avoid tickets, viewed tickets as just another cost of driving.

Many drivers in all groups are very aware of and make decisions based on not wanting to hit pedestrians. They are particularly concerned about this situation at night and are more likely to slow down or stop when pedestrians are present. All drivers also note being cautious around schools and in suburbs where children might be difficult to see. Drivers are far more likely to slow down at red lights in these areas. Younger female and middle-aged drivers seemed the most concerned with the impact of their actions on the safety of their passengers especially, when young children are involved.

Drivers' liability and who is "at fault" in a situation also has an impact on decisionmaking processes. Older drivers in particular are often more concerned with not being "at fault" than they are for their own safety.

4. How does experience with critical events (e.g., crashes, near-misses, etc.) impact their decisions, attitudes, beliefs, etc.?

Critical events have a strong impact on many drivers from all groups about the particular situation, but this feeling does not transcend to other aspects of their behavior. For instance, being rear-ended is more likely to prompt drivers to check their rearview mirror more often or to not stop short, but it does not necessarily impact their decision to run a red light if no one is behind them. Similarly those who have been hit by red-light runners might look carefully for cars coming on their right, but they do not necessarily stop running red lights themselves.

Some respondents in all groups reported changing their behavior based on experiences of family members. In one case, a woman's husband got into a terrible accident while making a left turn at an intersection. Now, she almost always slows down at intersections and waits for the light to change before turning. In another case, a woman described how her daughter's friend killed someone while going through a red light, and that incident serves as a constant reminder to be cautious when going through intersections.

One factor that might diminish any behavior-modifying effects of critical events for older drivers is that many of them do not perceive themselves as being "at fault" in most situations. While they are much more likely to be cautious as a result of their experience, they often do not think that there is any need to change their own behavior as a result of their critical experiences. For

example, one woman described how she pulled out from an intersection when she had a green light and was broadsided by a taxi running a red. However, this did not cause her to become more careful at intersections because the incident was not her fault.

5. What do drivers think that others in their peer group would do in this situation?

Most older and middle-aged drivers were not concerned about what their peer group would do in this situation and did not mention peer groups at all (with the few exceptions noted below). Young male and female drivers were the only ones that noted peer influence. A few said that if a friend in the car thought that they should "go for it," they might listen. Similarly, one driver whose girlfriend was impatient and wanted him to run the light would listen to her and go through. Many young drivers would be more cautious or less likely to go through the light if they were with their parents. Similarly, one middle-aged woman would drive more carefully and not go through a light when her husband was in the car, but would go through if she were alone. A few middle-aged women noted that they are more careful when their older children are in the car because they want to be a good role model.

6. To what extent is the act of going through the light under their control?

Many drivers in all groups said that going through the intersection was not under their control. The most commonly cited reason in all groups was what they perceived to be a "deliberately short" yellow phase duration. In particular, many drivers felt that yellow phase timing was rigged so that cameras would be income generators for the government.

In general, older drivers did not view themselves as in control in many of the situations. Many older drivers frequently mentioned that they might go through the light if another driver came up behind them too quickly.

Roadway conditions also impact perceived control, particularly among the groups in Chicago, IL, and Seattle, WA, as they cause many people to go through the light to avoid losing control of their vehicle. Among all drivers in Chicago, IL, and Seattle, WA, about half would stop and half would go through as a result of slippery conditions. These conditions did not seem to have nearly as much impact on the Washington, DC, groups. In particular, while many would still drive a little more carefully, most drivers in all age groups said slippery conditions would not affect their decision to stop or go.

7. To what degree, if any, does habit (e.g., "I don't think about it, I just always do it that way") affect whether or not drivers run a red light?

Habit did not seem to be much of a factor for any of the drivers. While many described their decisions as "automatic," they still felt that it was based on experience and depended on the situation. They often articulated many factors that instinctively went into the decisionmaking processes that contributed to their gut reactions.

Scenario 2: Left Turns at Busy Intersections

Scenario 2 was described to the focus group participants using the graphics shown below in figures 4 and 5 with the following verbal description: *"Stopped in the middle of an intersection, waiting to make a left turn on a busy street; an oncoming car is also waiting to turn left and makes it difficult to see other vehicles approaching in the next lane.; There is no dedicated turning lane and no dedicated turn signal; cars are waiting behind to also turn left (or go straight)."*

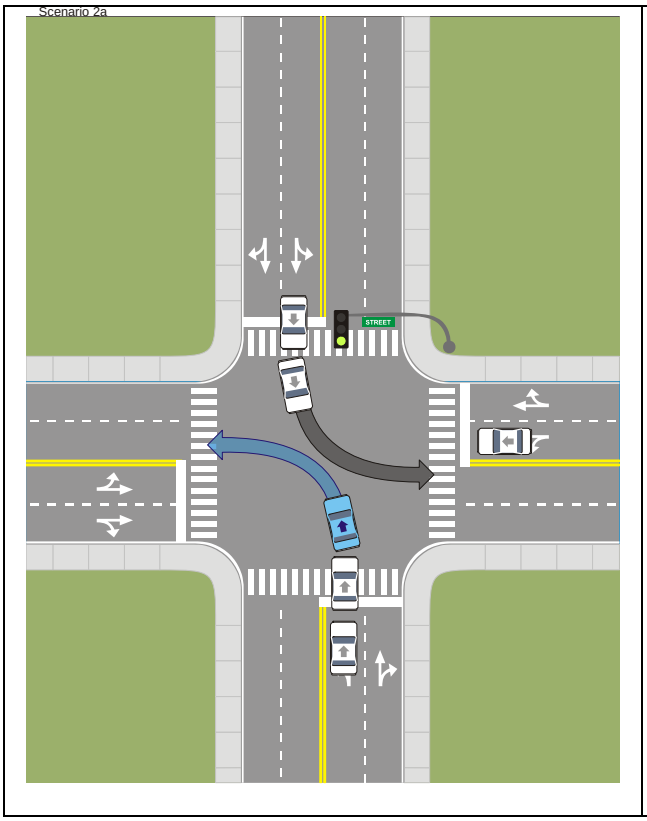

Figure 4. Graphic 1 used to describe scenario 2: Left turns at busy intersections.

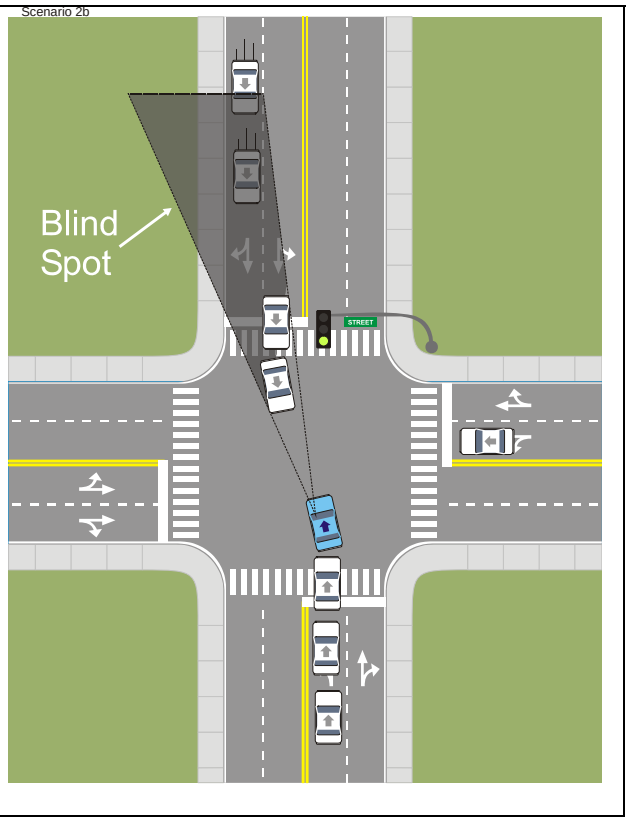

Figure 5. Graphic 2 used to describe scenario 2: Left turns at busy intersections.

The findings in this scenario did not break down as neatly by age group or geography as they did for the red-light-running scenario (scenario 1). When age or geographic breakdowns made a difference, they are noted in the following responses to questions. Otherwise, responses are discussed in order of magnitude across the whole respondent pool.

Cognitive/Decisionmaking Aspects

1. What are drivers most likely to do in this situation?

Most of the drivers in all groups indicated that this situation made them quite uncomfortable. In general, most drivers will creep out slightly to see if they can get a better view and make a decision about whether to turn or to abandon the turn and go straight instead. This typically involves the use of one of the following strategies:

A. Wait for the light to change to get some protection from oncoming traffic.

About half of drivers in all groups will wait until the light changes so that they can be sure that no one else is coming. Some of those that wait for the light to change will go after the light turns yellow and they have confirmed that oncoming cars are stopping. Many drivers, however, will actually wait until the light turns red so that they can be certain that no one else is coming.

- *"I would be very cautious about going any further left until it (the light) turned yellow or red."—Washington, DC*
- *"I would wait for the yellow and then I'd go."—Chicago, IL*
- *"When the light turns red, the oncoming cars won't hit you."—Washington, DC*

B. Avoid turn altogether.

Just about one-half of middle-aged and older drivers and some of the young female drivers would prefer to avoid any situation without an arrow or a dedicated turning lane and make three rights, go straight and turn around, or choose another route instead. Many have seen too many accidents in this situation to be concerned about being impatient or taking the risk to go. Others will just go straight if they feel they have to wait too long.

- *"If I can't see I will not take a chance. I would go straight and then turn around." —Washington, DC*
- *"I will figure out a different way to go."—Seattle, WA*
- *"The older I get, the more I avoid left turns."—Washington, DC*
- *"It is not worth taking a chance."—Chicago, IL*
- *"It will take three rights to get out of this situation."—Seattle, WA*

C. Barge their way in and force oncoming vehicles to slow.

About one-quarter of the young males and a few young female drivers pull up far enough into the path of oncoming traffic to block the oncoming car. Many of these drivers make sure they are out far enough into the intersection so the other cars will see them and have to let them go when the light turns yellow or red.

- *"If I pull out to the line, even if the oncoming left car is going to go, he can't speed up. He has to wait for me to turn."—Chicago, IL*

- *"Usually the blue car and the oncoming car are both inching. So I get further out there. Once that car is far enough down, then I can see. Usually other cars will let you go." —Seattle, WA*
- *"Eventually cars will have to stop if you go through."—Washington, DC*

D. Wait for the oncoming vehicle to turn and then go if there is no other oncoming traffic.

About a quarter of all drivers will wait until the oncoming car making a left goes first. This opens up the field of view for drivers to determine what to do next. If the outside oncoming lane is clear at that moment, then they will make the turn.

- *"You have to yield to the oncoming traffic. I would motion to the guy turning to go first." —Chicago, IL*
- *"I'd wait for the guy in front of me to turn so I can see the other lane."—Seattle, WA*
- *"I'd wait until the oncoming car made his left. Then see what to do next."—Chicago, IL*

2. What steps do drivers take in making the turn?

While most drivers were somewhat anxious in this situation, some drivers in all groups described this scenario as a game or a dance because both left-turners are in the same situation. To them it is all about who goes first, making eye contact, inching up as far as possible without getting hit, and then trying to make the turn. The four basic steps identified throughout the focus groups include:

A. Intersection entry.

Most of the drivers in all groups advance directly to the middle of the intersection without hesitation, regardless of how much traffic is coming. The remaining few drivers will first wait at the stop line until there's no traffic coming, then inch forward. About half of those who advance to the middle of the intersection will then gradually creep out into the oncoming lane to see if they can get a better view. The other half of drivers that advance into the intersection will stay in their lane (see next section). Some drivers noted that by advancing into the intersection to get a better view they also decrease the travel distance required to get across. Similarly, some were more likely to inch out in a larger intersection because they had more room to go before potentially getting hit by oncoming traffic.

- *"I would get myself out into the intersection. If I can't see cars, I would wait for the light to turn red, then go."—Seattle, WA*
- *"I will get way out in the middle if I am behind someone so that I can go through with them."—Seattle, WA*
- *"If it's a fresh green you don't creep. You can tell when traffic runs out then inch out more."—Washington, DC*
- *"Pulling up gives me a better view and less time needed to make the turn."—Washington, DC*

B. Vehicle positioning in the intersection.

Most of the older, middle-aged, and young female drivers that would make the turn would inch forward but remain mostly straight in their lane. An immediate concern of these drivers was to avoid encroaching into the oncoming lane and being hit by opposing traffic. Many drivers were also concerned that if they turned their wheels while inching forward and then got hit from behind, they would be hit head on by oncoming traffic. This possibility prompted them to keep their wheels straight.

- *"I would creep toward the car coming at me but stay straight enough to not get hit" —Washington, DC*
- *"I would inch out but stay straight"—Seattle, WA*
- *"I would keep the wheel straight and pull all of the way up to the middle to avoid getting rear-ended, then turn when it is clear."—Chicago, IL*

Most young males and about a quarter of the young females and middle-aged drivers would go to the middle of the intersection but position themselves in the lane of the opposing traffic or slanted toward opposing traffic (yet protected by the oncoming turning vehicle).

- *"I would creep up and angle myself slightly but not into the other lane. Then if I can't see I would wait there until the light turned red."—Chicago, IL*
- *"I would creep and go a little straight, then left."—Washington, DC*

C. Decision to turn.

Most respondents prefer to wait until no traffic is coming and there are no cars in sight. About half of the respondents accept that since "no traffic/no cars" is often unlikely, they look for a gap where they can turn instead. The other half of drivers think it is safest to wait until the light changes yellow or even red. This situation is especially true during the day when it is busier.

- *"Once there is no traffic in the right and the left cars are turning left, I would go."—Chicago, IL*
- *"I'd wait until I am sure there is no traffic coming and inch out. Then when the traffic was clear, I'd turn."—Seattle, WA*

D. Acceleration.

Once drivers make the decision to go, most accelerate quickly to get out of the intersection as soon as possible. A large proportion of people are uncomfortable when they go because they are concerned that they missed something or misjudged the gap. Many make the decision and then feel that they are committed to it and that the resulting consequences are out of their hands. Older and middle-aged drivers seemed more likely to place the responsibility in hands of others with phrases like "proceeding then praying." Younger groups felt similarly but described it as "gunning it," "going for it," etc., which suggests a more assertive attitude about the turn.

- *"I would pull up to get past the other turning car, then punch it and go."—Chicago, IL*
- *"You just creep out and gun it." —Washington, DC*

- *"That's what we have by me. It's Russian Roulette. I called the city about it."—Seattle, WA*
- *"I would proceed slowly and pray."—Washington, DC*

Across the board, drivers note that they would check for the pedestrians before going.

- *"If you turn with pedestrians you are taking a big chance."—Chicago, IL*
- *"If pedestrians are around, I'd sit and wait. If not, I'd go for it."—Chicago, IL*
- *"I would always be checking the crosswalks."—Chicago, IL*

3. How do drivers decide (what steps are involved) whether or not a gap in traffic is sufficient? What factors are relevant? What size gaps are they comfortable with?

The speed and distance of the oncoming traffic are probably the most common factors that most drivers cited about judging the gap. Some people watch oncoming cars go by and try to gauge the time it takes to close the distance between themselves and the oncoming cars. Others judge the gaps until they feel comfortable with enough distance to make a move. Still others consider it more of a gut decision.

- *"You judge the gap by speed of car and type of car."—Washington, DC*
- *"It depends on how well you can see the road and how fast the cars are coming." —Washington, DC*
- *"Speed, traffic—you need to factor it all in."—Chicago, IL*
- *"The speed of the oncoming traffic is a factor."—Washington, DC*

Some drivers in all categories noted that if they are familiar with the intersection, they act more casually; i.e., they would be more comfortable with the surroundings and traffic patterns and thus more likely to take a chance and make the turn with less of a gap.

- *"If I know the intersection and how cars will act, that changes my behavior."—Chicago, IL*
- *"It matters if I know the intersection. You wait for the cycle then go."—Washington, DC*

Many older drivers and some young males were concerned about passengers in this scenario even though they were not concerned with passengers in the red-light-running scenario. The presence of passengers had a distinct impact on what drivers judged to be an acceptable gap size, making them more cautious and likely to wait longer to get safely across.

- *"If there is a female in the car you are more conservative."—Washington, DC*
- *"I was a passenger coming from the other direction in an accident like this."—Seattle, WA*
- *"If my car is really full it reacts differently, and I'd probably be more cautious." —Washington, DC*

While no drivers directly defined what an acceptable gap size was, they often noted that this varied based upon speed and distance of oncoming cars, passengers, types of vehicles involved, weather, and the amount of congestion. These are discussed at greater length in the "complicating factors" section below.

4. What other information or considerations come into play?

Many people are primarily looking at the light and the oncoming traffic. In addition, most drivers watch out for what happens when the oncoming car turns. While it opens up the opportunity to see what's coming, it also presents questions about the oncoming cars in the inside lane. Even when the light is yellow or red, drivers anticipate that these drivers may want to make it through the intersection too. This influences how far out in the intersection drivers think they should be. Some drivers focus on the nonturning cars in the oncoming inside lane—especially if the driver became frustrated while waiting for the turning car. Many respondents were concerned that these oncoming drivers might speed up and hit them while they made their left turn. Drivers anticipate this possibility by looking for turn signals in the oncoming traffic behind the first car. However, many drivers don't trust the signals and they look to see what the oncoming vehicles actually do.

- *"You've got to watch out for the guy in the second white car. If the car turning gets through before you he's gonna sail through—he's already impatient."—Seattle, WA*
- *"I don't trust (turn) signals. I got hit head-on that way and the seatbelt saved me." —Chicago, IL*
- *"If you can't see their signals, it is difficult to judge."—Washington, DC*

5. What are some other strategies that drivers use to handle this situation?

Drivers in all groups mentioned a variety of strategies or tricks that they use to deal with this scenario. Some drivers thought it was important to make eye contact with other drivers to encourage them to turn or to let them know when it is clear to go.

- *"You are edging forward and making eye contact, so you both have to be clear that there are no cars in the blind area."—Seattle, WA*

Some drivers look through the windows of the cars to see if they can get a better view.

Some young males pull out far enough into oncoming lane so they can get a better view of what oncoming vehicles are doing. This also lets oncoming vehicles see them and have to let them go when the light turns yellow or red.

A few drivers said if they had other passengers in the car they could "spot" for you.

Complicating Factors.

1. Other vehicles.

Many of the respondents said that they did not care about the cars behind them, yet about half of respondents had strategies for addressing them in one way or another. The other half said they would just let the cars honk. Young females and older drivers seemed to be the most concerned about the cars behind them. Many would pull up as far as they could so the cars could get around them. Many also do this as a "courtesy" as they too do not want to be behind drivers who aren't courteous enough to let them go by. A few people put their turn signal on well in advance to give these drivers the opportunity to get around them.

- *"I want to make driving as efficient as I can for the guy behind me so he can turn too." —Seattle, WA*
- *"I feel very nervous in this situation and feel pressure to go."—Washington, DC*
- *"If they are honking let them honk."—Chicago, IL*
- *"I experience this every day. I put my turn signal on a block before so the cars behind me have been warned."—Seattle, WA*

As discussed previously, many drivers are concerned that the vehicles behind the oncoming turning vehicle might try to go through the intersection once the turning vehicle goes, even if the light is yellow or red.

2. Heavy traffic congestion and long delays at intersections.

Some drivers in all groups felt that congestion played a big factor in their decision to turn and many would try to go through the light as a result. They were also concerned about getting stuck in the intersection because of heavy congestion. A few older and some younger female drivers were not concerned enough about long delays at intersections for it to impact their decision to turn. Those that were concerned mentioned that they did not want to wait through another whole light cycle, so they would go through the light. A few said they would avoid the intersection altogether if the line of turning-lane traffic was too long.

3. Pedestrians/bicyclists crossing in the turn path.

Many of the drivers in all groups noted that they would always be checking the crosswalks. Some of the older drivers were not only worried about those walking but also bicyclists, skateboarders, roller bladers, and scooters. A few of the older and the middle-aged drivers also commented on how pedestrians and bicyclists are the ones that do not obey the rules, and also that they often wear black so that you need to watch out for them—especially at night.

4. Nighttime driving.

Many of the respondents from all groups were more concerned at night because of reduced visibility. This factor made them more cautious and willing to wait longer to be sure that it was safe to go through the light. A few also noted that they would be more careful at night with the increased likelihood of drunk drivers. Some drivers also indicated that there are benefits at night. In particular, they are able to see the cars coming from further away because of their headlamps.

5. Glare from oncoming vehicles.

Some of the older respondents mentioned that glare from oncoming lights at night made them more cautious. Some of the younger respondents noted that they were concerned about how glare from oncoming lights changed their ability to judge the speed of the oncoming traffic because oncoming vehicles sometimes seemed closer or further away than they actually were. Others noted that glare from the sun causes them to be more conservative in their gap judgments.

6. Terrain.

Some respondents from the Seattle, WA, groups mentioned being on a hill as a factor. This would cause them to wait for the light to turn red because the oncoming cars cannot see them as well.

7. Poor roadway traction conditions.

Weather was the most commonly cited complicating factor with regard to drivers' decisions and timing for making the left turn. Many drivers were more cautious in the rain, ice, and snow. This is mostly because the oncoming traffic would have a more difficult time stopping. Most young males in Washington, DC, however, did not think the weather was a factor unless it impacted visibility. This contrasts with young males in Chicago, IL, and Seattle, WA, who did view it as an important factor.

8. Vehicle type.

Many drivers from all groups mentioned that turning in this scenario depends on the type of vehicle that they and the oncoming driver are driving. Specifically, some drivers noted it is harder to see in a small car, which requires greater caution. This factor would be even more of a disadvantage if the oncoming vehicle were an SUV or a large truck. Some younger drivers mentioned that having a powerful car and quick acceleration were factors that affected their decision to go and led them to accept smaller gap sizes. In contrast, a few others said they had old cars and that they would be very cautious because of lack of pickup.

A number of people mentioned that it would be beneficial to be in a nice big vehicle like a truck or an SUV because they would then be able to see well past the oncoming car. One person who drives a large truck said he had this advantage. A few drive two different cars and feel they can see better in their truck or SUV and have an easier time in left-turning situations such as this one. An equal amount of other drivers noted that the type of oncoming car also made a difference since it had the potential to block what they could see.

Scenario 3: Turning Left onto a Major Road with Moderate Traffic

Scenario 3 was described to the focus group participants using the graphic shown below in figure 6 and with the following verbal description: "*A vehicle is stopped on a minor road with a stop sign, waiting to turn left onto a major road (that has no stop sign); a consistent flow of vehicles going at high speeds is crossing in both directions on the major road.*"

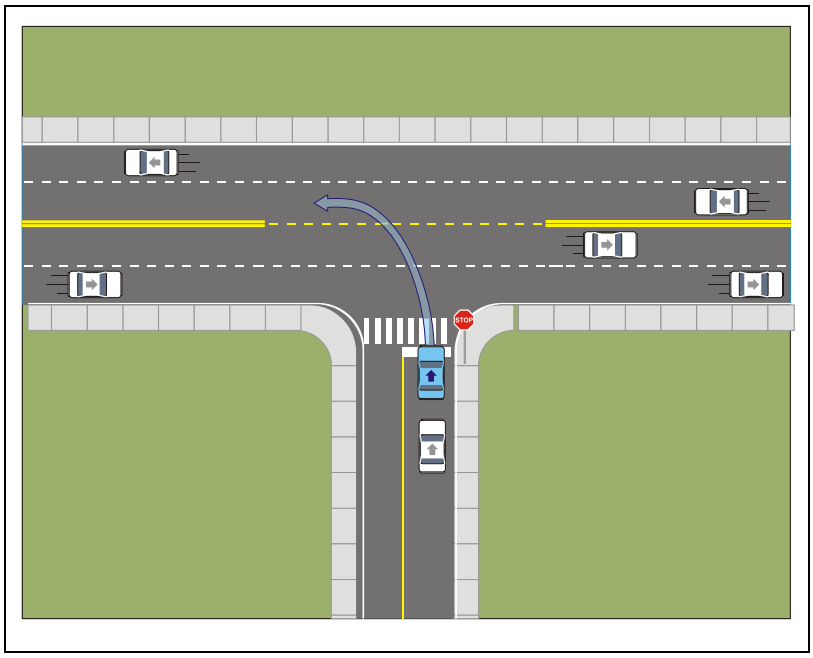

Figure 6. Graphic used to describe scenario 3:
Turning left onto a major road with moderate traffic.

As with scenario 2, the findings in this scenario did not break down as neatly by age group or geography as they did for the red-light-running scenario (scenario 1). When age or geographic breakdowns made a difference, they are noted in the following responses to questions. Otherwise, responses are discussed in order of magnitude across the whole respondent pool.

Cognitive/Decisionmaking Aspects

1. What are drivers most likely to do in this situation?

More than half of drivers in all groups would make the turn. The specific steps they would take are discussed in the next section. The remaining minority of drivers from all groups, especially those in the older and young female groups would decide not to try to turn left and instead make a right turn. From there they would make a U-turn or turn around in a parking lot. These drivers would also avoid the situation in the future by finding a different route.

- *"I would go. I could make it."—Chicago, IL*
- *"You've got to make a left at some point."—Chicago, IL*
- *"Whatever I did to get out of this situation, I would never go back to this intersection again."—Washington, DC*
- *"I'd wait for a while, then turn right."—Seattle, WA*

2. What steps do drivers take in completing the action?

The largest proportion of drivers in all categories would make this turn in stages. These stages are described below.

A. Viewing traffic.

Just about all drivers begin by checking for pedestrians and creeping forward slightly to get a better view. However, many would not go any further than the crosswalk until they had a chance to assess the situation and get a sense of the speed and timing of the traffic.

- *"I would creep out further to see if I could see but not too far."—Seattle, WA*
- *"I sit in the crosswalk unless there is something blocking me."—Washington, DC*
- *"I would let some cars go by and not go right away to get a sense of timing."—Chicago, IL*

B. Gap judgment.

Once they were closer to the intersection, most drivers making the turn would alternate between looking in both directions. First they would look at right-direction traffic, then at left-direction traffic, and back again. A few look at only at right-direction traffic until there is a safe gap then look at left-direction traffic.

- *"I would look back and forth and see if I had time to get to the yellow line, then I'd look back right again to get the rest of the way."—Washington, DC*
- *"I look left, then right."—Seattle, WA*
- *"I would look left, then if I had room, I'd look right. Then I'd look to determine if I had enough time."—Washington, DC*

C. Strategies for turning.

If there was a gap on the left but none on the right, almost half of the drivers making the turn would pull out after the first right-going car went by and wait in the inside right-going lane until there was a sufficient gap in the left-going traffic. Many drivers that use this strategy assume that right-going traffic will see them and stop or slow down. Similarly, some drivers would pull out into the outside right-going lane so that other cars would have to let them in.

- *"I would view the spacing of the cars and the fact that there are two lanes…so I'd pull out into the first lane and look."—Seattle, WA*
- *"I would wait until the close lanes were clear then move into the middle to wait for it to clear on the other side."—Chicago, IL*
- *"I would pull out so that cars would have to let me in."—Seattle, WA*

The other half of the drivers making the turn would wait until there were sufficient gaps in both directions. These drivers tend to believe that it is safer to make the turn in one maneuver rather than stopping half way, which might increase the potential for right-going cars hitting them. Some drivers would wait (or hope) for a nearby traffic light to stop traffic in either direction so that they could have a large gap.

- *"If I am running late I am more likely to go for it, but I will not pull out into the middle." —Seattle, WA*
- *"If there is a lot of traffic I'd pull out as soon as it passes. I wouldn't inch out and assume people are going to stop."—Chicago, IL*

- *"I'd sit for a while. If lights were on the other side, I'd imagine I had a chance."—Seattle, WA*

D. Making the turn.

Among those that would "gun it" and go all of the way across, about half would go into the outside left-going lane (many would do this action even though they knew they shouldn't) to avoid the car in the inside left-going lane coming up on them too quickly. The other half would wait until they were certain that they could at least get in "the clear" past the inside left-going vehicle. Some would turn into the inside left-going lane then quickly signal and get into the outside lane, while others would accelerate to get up to speed with the car in the left-going lane as quickly as possible.

- *"If the speed limit is 50 (mi/h (80 km/h)), you'd pull out, then get out of the guy in the far left's way."—Chicago, IL*
- *"I learned in Driver's Ed. that you need to turn into the left lane, but I'd put blinders on, turn left and try to move right."—Washington, DC*
- *"Lots of times when you make this turn you have to straighten out and get up to speed or cars coming up will get frustrated."—Seattle, WA*

3. What is the decision process?

The decisionmaking process consists of information gathering and decisionmaking stages.

A. Information gathering strategies.

Most drivers alternately look back and forth and judge gaps in both directions. They first take in the distance and speed of the car in the right-going outside lane, then evaluate the distance and speed of the car in the left-going inside lane. Drivers using this strategy spend the same amount of time looking in each direction and check each direction fairly often. Before they turn, some noted that they always check back to be certain that it is still safe.

- *"I am looking at both sides."—Chicago, IL*
- *"I have to look for gaps each way."—Seattle, WA*
- *"I look both ways twice."—Washington, DC*

Some drivers just look exclusively at right-direction traffic until there is a safe gap, and then look at left-direction traffic for a safe gap. Most of those that do, end up looking at right-going traffic longer than left-going traffic, since once they find a safe gap in left-direction traffic they look back again at right direction traffic to update their information before they make the turn. These drivers also look at each side far less frequently than other drivers.

- *"I look more left then right."—Seattle, WA*
- *"At first I am only worried about the first two lanes of traffic."—Chicago, IL*

Some drivers split up this task by going into the middle of the roadway as an interim step. Those that wait in the middle focus only on the two right-going lanes, then the two left-going lanes.

Once drivers have determined that the gaps in both directions are sufficient, most drivers focus on the car in the left-going inside lane because they will be in conflict with this vehicle longer than with the other vehicles (since they will be turning into this lane).

- *"It would be okay as long as there were no cars in the near left (right-going inside) lane. And the car in the far left (inside left-going) lane was able to see you."—Chicago, IL*
- *"I assess the distance and whether I can get by the guy coming on the inside (right-going) lane. I am also worried about the guy in the far left (inside left-going) lane."—Chicago, IL*

Only some drivers pay attention to the car in the outside left-going lane. About half of those that look at the car in this lane do so to determine if it is safe to get over into that lane after they make the left turn into the inside lane. The other half are evaluating if they can turn directly into the outside left-going lane, to avoid being hit by the oncoming inside left-going car.

- *"I'm going to pull into the right lane to avoid having trouble getting up to speed."—Seattle, WA*
- *"I would do it in two steps, move into the left lane, put on turn signal and then move over." —Chicago, IL*

B. Decisionmaking.

Some drivers in all groups make the decision to turn based on experience and by going with their "gut" instinct. They also factor in speed, distance conditions, and their car's ability to accelerate when they make the decision. Young males are the least likely to hesitate.

- *"You wait for a while and if you think you can make it you 'gun it'."—Washington, DC*
- *"It depends how fast your car goes. If I think I've got it, I'd punch it." —Chicago, IL*
- *"I know when to go by guessing and familiarity. I know in my head how long it takes." —Washington, DC*

Some drivers in all age groups describe this task as one that gives you "an adrenaline rush combined with fear" or other similar terms. Other drivers become impatient as time passes, and become more likely to make rash decisions. These drivers shoot out into the intersection more readily and seem willing to accept the consequences.

- *"I'd think it's too dangerous and would not want to turn but sometimes an adrenalin rush will get me through it."—Washington, DC*
- *"I am more likely to go if I am impatient, and the cars keep coming."—Seattle, WA*

Some drivers in all groups think through the decision to turn and are very cautious. They too mention taking into account speed and distance conditions and their car's ability to accelerate. Older drivers and young females are the most likely to be cautious.

- *"I am being very careful in this situation. I am aware of my car and its performance." —Chicago, IL*
- *"If I had an old car I would wait for a better opportunity. If I had a better car I might venture out."—Chicago, IL*

- *"It depends on the size and the power of your car."—Washington, DC*

In all groups, whether or not other cars were aware that a driver intended to turn was a factor in some drivers' decisionmaking. These drivers made the assumption that other drivers would see them and slow down to accommodate their turns. If they couldn't be sure that a driver was paying attention, could not make eye contact, or felt they were not particularly visible to the other cars, they would wait or pull out to make the other drivers more aware of their presence.

- *"I would watch to see if the car in the far left lane was paying attention."—Chicago, IL*
- *"Usually cars in the second set of lanes will let you go."—Washington, DC*
- *"If the traffic is slowing I might inch out so they see me and they might let me go."—Seattle, WA*

Some drivers in all groups mentioned that one complicating factor was the possibility of oncoming cars changing lanes. A few drivers even noted that they would hope the inside left-going car was changing into the right lane.

- *"I might be more likely to go if the far left car had its blinker on."—Seattle, WA*

4. How do drivers' decide (what steps are involved) whether or not a gap in traffic is sufficient? What factors are relevant (e.g., speeds, distance to cross, weather)?

Many drivers in all groups determine whether or not a gap is safe by taking in the distance and speed of the cars in the oncoming lanes on both sides.

- *"You try to time the speed of cars coming from both sides."—Chicago, IL*
- *"Judging the gap would be determined by speed and who would be turning from the side streets."—Washington, DC*

Many noted that they instinctively know how fast cars typically go and, based on that, they would wait for a gap that they felt their car would make it into. The "speed of the road" also made a difference as to whether people felt they really had to "gun it" or could make the turn in a more leisurely fashion.

- *"Depending on how fast the traffic is going, I would gun it or go leisurely."—Seattle, WA*
- *"I am looking back and forth. Then I gun it to get across."—Washington, DC*

Out of all of the participants, only one middle-aged female mentioned that she would look beyond the nearest vehicles for safe gaps farther down the road.

- *"I would judge it (gap) further down the road then prepare to turn earlier."—Seattle, WA*

A few other respondents mentioned that the gap in left-going traffic must be larger because it will take them longer to get there.

- *"I would look at the traffic I am turning into for a big space in the far lane. In the close lane it can be a small space. I am focused on where I am going"—Washington, DC*

Some respondents in all groups noted that driving at night and on hills made judging the gap more difficult because they could not see as well. Similarly, older respondents also were concerned about not being able to judge gaps as well because of glare at night. Some other respondents noted that these factors could also be helpful since headlamps can be seen from farther away and because visibility might be better at the bottom of a hill.

- *"I would wait longer because of headlight glare."—Washington, DC*
- *"You can see headlights, which is good, but it is harder to judge the speed."—Seattle, WA*
- *"If you are on top of a hill, they can't see you. If you are going the other way it's easier — Seattle, WA*

About one-fifth of respondents felt that the longer they waited and the more impatient they became, the more likely they were to make bad judgments about the acceptable size of gaps and the distance of approaching cars.

- *"Another thing about the gap is that it depends on how long you've been waiting." —Washington, DC*
- *"I am more likely to go if I get impatient."—Seattle, WA*
- *"If it's a long wait, and you are getting more impatient, and more cars are behind you, you take any gap."—Chicago, IL*

The definition of safe gap has an enormous range among drivers. While a few drivers mentioned that they wouldn't think it was safe to go unless no cars were visible, a few other drivers thought that one car length was acceptable. The majority of drivers fell somewhere in between, and the actual gap size depended on a variety of factors (see previous section). Many young males perceive much smaller gaps as being acceptable than older and young female drivers.

- *"I am looking and figure I need one car length. Here I've got three, so if I'm at the yellow line at that point, I'll make it."—Chicago, IL*
- *"You definitely have to shoot out, move up to shorten your distance, get a better look, shorten how far you are, and then find one (a gap) you think you can make."—Washington, DC*
- *"You can't back up. You're forced to get your foot in there."—Seattle, WA*

5. What external factors make the task of deciding when to turn more complicated/ difficult or more demanding?

Many drivers mentioned the additional lanes in each direction as a complicating factor. In particular, they had to also watch for oncoming cars changing lanes. Some drivers perceived advantages of the extra lanes, such as the ability to creep into the nearest lane and also to have a choice between which lane you got into after the turn was made.

- *"You should see the guy coming before making the turn, and if the far lane is clear you should go over in one motion."—Chicago, IL*
- *"If the guy in the left lane is going faster than expected then I would turn into the right lane after my turn."—Seattle, WA*

- *"In these situations I turn left and make time to get in the far lane. Sometimes I have to drive on the wrong side and merge."—Washington, DC*

Many noted that obstructions along the curb such as parked cars or vans, buses, buildings, shrubbery, etc., would make it harder to see oncoming vehicles and judge gaps. This would cause them to inch out further than they are often comfortable with.

- *"I have a situation like this near where I live and there is a house with an overgrown jungle. So I have to pull out as far as I can go without getting hit."—Seattle, WA*
- *"I would edge out to see further down the road, beyond trees, etc.—Chicago, IL*
- *"I would creep a little but not want to go past the crosswalk."—Seattle, WA*

Complicating Factors

1. The presence of other drivers waiting to turn behind them.

Other drivers in line behind, while sometimes adding a slight amount of pressure, did not have nearly as much impact on the respondents as they did in the left-turn scenario. Many noted that if the car behind them was turning left, it soon would be in the same position. If the car was turning right, the driver would likely be able to go as soon as you could.

2. Heavy traffic congestion and long delays at intersections.

Most drivers were willing to wait a long time and were much more patient in heavy traffic in this scenario than the previous one. However, about one-fifth of respondents felt that the longer they waited and the more impatient they got, the more likely they were to make bad judgments about the acceptable size of gaps and the distance of approaching cars.

3. The presence of pedestrians/bicyclists crossing in the turn path.

While most drivers would be sure to watch out for pedestrians in their path, they were far less concerned about them in this scenario than they were in the red-light running and the other left-turn scenario. Drivers were more concerned about pedestrians and bicyclists in the crosswalk they would be turning into than the one that was right in front of them because they felt it would be easy to see them there.

4. Poor visibility conditions (e.g., fog, nighttime).

Most groups had mixed views about whether nighttime was problematic because, while it made it more difficult to judge gaps, the darkness also made it possible to see oncoming cars from farther away. Many drivers noted that twilight was the worst time because other cars are hard to see and they do not often turn on their lights.

5. Glare from oncoming vehicles.

Many said they would wait longer because of headlamp glare in the country, but not in the city where it is not as bad. Some were more concerned about glare from the sun and thought they might not make the turn at all in that case.

6. Poor roadway traction conditions (e.g., rain, ice, snow).

Many drivers in all categories would be concerned about slippery conditions including whether the oncoming cars would be able to stop or slow down. Drivers were also concerned about having problems accelerating, skidding, or "fishtailing" if they made the turn too quickly. Most noted that, hopefully, the poor traction conditions would have the side-effect of making other drivers go slower as well.

Scenario 4: Rear-End Crashes

Scenario 4 was described to the focus group participants using the graphics shown below in figures 7 and 8 with the following verbal description: "*Approaching an intersection at speed, the car in front stops suddenly when the light changes to yellow. The driver needs to slam on the brakes to avoid a rear-end collision.*"

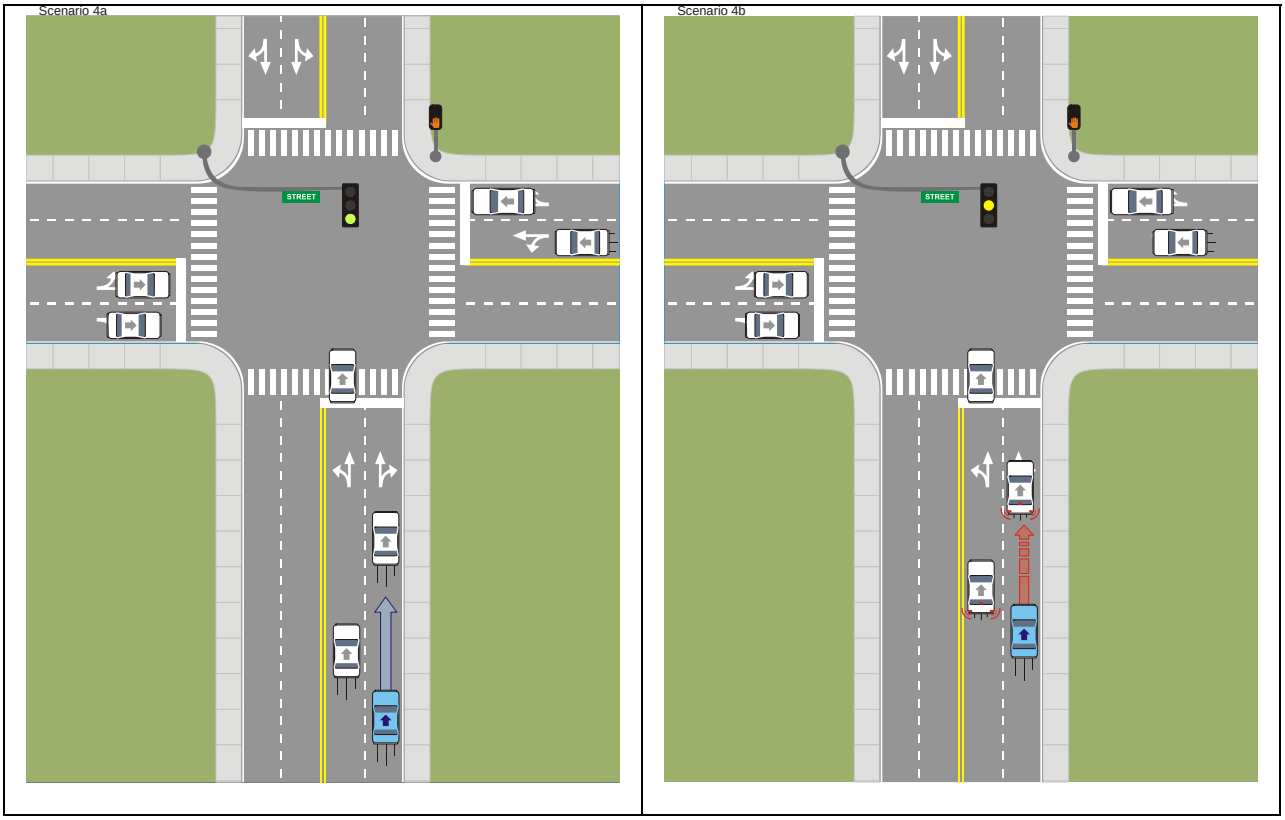

Figure 7. Graphic 1 used to describe scenario 4: Rear-end crashes.

Figure 8. Graphic 2 used to describe scenario 4: Rear-end crashes.

As with scenarios 2 and 3, the findings in this scenario did not break down as neatly by age group or geography as they did for the red-light-running scenario (scenario 1). When age or geographic breakdowns made a difference, they are noted in the following responses to questions. Otherwise, responses are discussed in order of magnitude across the whole respondent pool.

Cognitive/Decisionmaking Aspects

1. How many drivers have been involved as the following vehicle in a rear-end crash or had a near-miss at an intersection?

More than one-sixth of the drivers (across all the focus group sessions) recounted specific rear-end crashes they experienced as either the lead or following vehicle, and over one-third mentioned near-misses that they had been involved in. However, based on the types of comments made in other sections of the discussion of this scenario, it is likely that these estimates significantly underrepresent the number of drivers that have actually been involved in a rear-end crash.

2. What were the circumstances that caused the incident to happen?

Drivers identified four types of circumstances that typically lead to near-misses or crashes.

A. Not paying attention.

Some drivers in all groups do not always pay attention even though they know they should. Many of these drivers have gotten into collisions as a result of not looking at the road or the car in front of them. Many respondents in all groups, especially older drivers, noted that many dangerous situations develop when others are not paying attention. Many younger drivers mentioned cell phones and other reasons (e.g., playing with the radio) that they have had collisions or near-misses.

- *"I was hit by a drunk driver. Now I am aware of how fast cars behind me are going, and options for getting out of situations."—Chicago, IL*
- *"I was on the phone in a busy intersection. I am cautious but I looked down for a second and the woman in front of me stopped short. Now I don't use my cell phone or take my eyes off of the road."—Chicago, IL*

B. Tailgating.

Some drivers from all groups have experienced collisions or near-misses when they were driving too close to the car in front of them. Most have learned from these experiences and now follow stopping distance rules or leave more room between lead cars and themselves. They are also more likely to look behind them to look out for cars that are driving too close to them.

- *"I had a rear-end collision because I was driving too close."—Chicago, IL*
- *"My brakes didn't work in the rain. Since then I stop three car lengths behind in the rain." —Washington, DC*
- *"My best friend was following me too closely and hit me so I am really careful tailgating now."—Seattle, WA*

C. Making faulty assumptions about the traffic flow.

Some drivers from all groups have gotten into rear-end collisions as a result of incorrect assumptions they made about the traffic flow. In one situation recalled during a focus group, the

car ahead sped up to go through the light and the driver followed. Then the lead driver (apparently) changed his mind and stopped suddenly. In a few other situations, drivers were cut off by a driver abruptly changing into their lane right in front of them, and they were unable to stop in time.

- *"I've been in this situation. I thought the car in front of me and I were both speeding up to go for the light, then the car in front changed his mind and stopped short. I learned from it. Now I don't do that."—Washington, DC*
- *"That (the scenario) happened to me. A school bus went into my lane then slammed on the brakes. You have no choice."—Seattle, WA*

D. Not slowing down as they approach intersections.

Some drivers from all groups have been in rear-end collisions because they did not slow down soon enough while the lead vehicle slowed down abruptly at the intersection. Some middle-aged and younger drivers do not always slow down as they approach intersections (even though they know they should), especially when they are late. Some will go through the light rather than stopping too abruptly.

- *"When lights are going from yellow to red it's so close. People stop quickly, and I get angry. A few times I've gone through (to avoid a crash). Now I pay more attention."—Chicago, IL*
- *"I don't slow down at yellow lights when I know I am late."—Washington, DC*
- *"I was rear-ended with kids in the car so I don't go as fast and leave more space between cars."—Seattle, WA*

3. How closely do respondents typically follow other vehicles? What factors determine how closely drivers follow other vehicles?

Many drivers cited rules that help them to judge how far they should drive behind the other cars. The most common ones were the "2-second rule" or "for every 16 km/h (10 mi/h), drive one car length behind the lead car." Other tricks were also noted such as watching the brake lights in front of them, IDPE (identify, predict, and execute), making sure they can see the tires of the car in front of them at intersections, and looking 10 feet ahead of them while driving. Many of the young female and older respondents noted that they were not very likely to be in this situation because they leave ample stopping distances between the cars.

- *"Always leave room. If the guy brakes fast you can stop."—Chicago, IL*
- *"If you have to slam on the brakes you are too close."—Seattle, WA*

Some drivers in all groups noted that the distance at which they follow other vehicles depended on the types of cars that they and others were driving. Some noted that SUVs take longer to stop and thus leave more space when driving one. A few young males noted that they pay attention to whether or not other drivers particularly "worked on" or "cared" about their cars, since they thought that it would make the other drivers more careful. A few other young males noted that they are more careful and leave more space if they are driving a new car.

- *"It depends on the type of car in front of you. The SUV stops more slowly."—Washington, DC*
- *"If the car in front of you is tricked out, you know they are trying to preserve their car too. The guy in his 40s with a BMW doesn't care about his car, watch out more for him."—Washington, DC*
- *"A car accident with a new car has the most impact."—Chicago, IL*

Many respondents from all categories are cautious about following other vehicles because they know they will be liable if they hit the car in front of them. Many others noted that they cannot trust the drivers in front of them to be paying attention so they leave more room in front of them and follow stopping distance rules.

- *"I would stop because anytime you hit someone in this situation it is your fault" —Washington, DC*
- *"That's why I follow the car length rule. I don't know why the car ahead is stopping…I can't assume because the light is yellow he is slowing down just for that."—Chicago, IL*
- *"He shouldn't stop that close to the intersection, but it doesn't matter, it's your fault if you hit him."—Seattle, WA*

4. What are some strategies for avoiding rear-end conflict situations?

A. As following vehicle:

Most drivers hit their brakes as soon as they see any brake lights go on in front of them. While most respondents infer that the lead car is braking as a result of the traffic light change, a few look to see if there is any other reason the lead car is stopping suddenly (such as the presence of pedestrians or a hazard on the road). Many drivers try to anticipate the situation using a variety of methods (see next section) and some leave more stopping distance in front of them. Drivers often do this as a result of critical situations they have experienced when they did not leave enough room to stop. Finally, some drivers slow down as they approach an intersection. These are the more cautious drivers and a large number are older drivers who have learned from experience not to rush.

- *"I would slam on my brakes without thinking (in response to the brake lights)." —Washington, DC*
- *"I've been the blue car and stopped on time, but I've also been the white car and been hit. Now I always slow down at yellow lights."—Chicago, IL*
- *"You have to take your foot off of the accelerator and be more cautious when you enter the intersection."—Seattle, WA*

B. As lead vehicle:

Most drivers tend to look in the rearview mirror at the following car more frequently. Some have learned from experience to pump their brakes ahead of time to show their brake lights and to warn other drivers that they will be stopping soon.

- *"I was hit from behind once, so I always look behind me now."—Chicago, IL*

- *"Looking at this image gives me an instant bang. I am more cautious now.—Washington, DC*
- *"I will tap my brakes to warn people behind me."—Seattle, WA*

5. How do drivers detect or anticipate when the lead vehicle will slow or stop?

The light change plays an important role in drivers' ability to anticipate the actions of the lead vehicle. The traffic signal status is of primary concern to most drivers, and is only slightly less important than the brake lights of the lead vehicle. Specifically, most drivers prepare to stop when the light changes and start watching the lead vehicle to see what it does. When the light changes, they will next try to determine whether the lead car is going to slow down or speed up to get through the light. Usually, when they see the brake lights, they will assume that the lead car is going to stop.

- *"I don't want to slam on my brakes so I slow down on yellow."—Chicago, IL*
- *"If he is already braking, you'd stop."—Washington, DC*
- *"I'd down shift, then look at why the guy is stopping, then maybe worry."—Washington, DC*

Just about all drivers detect that the car in front of them is stopping because the brake lights capture their attention. In particular, the brake lights immediately switch the driver's focus from the traffic signal to the lead car. While some respondents noted that they felt the brake lights meant the driver was slowing down, most interpreted the brake lights to mean that the driver was stopping. None of the respondents mentioned picking up information about the speed at which the lead vehicle was braking based on closing speed or any other factor.

- *"If I'm not paying attention then look up and see (brake) lights, my instinct is to slam on the brakes."—Washington, DC*
- *"When I see cars braking, I brake."—Washington, DC*
- *"If he's got brakes on, I am already ready to stop."—Seattle, WA*

Many of the younger drivers, after seeing the lead vehicle put on its brakes, are sometimes uncertain about whether the lead car is slowing down before going through the intersection or actually stopping. These drivers may sometimes delay their decision to stop (although they will slow down) until they determine whether or not the lead vehicle is going through the intersection.

- *"You hope that person in front of you goes through. Otherwise I'd be yelling, 'Why didn't you go through the light?'"—Chicago, IL*
- *"I would be watching brake lights to estimate whether the person will actually stop." —Washington, DC*
- *"I have a heightened awareness about the driver. (That makes a difference whether he will stop or not). Is it grandpa or is he on a cell phone?"—Seattle, WA*

Another strategy that some drivers in all groups use is to anticipate the light change. For example, some drivers watch the light as they approach the intersection, which makes it easier to anticipate what will happen next. Some of the drivers also mentioned that they note how long the light is green, and if has been green for some extended time, they assume it will change soon and start to slow down.

- *"If you've seen the light is green for a while, you know a yellow is coming. You also know it if you travel on this road often."—Chicago, IL*
- *"As I was coming to the intersection I'd be looking at the light. If it was green for a while I'd go slow and leave a couple of car lengths behind."—Seattle, WA*

Some drivers in all groups look for signs that the light is about to turn yellow by checking the pedestrian signals. Those who do become more alert and prepare to stop before the light changes.

- *"When I see the pedestrian signal flash, I know the light is going to change."—Chicago, IL*
- *"When the traffic is clear and you can see ahead, sometimes you can see the lights ahead. If I see a flashing hand and know I am a block away, I'd slow down. You know you won't make the light."—Chicago, IL*

6. What are drivers likely to do in response to this situation?

Most drivers' overriding initial reaction to this scenario is that their options are limited. Many drivers would consider getting into the inside lane if there was space. In the scenario example, however, the car in the inside lane eliminated this option, and without a shoulder, about half of all drivers said they would go up on the curb if they could not stop on time. Just about all drivers would not pay attention to anything outside of the immediate situation involving the car that stops short in front of them.

- *"You'd be kind of limited. You might go up on the curb."—Seattle, WA*
- *"I would not go left because if the person in the left lane were turning he would be waiting for oncoming traffic. I try to stay away from whoever is making a left."—Chicago, IL*
- *"I would slam on my brakes without thinking, but I wouldn't notice anything but the light and the car in front of me."—Washington, DC*
- *"If you need to, use the shoulder."—Washington, DC*

About half of all drivers noted that they would already be slowing down as they were approaching the intersection, so they thought that they would be able to stop in time.

- *"I would not be in this situation. I usually start slowing down anyway."—Seattle, WA*
- *"If you are at an intersection you should be aware of what people are doing and slow down."—Washington, DC*

About one-quarter of the drivers in all groups would also be looking behind them to see how close the following car is to determine if they might get hit from behind if they stop too suddenly.

- *"I'd stop and glance up to see if someone is behind me."—Seattle, WA*
- *"I would be mad at the car for stopping. Then I'd inch up as I'd be worried about the car behind me."—Washington, DC*
- *"After braking I would look in my mirror."—Seattle, WA*

Complicating Factors

1. Lead vehicle.

Some people noted that they try to gauge how the driver in front of them drives as they go along. Many noted that they see if they have an old or a new car, determine their age, and try to anticipate how they might behave. Some younger drivers noted that if the lead driver looks likely to stop (e.g., is older, has new car, etc.) they will leave more room. A few mentioned that if the lead car was heavy or large, it would probably have to go through because it would not be able to stop in time. If that happened, people noted that they might also follow the lead car through the intersection as opposed to stopping short.

2. Heavy traffic congestion and long delays at intersections.

Some drivers noted that congestion was a big factor because it made them tailgate more closely during rush hour. Long delays at intersections were not even mentioned in these scenarios.

3. Poor visibility conditions (e.g., fog, nighttime).

Poor visibility was not mentioned at all as a factor in any of the groups. When prompted, drivers seemed to think that this situation required attention to their immediate surroundings, which would not be affected by poor visibility.

4. Glare from oncoming vehicles.

A few drivers in various groups mentioned that they leave more space in front of them if glare from the sun makes it hard to see, but no one mentioned glare from oncoming vehicles as a factor.

5. Poor roadway traction conditions (e.g., rain, ice, snow).

Slippery conditions were not a big factor for some drivers because they do not think that they have any choice but to try to stop suddenly in this scenario. A few noted that if the other car went through, they might also go if it was slippery because they did not think they could stop in time. A few other drivers noted that they would leave more space between themselves and the car in front of them when it was raining.

6. Intersection terrain (uphill, downhill, flat).

A few drivers noted that it would be harder for all drivers to stop if they were going downhill. Some would have anticipated this and would have started braking sooner.

PARTICIPANT RESPONSES TO THE NINE ENGINEERING COUNTERMEASURES

Countermeasure 1.1: Red-Light Camera

Countermeasure 1.1 was described to the focus group participants using the graphics and text shown below in figure 9.

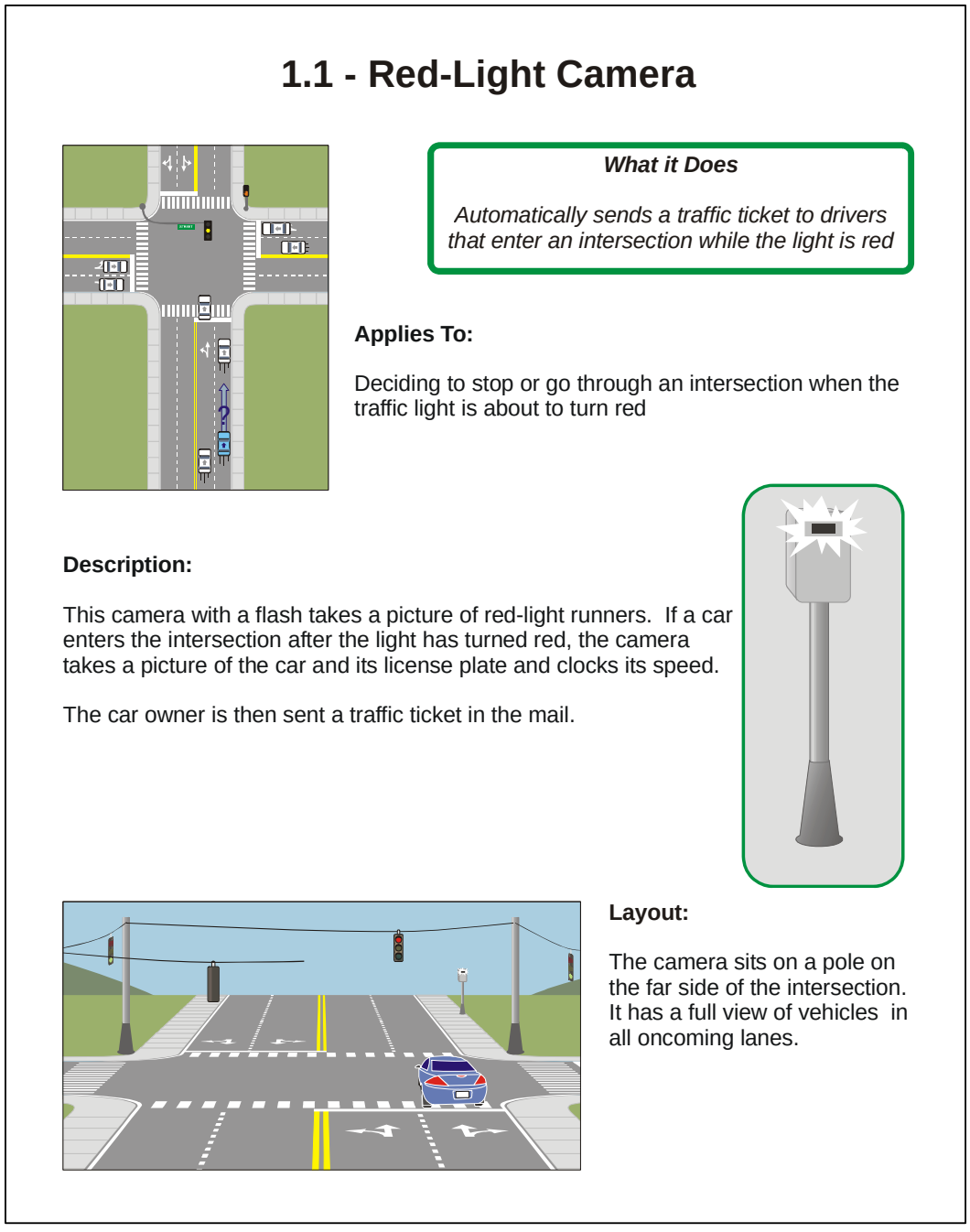

Figure 9. Graphics and text used to describe countermeasure 1.1: Red-light camera.

Would Implementing This Countermeasure Improve Safety?

Two-thirds of the older drivers (primarily those from Washington, DC, and Chicago, IL, where cameras are common) were strongly opposed to red-light cameras and did not feel that they would improve safety. The other third of older drivers (primarily in Seattle, WA) thought that these would be a great safety improvement.

- *"In this country you have the right to face your accuser."* Another said, *"You don't have the right in this situation."—Chicago, IL*
- *"It's entrapment. The yellow light is too short for these (red light cameras)and if you go through the yellow it still gets you."—Washington, DC*
- *"That would be wonderful. They should have that on every corner."—Seattle, WA*

Conversely, about two-thirds of the young male drivers (primarily from Washington, DC, and Chicago, IL) thought that red-light cameras worked and improved safety from their direct experience with them or from what they had heard or read about them. Many were in favor of using them because they did improve safety, but still pointed out drawbacks, such as when someone borrows a car and gets a ticket, or when a camera catches drivers in the intersection while making legitimate turns. Most young males from Seattle, WA, were more reluctant to admit that the cameras improve safety, and they did not trust them.

- *"If you got a ticket and are aware of a camera, you will be careful."—Washington, DC*
- *"I heard that it does work and less people are getting tickets now."—Chicago, IL*
- *"If people are more cautious, there would be less accidents."—Chicago, IL*

About half of the middle-aged and younger female drivers were in favor of the cameras and felt they would help create safer situations. They felt that the cameras would be effective because people do not like having to pay money and the tickets are expensive. Accordingly, these drivers reported that they often change their behavior in intersections that they know have cameras. Furthermore, many approach intersections more cautiously until they confirm that no camera is present.

- *"It would make a difference for me because it's a $200 ticket."—Seattle, WA*
- *"I have read about these and they have been proven to work. The number of tickets is going down."—Chicago, IL*
- *"I can think of an intersection with a red-light camera and I always stop there." —Washington, DC*

What are Some of the Implementation Issues?

Many respondents noted that in order for red-light cameras to be effective, people would need to be educated about them. Most were in favor of posting signs where red-light cameras were located and others thought a public service announcement (PSA) campaign would be effective. Some respondents noted that they should only be placed at dangerous intersections or places where many people ran red lights.

- *"You would need a PSA defining what running a red light is."—Seattle, WA*

- *"If they have signs saying it's there, that's when it helps."—Washington, DC*
- *"You should have a sign. You can't do things like this without letting people know." —Seattle, WA*

Many thought that they would be ineffective with "habitual" red-light runners or drunk drivers. Their assumption was that it would not work for those that blatantly disregarded the law since they would disregard the cameras as well. A few middle-aged drivers noted that habitual red-light runners would not pay their traffic tickets anyway.

- *"There is a difference between habitual red-light runners and people that are safe drivers that just run red lights occasionally."—Washington, DC*
- *"It won't stop drunk drivers. When deciding what to do they don't know what they are doing."—Chicago, IL*
- *"It wouldn't work for people who are reckless and habitually run red lights because they don't pay traffic tickets."—Washington, DC*

When asked if the cameras should be moved around, many drivers had mixed reactions about whether or not it was a good idea. On the one hand they felt that the cameras should remain at dangerous intersections and that it would be fairer if people knew where the cameras were. On the other hand, they did acknowledge that just the threat of being caught was effective and that a greater area could be covered by moving them around. A few drivers also mentioned that if the cameras were positioned as low as are shown in the picture, they would probably be vandalized.

- *"Do not move the cameras around or it would defeat the purpose of safety. It should be at dangerous intersections."—Chicago, IL*
- *"You have to market that if you decide to move them around."—Seattle, WA*
- *"It wouldn't matter if they moved them around or not or had dummy cameras. Just the sign that warns you there is a camera stops people from going through."—Chicago, IL*

What are Some of the Advantages and Disadvantages?

Safety was the primary advantage noted. However, some drivers also noted that cameras would free up police officers for other activities.

The biggest disadvantage introduced by the majority of the groups was that they did not trust cameras to work as described. Despite the clear countermeasure description that the camera would only take a picture of those entering the intersection while the light was red, this statement was not often believed. The concern was that it was possible to get a ticket when going through while the light was yellow. Another disadvantage was that many drivers from all groups believed that lights were timed to generate revenue rather than to improve safety or traffic flow. Even though the respondents were told that speed would also be clocked, many thought that they could get tickets when they were waiting to make left turns at unprotected intersections and the light changed to red, or when they were slowing down to make right turns on a red.

- *"Does this take into account the person turning left?"—Seattle, WA*
- *"I don't think it is a deterrent, and it is faulty."—Washington, DC*
- *"If it was for the red light it would be okay, but not on the yellow."—Chicago, IL*

Many other respondents were concerned about the lack of a human element. Many felt it was like "big brother" watching you. Others felt they never went through red lights but that they'd be wrongly accused and unable to contest it because the photo provided indisputable evidence. Many of the older respondents felt that the younger respondents would benefit and learn more from the effect of being pulled over by actual police officers versus just getting a ticket in the mail.

- *"I'd be more comfortable getting a ticket from a person than in the mail."—Seattle, WA*
- *"My husband drove through a yellow and still got a ticket. When he tried to contest he didn't win."—Chicago, IL*
- *"There is something psychologically more effective for changing the young mindset to be pulled over by the police instead."—Washington, DC*

Another disadvantage commonly cited by many drivers in all groups is that cameras could cause more rear-end collisions because people would slam on the brakes when they saw the camera or the flash. Some drivers also mentioned that it could slow traffic flow. Additionally, not showing who is driving in the photo was cited as a concern by some drivers since there was a possibility of wrongfully getting a ticket if someone else was driving your car.

- *"I've never gotten one but I see the flashes. I'm not sure it will necessarily make people drive safely as I stop short so I won't get a ticket."—Washington, DC*
- *"It causes problems, especially in the city. All are posted. The yellow lights are short and people slam on their brakes. The potential for rear-end collisions is worse so it's worse for safety."—Chicago, IL*
- *"It's bad if someone is driving your car."—Seattle, WA*

Young female respondents were the only ones that noted that they would take the ticket rather than put themselves in unsafe positions. Some noted that they might not stop because they did not feel they were in a safe area or if they had someone drive up behind them. Others thought they would rather take a ticket than get rear-ended.

- *"If I am in a bad neighborhood, I will not want to stop at the light. I would fight the ticket based on circumstances."—Chicago, IL*
- *"It's bad if you slam on the brakes and someone hits you."—Seattle, WA*
- *"If I am too close I won't stop because I'd worry about skidding. I'll gun it and take the ticket."—Washington, DC*

What Would It Take To Make Red-Light Cameras Acceptable?

When asked what it would take to make red-light camera acceptable to those opposed to them, many drivers across all groups said it would depend on how well the system worked. It would be important to make sure that it was fair and that those who were turning left in the middle of intersections when the light turned red and those that were making rights on red would not get tickets.

- *"What if you are making a left turn? It would be important to make sure that it is fair." —Seattle, WA*

- *"It has to account for people making left turns."—Chicago, IL*
- *"Does this take into account the person turning left?"—Seattle, WA*

Other drivers noted that it would be fine if it were there to improve safety, but not to raise money, which is what they believe is currently the primary purpose of the cameras. For areas where drivers are not familiar with them, one respondent recommended a "three strikes, you're out program."

- *"It would make a difference whether the purpose was to raise money or for safety." —Washington, DC*
- *"It's one thing to have the government have laws; it's another thing to have a third party enforcing them for their own gain."—Chicago, IL*
- *"No one in the area is familiar with these (red light cameras) so there would have to be some type of 'three strikes, you're out' program."—Seattle, WA*

A few drivers from all groups said that it would be helpful if the camera picture could identify the driver so the vehicle owners could determine if a ticket was the result of someone else driving their vehicle. A few countered that there could be privacy issues for people that would not want others to see who was in the car with them.

- *"They should take a picture of the driver. It's not always you driving the car."—Seattle, WA*
- *"When I was first learning to drive, a ticket came to the house. Everyone blamed it on me but it turned out that it was my mom."—Washington, DC*
- *"It's bad if someone is driving your car."* Another said, *"What if the passenger isn't wearing a seatbelt."—Seattle, WA*

A few others from different groups thought that there should be a way to contest the ticket. Accordingly, they did not like that the photo was one instantaneous shot that did not take in the whole picture. One young male driver suggested using a video so people could see if extenuating circumstances caused drivers to go through the light.

- *"It would help for people running light(s) but in circumstances where you have to go and then you get busted it's not good. If there was a video you could argue it."—Chicago, IL*

A few others mentioned that the cameras would be more acceptable in high-priority locations such as dangerous intersections or those near schools.

- *"Targeting schools would be good for public safety."—Seattle, WA*

Countermeasure 1.2: High-Visibility Traffic Lights

Countermeasure 1.2 was described to the focus group participants using the graphics and text shown below in figure 10.

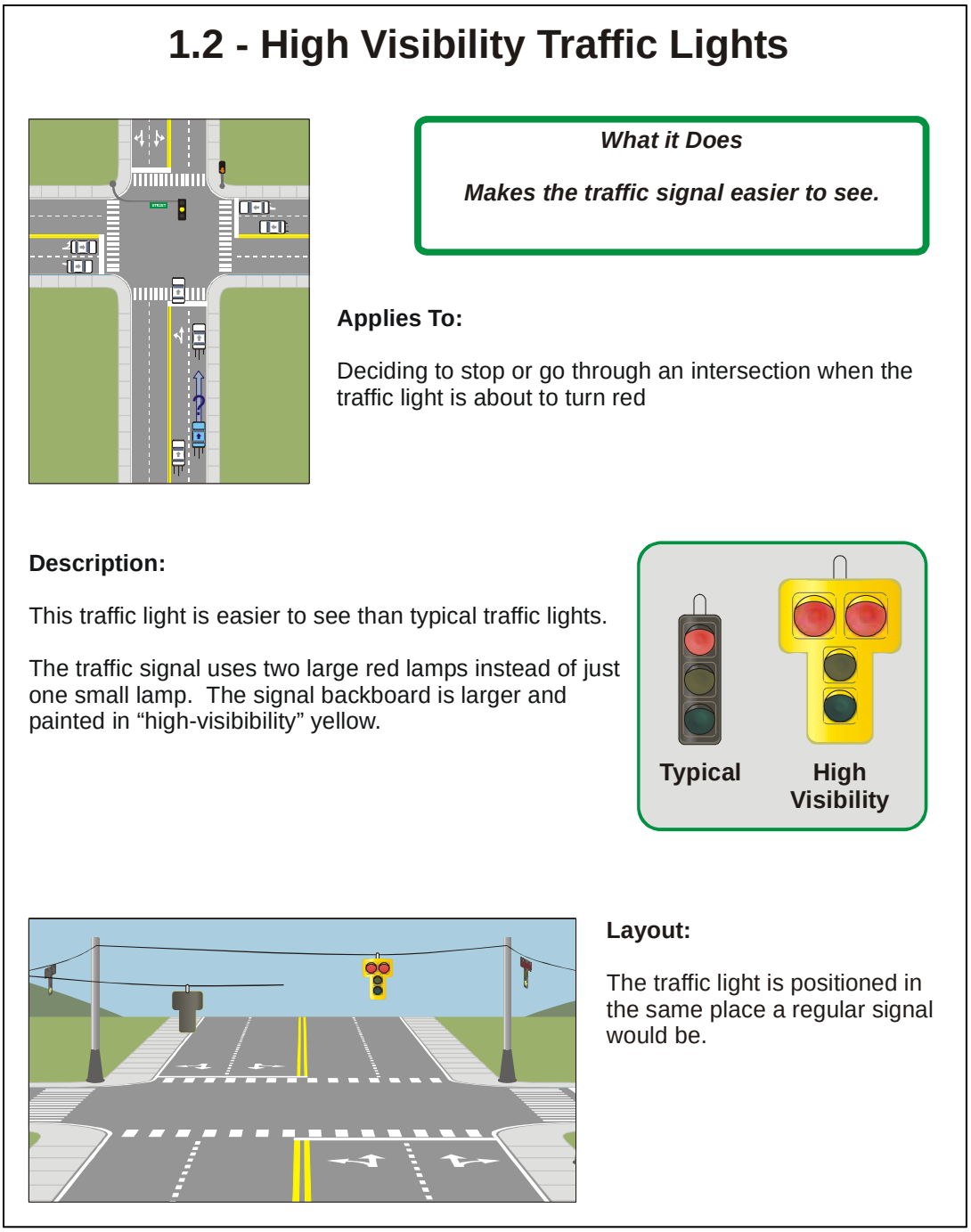

Figure 10. Graphics and text used to describe countermeasure 1.2: High-visibility traffic lights.

Would Implementing This Countermeasure Improve Safety?

Most of the older drivers were very receptive to high-visibility traffic lights and thought they would be a big help for themselves and effective for improving safety in general. Many liked different aspects of the signals. Some liked the larger size, some liked the big backboard, and others liked the double red lamps.

- *"The size is great, you can change color of back drop (for the yellow)—but the two big red lights popping out you'd see."—Seattle, WA*
- *"I like it. It addresses the situation. It would also help with the glare."—Chicago, IL*
- *"It is good to have a backup light as sometimes the light goes out."—Washington, DC*

Most of the young male drivers did not think this would improve safety, since lack of conspicuity was not the reason why they go through red lights. A few thought it might help if they were not paying attention, but others thought if they were not paying attention it would not matter how visible the light was.

- *"If I'm distracted it won't matter how large the light is."—Seattle, WA*
- *"Seeing or not seeing the light has no real impact on red-light runners."—Chicago, IL*
- *"It won't help me because that's not the reason I'm going through. It might help if you weren't paying attention."—Washington, DC*

Just about half of the middle-aged and young female respondents thought it might be helpful, while the others thought it did not apply to them. The respondents that did not think it applied to them thought that it might help older people see the traffic lights and that it could not hurt.

- *"When I'm in my car and there is a big truck that blocks the light, I could go through the red. If the light is bigger, that might not happen."—Washington, DC*
- *"This is good for older people or people who go through the light by mistake."—Chicago, IL*
- *"It wouldn't make a difference for this group but it might help old people. It's not going to hurt anyone."—Seattle, WA*

What are Some of the Implementation Issues?

Many respondents from all categories thought this would work best in suburban or rural areas. They thought it might get lost in all of the other downtown lights. On the other hand, a few drivers thought it might help in the midst of the other downtown lights as well.

- *"This would help in rural situations where it is darker at night and you are not familiar with the area."—Chicago, IL*
- *"The lights downtown are easy to go through and not know it."—Seattle, WA*
- *"Anything that makes lights more visible is good."—Washington, DC*

Some drivers thought that this would be good if the intersection was dangerous. Others questioned whether they would be useful when the light was blocked by an SUV or a big truck, and suggested that increasing the overall number of traffic lights (e.g., in different positions) might make it easier to see around trucks.

- *"It depends on the intersection. It would be good if there's a record of problems, but not everywhere."—Seattle, WA*
- *"At a big intersection, if you had two lights, it would be more helpful."—Washington, DC*
- *"The two red lights won't make a difference. You should have more of the regular traffic lights so you can see around trucks."—Chicago, IL*

Many respondents that liked the lights were concerned about seeing the yellow lamp with the bright yellow background. A few respondents suggested using "neon" lime green backgrounds that they've seen elsewhere and making sure to replace bulbs regularly.

- *"There's not enough contrast with the yellow light on yellow."—Seattle, WA*
- *"Will the yellow light show up on the yellow background?"—Chicago, IL*
- *"More important than high visibility is making sure no lights are out."—Washington, DC*

A few respondents made other suggestions including using a brighter bulb; possibly having one sign that flashes; a green light that flashes to yellow; or having one light-emitting diode (LED) traffic light that changes from red to yellow to green, because it is easy to see (and is cheaper/easier to maintain). They had seen most of these ideas implemented in other locations.

What are Some of the Advantages and Disadvantages?

No advantages were mentioned other than the safety-related benefits described above. With regard to disadvantages, some middle-aged and younger male drivers thought that the double red might be confusing and that the traffic light seemed expensive.

- *"I would wonder why there is a double red if I was just learning to drive."—Washington, DC*
- *"I would like it better if it only had one red light. Two lights are confusing."—Chicago, IL*
- *"It wouldn't hurt, but it's a lot of money."—Chicago, IL*

Countermeasure 1.3: Advance Traffic-Light Warning Signs

Countermeasure 1.3 was described to the focus group participants using the graphics and text shown below in figure 11.

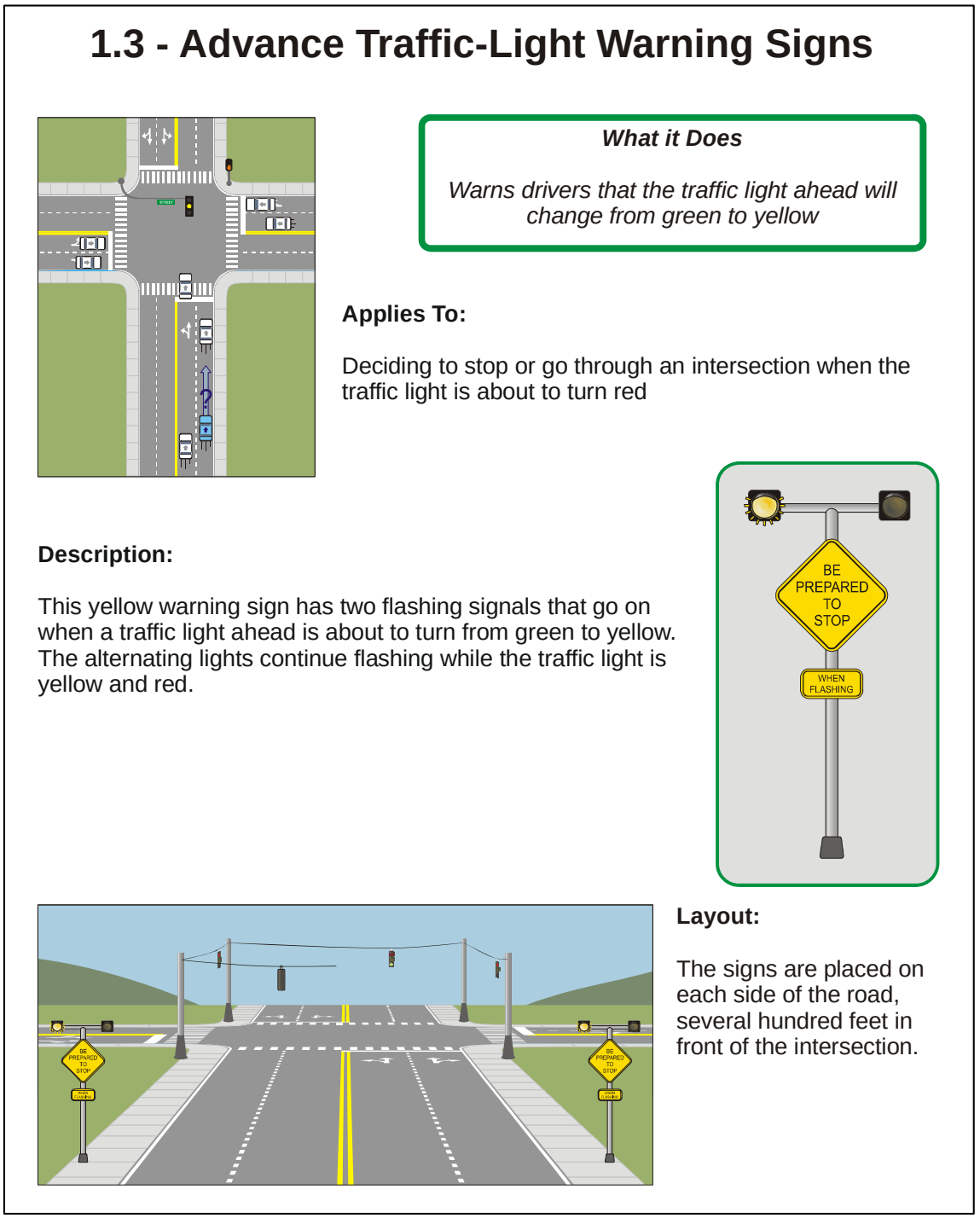

Figure 11. Graphics and text used to describe countermeasure 1.3: Advance traffic-light warning signs.

Would Implementing This Countermeasure Improve Safety?

About one-third of the middle-aged and young drivers thought that this countermeasure would be effective overall. Just about all of them thought it would be helpful under the condition that key implementation issues were addressed (see below).

- *"I have seen this, and I find it useful."—Seattle, WA*
- *"I like it. It helps you to measure distance."—Washington, DC*
- *"This one works. You see it and know what speed to go."—Chicago, IL*

Just about all of the older respondents thought it would be helpful and improve safety in most situations. Some thought it would work best in high-speed areas.

- *"I think this is very helpful."—Seattle, WA*
- *"We need more of these devices, especially for young kids."—Chicago, IL*
- *"This is very effective in high-speed areas." Another said, "It's not good under 30 mi/h (48 km/h) but for high speeds it could help."—Seattle, WA*

Some of the younger and middle-aged respondents that did not think this approach was effective and did not trust the sign.

- *"I wouldn't trust it. Each driver would be wondering, 'How much time do I have?'"*
  —Chicago, IL

What are Some of the Implementation Issues?

One issue identified by some younger and middle-aged drivers was that they did not trust the sign to be accurate based on their actual travel speeds. Also, other drivers in these groups noted that people might not see it or they might confuse it with other roadway signage, such as construction signs. Some of these respondents also noted that once people got used to it they would ignore it.

- *"I disregard these signs as they are too early before the light."—Washington, DC*
- *"I am not sure people would notice this in heavy traffic."—Seattle, WA*
- *"It depends what color it is. It could be confused with construction signs (and someone else thought train crossings)."—Chicago, IL*

Just about all of the respondents thought that this countermeasure would be more effective in rural and suburban areas. They equally agreed that it would be good in areas where the speed limit is above 56 km/h (35 mi/h) so that drivers would have some warning and be able to slow down. Some respondents in all categories thought it would be helpful in areas of low visibility, on curves and hills, and in the fog or other bad weather. Most did not think it would be at all useful in urban environments.

- *"This has no value on a 25 mi/h (40 km/h) road but on a high-speed road it would be important."*
  —Seattle, WA

- *"This would be good for dark roads or rural areas."—Chicago, IL*
- *"It wouldn't be helpful downtown, but in larger expanses with miles between things it would be more helpful."—Washington, DC*

What are Some of the Advantages and Disadvantages?

No advantages were mentioned other than the safety-related benefits described above.

One disadvantage noted by some of the younger males was that they might actually speed up in response to the warning if they felt they were close enough to go through the intersection before the light changed.

- *"Depending on how fast you are going I might speed up if I was right at the sign."—Seattle, WA*
- *"When it started flashing, you might gun it and that would make more of a problem." —Washington, DC*
- *"I'd obey it but if I were running late, I might not."—Seattle, WA*

A few other drivers were concerned that it might give drivers a false sense of security about the time that drivers had to get through, be distracting/confusing, or be hard to see if it was positioned by the side of the road.

- *"It might give you a false sense of security that you would have time to get through." —Chicago, IL*
- *"A yellow light asks you, do you have time to make it? This would have to let you know you wouldn't."—Washington, DC*
- *"I think it's a distraction."—Chicago, IL*
- *"You should make the sign clearer and more visible—maybe overhead."—Washington, DC*

Countermeasure 1.4: Intersection Collision-Warning Systems

Countermeasure 1.4 was described to the focus group participants using the graphics and text shown below in figure 12.

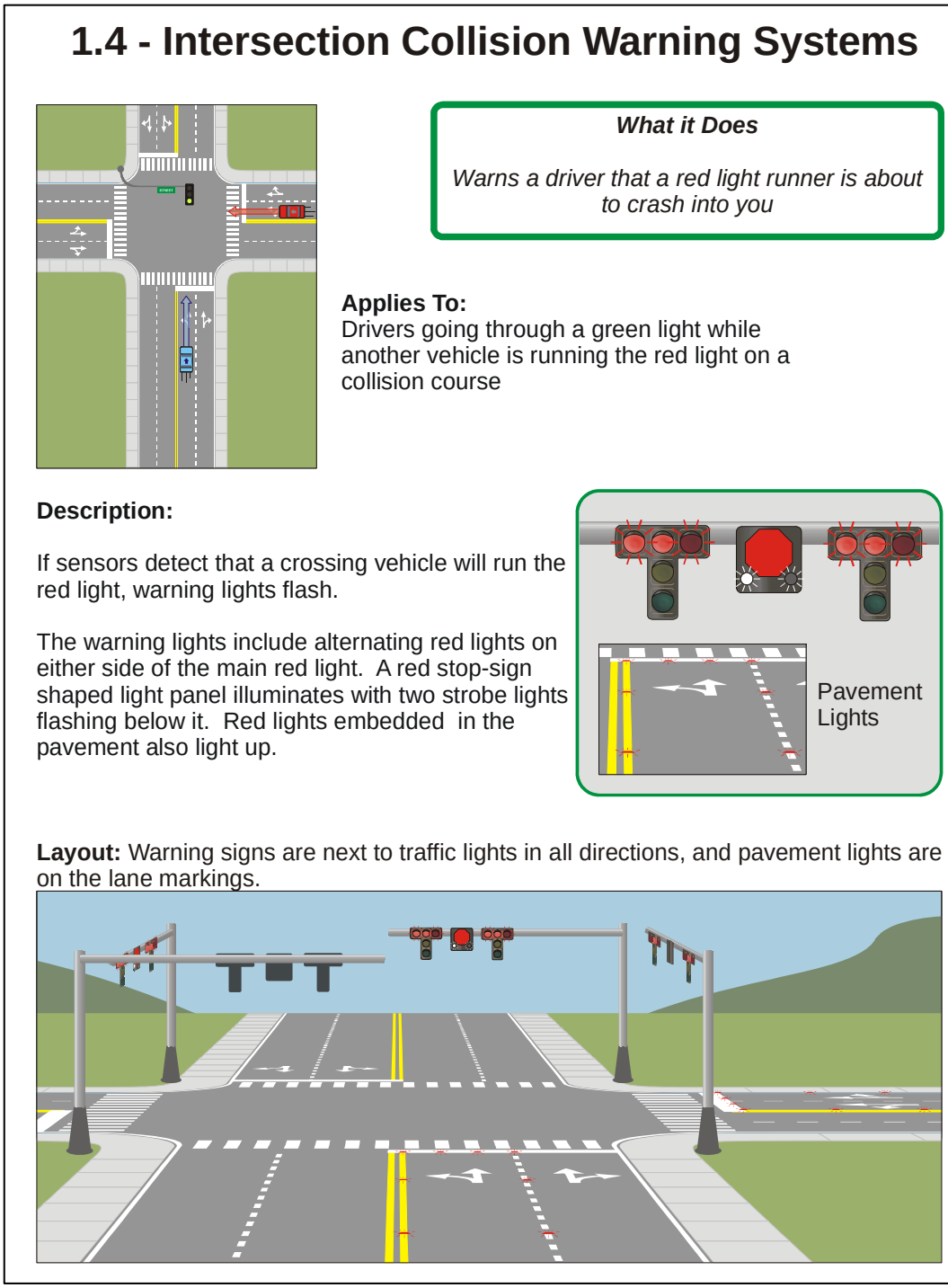

Figure 12. Graphics and text used to describe countermeasure 1.4: Intersection collision-warning systems.

Would Implementing This Countermeasure Improve Safety?

The initial reaction from drivers in most groups was positive. About three-quarters of the respondents across all age categories in Washington, DC, thought it would work. Just less than half of the drivers in Chicago, IL, and Seattle, WA, (across all age groups) were receptive to the basic idea. Many liked that a system was being considered to help protect them as potential crash victims and many of the respondents said they would definitely stop if they saw this. However, as people began to discuss the topic further, they began to consider whether or not it could be effective due to engineering drawbacks or as a result of the confusion that it might cause other drivers (see discussion of implementation issues, below). Some had an initial negative reaction to all of the extra lights.

- *"This has potential. When you see the lights from the police and ambulance (new ones in area) you stop."—Chicago, IL*
- *"This would improve safety."—Washington, DC*
- *"In a police car chase this would help."—Seattle, WA*
- *"This is good if a sensor can give someone enough time to make a decision."—Chicago, IL*
- *"Getting rear-ended is better than getting killed by being broadsided."—Washington, DC*
- *"What is interesting is that it stops everyone. If the person running the light sees all of this crazy, kookie stuff coming up it might even stop them."—Chicago, IL*

What are Some of the Implementation Issues?

Some of the respondents thought that this countermeasure had potential in a different form but thought it was "too much" as it is. Many suggested having fewer lights or that eliminating the pavement lights would be an improvement. Others thought that the strobe light was unnecessary. A few suggested other types of advance warnings such as placing the warning lights before intersections, adding sounds, or using yellow lights might make it more effective.

- *"It would be a good idea in a different form."—Washington, DC*
- *"There is too much going on."—Chicago, IL*
- *"I like most of it, but I don't think the flashing stop sign is necessary." —Washington, DC*
- *"It might make people paranoid, and it is very busy."—Washington, DC*
- *"I don't like bright lights jumping at you."—Seattle, WA*

A number of respondents mentioned it would be necessary to have a big campaign to let everyone know what it was and what drivers should do when they see it. Many others thought it needed no explanation.

- *"You would have to have a campaign to educate the whole country."—Seattle, WA*
- *"It would be good if everyone knew that it meant you are about to get hit in an intersection." —Washington, DC*
- *"There is enough red here to make sure anyone would know what to do."—Chicago, IL*

Many other people questioned how all of the timing would work, and whether the blue (shaded/gray) car would have enough of a warning to stop on time. Similarly, some drivers were skeptical that the technology would even work properly. Others thought it might be very

confusing to drivers and that they might not know what to do. A few thought they might wonder if they should stop or go.

- *"It seems like it is not enough time to make it all happen. You could be in the intersection when it went off and get hit anyway."—Seattle, WA*
- *"I don't think the technology will work."—Washington, DC*
- *"They probably had the same reaction when they put in the first stoplight. Sounds great but looks chaotic."—Seattle, WA*

What are Some of the Advantages and Disadvantages?

No advantages were mentioned other than the safety-related benefits described above.

Drivers identified several disadvantages with this approach. Many respondents were concerned that the signals and flashing lights might "freak out" certain drivers and actually cause more crashes when they stopped short. Many others were concerned that so much taxpayer money would be spent addressing the actions of irresponsible drivers and lawbreakers—even if it was to protect others.

- *"If someone was the hysterical type, they might brake too suddenly and get rear-ended." —Washington, DC*
- *"You can have more accidents if people freak out. Why can't they just delay the light from turning green if this happens."—Chicago, IL*
- *"Your gut would be to slam on the brakes without regard for the people behind you." —Seattle, WA*
- *"It's a marginal benefit for a big cost."—Seattle, WA*

A few thought that this was solving the wrong problem and that it was not addressing the drivers who go through the red light. Also, some respondents thought it might make some drivers lazy and more likely to depend on the extra lights to look out for them.

- *"It's passive approval to go through red."—Seattle, WA*
- *"It might say to someone 'no one is coming' if the light is not tripped." —Washington, DC*

How Does This System Compare to an In-Vehicle Warning System?

Most of the respondents were less receptive to the idea of having the warning system in their automobiles. They were concerned that, unlike seatbelts, these would not be useful unless everybody had them. They also felt that they would have the same impact in terms of startling some drivers, but at least with the on-the-road system drivers would have a clear indication of why the lights were flashing. A few drivers did not like the idea of increasing the cost of their cars. A few others indicated that it would be less effective because it might not warn the driver running the red light, as is the case with the intersection-based system. A few of the older respondents mentioned that perhaps there should be sound in addition to lights.

- *“It would still distract you.”—Seattle, WA*
- *“I’d like that but I’d be concerned that others didn’t have it.”—Chicago, IL*
- *“It’s just like the Jetsons. But there’s always going to be people that don’t have the technology.”—Washington, DC*
- *“Is it free?”—Seattle, WA*
- *“I prefer it in the car instead of digging up the street.”—Seattle, WA*

Countermeasure 2.1: Protected Left-Turn Lights

Countermeasure 2.1 was described to the focus group participants using the graphics and text shown below in figure 13.

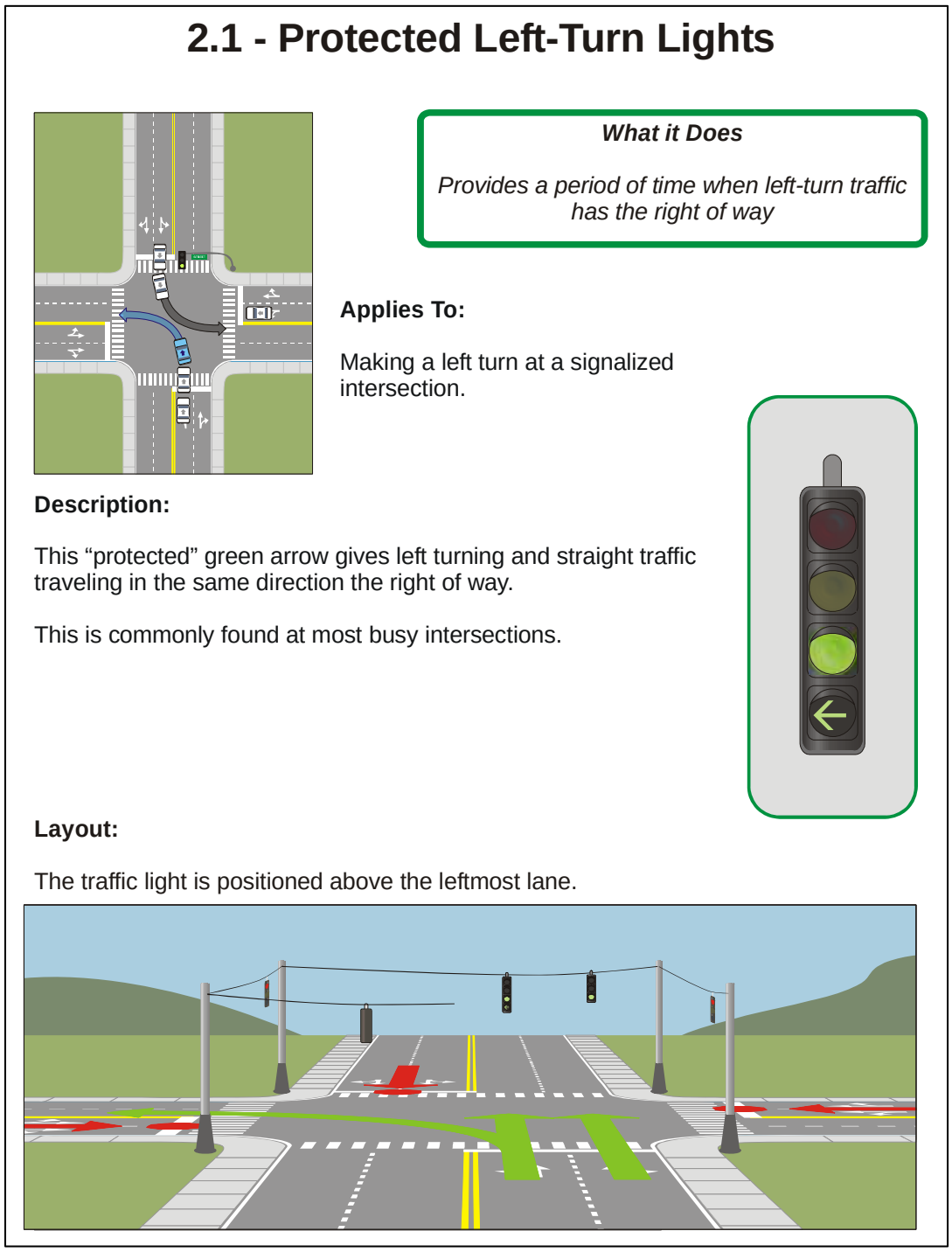

Figure 13. Graphics and text used to describe countermeasure 2.1: Protected left-turn lights.

Just about all respondents across all focus groups wished that protected left-turn lanes were provided at every busy intersection. Most drivers in all groups felt that protected left-turn signals were very effective at improving safety. A few noted that they like it when the green arrow is long enough. A few drivers mentioned that that they had problems when the traffic signal had both a green light and a green arrow on at the same time. A few drivers suggested that the light could be improved by including a sensor that only activated the turn the arrow when someone is in the turning lane. This would improve traffic flow when no cars are waiting to turn. A few respondents said they would like to have something to stop pedestrians from walking when drivers had the green arrow. One respondent also mentioned that it might be good to have a green arrow that turned into a flashing yellow light.

- *"I like this. It helps keep traffic moving, and it is safer."—Seattle, WA*
- *"They should have these at every traffic light."—Chicago, IL*
- *"I love it." "It's great." "It improves safety." "It decreases my anxiety so much."—Various drivers, Washington, DC*

Countermeasure 3.1: Automatic Gap Detection

Countermeasure 3.1 was described to the focus group participants using the graphics and text shown below in figure 14.

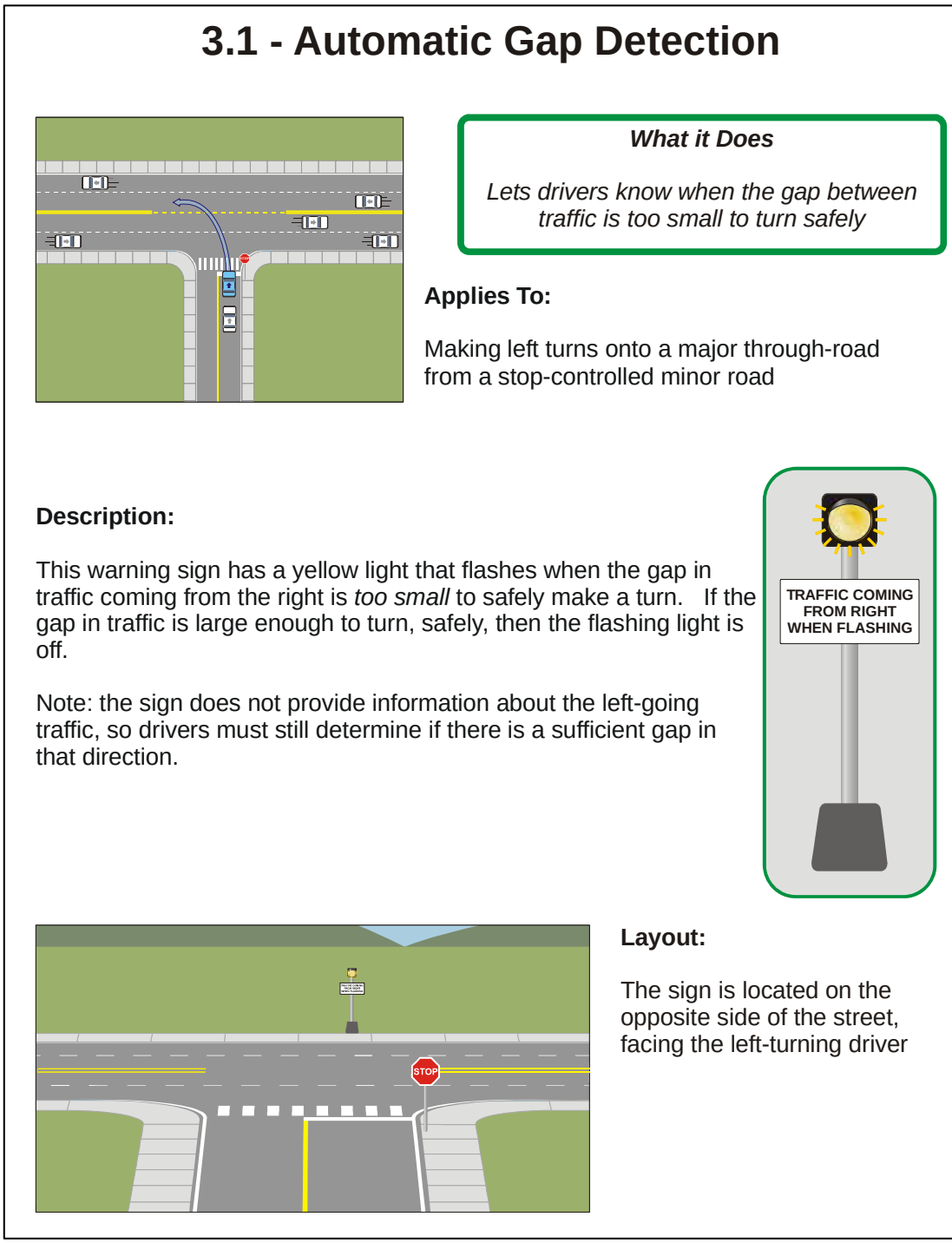

Figure 14. Graphics and text used to describe countermeasure 3.1: Automatic gap detection.

Would Implementing This Countermeasure Improve Safety?

About one-third of the drivers across all groups thought this was a good idea and would improve safety. Most of the young females in Chicago, IL, thought that it would be helpful and that it made sense.

- *"This would be wonderful."* Another said, *"It would really help. —Seattle, WA*
- *"I like that it tells you if you can't make it across."—Chicago, IL*
- *"For an inexperienced driver it might help."—Chicago, IL*
- *"If this was a right turn only and there was a big hedge that I couldn't see, this would be helpful."—Seattle, WA*

Many drivers across all groups were concerned about whether or not they could trust this countermeasure and commented that they would rather judge the gaps "with their own eyes."

- *"I trust a lot of things, but I would not trust this. There are too many factors."—Seattle, WA*
- *"I'd trust my eyes before the light."—Washington, DC*
- *"They have something like this when merging on the highway, but I still have to see for myself."—Chicago, IL*

Some of the respondents said they would still prefer to have a light at the intersection, a traffic island, or a "suicide lane" in the middle (that would allow them to split up the turn) instead of this countermeasure.

- *"If you are putting a light here you should make it a traffic light."—Seattle, WA*
- *"I still vote for the island."—Chicago, IL*

What are Some of the Implementation Issues?

Drivers from all groups said that this would be most effective if it only addressed the oncoming traffic from the right. They also thought that it would be confusing if the warning tried to tell the driver what was happening on both sides. The other half of the respondents were concerned that it did not tell you what was happening on both sides.

- *"No! It would not be better if you were monitoring both sides."—Seattle, WA*
- *"The right side makes the most sense. Both sides would make it confusing." —Washington, DC*
- *"You would have to do it on both sides for it to work."—Chicago, IL*
- *"I would still be worried about traffic coming from the left."—Washington, DC*

Many respondents were not certain if the timing of this countermeasure would work properly. Some wondered how the technology would be able to judge how fast their car could go. Others noted that it would have to accommodate the lowest common denominator. A few drivers were concerned that it might not be able to account for the weather.

- *"This is the same as linking the light to the slowest reacting car."—Washington, DC*

- *"You can't always predict what will happen. There could be timing problems or conditions might change it."—Chicago, IL*
- *"My car starts up quickly. Some are slower. How would it know?"—Seattle, WA*
- *"What speed should you go? What speed are they going?"—Chicago, IL*

A few suggested that the warning should be accompanied by a continuous blinking light in both directions of the busy road indicating to oncoming traffic that someone might be turning in front of them. Others expanded on this idea by suggesting that it should only blink if cars are trying to turn. A few others suggested that the warning signal should blink when it was safe to turn instead of when it is unsafe.

- *"It would be better for the cars on the busy road so they know you are coming."—Chicago, IL*
- *"It would be better if it was not blinking when it tells you when to go."—Washington, DC*

A few other respondents were concerned that the sign would be too difficult to read because the text was too small or too verbose. Some mentioned that the flashing yellow was confusing and they might not understand it.

- *"You'd have to have a very big sign for it to be noticed."—Washington, DC*
- *"There is too much verbiage (on the sign). I'm concerned about drivers that don't speak English."—Seattle, WA*
- *"What's a flashing yellow? I know what a flashing red is. It would make us worse drivers than we are."—Washington, DC*

What are Some of the Advantages and Disadvantages?

No advantages were mentioned other than the safety-related benefits described above.

Drivers identified several other disadvantages to this approach. Some drivers across all groups felt that people might get lazy or dependent upon the sign and not check the actual gap properly. Some other drivers did not see the need for this countermeasure or would ignore it in favor of their own judgments.

- *"Some people would use it blindly. It won't be perfect so you'd still have to look for yourself."—Chicago, IL*
- *"I would be concerned that people would be relying on this instead of their instincts."—Washington, DC*
- *"I don't see the need. You know the traffic." Another said, "I'm not sure if I need lights telling me to go."—Chicago, IL*

What About a Gap Advisory System?

Participants were also asked their opinions regarding a similar version of the gap detection system that replaces the blinking light with a "time-to-arrival" countdown indicating how many seconds that drivers have before oncoming traffic arrives. In general, respondents from Washington, DC, were more receptive to this and thought that it would be more helpful than did

those in Chicago, IL, or Seattle, WA. This difference might be because Washington, DC, currently has similar countdown technology on its pedestrian walk signs.

- *"I like the idea of numbers counting down, I would change my mind based on that." —Washington, DC*
- *"It could be good. It depends on what it's based on."—Washington, DC*
- *"It would be better to have a countdown."—Chicago, IL*

When asked, just about all respondents in Chicago, IL, and Seattle, WA, thought it would not help or make a difference to them. A few drivers in Washington, DC, also noted that they were concerned that it would be confusing or that it might slow down traffic.

- *"I don't see an advantage of the countdown situation. People have to see for themselves." —Chicago, IL*
- *"I don't think the countdown would be better."—Seattle, WA*
- *"People would be challenged. They might not know what fifteen seconds are when they are driving. It's not the same thing as walking."—Washington, DC*

Countermeasure 3.2: Synchronized Adjacent Traffic Signals

Countermeasure 3.2 was described to the focus group participants using the graphics and text shown below in figure 15.

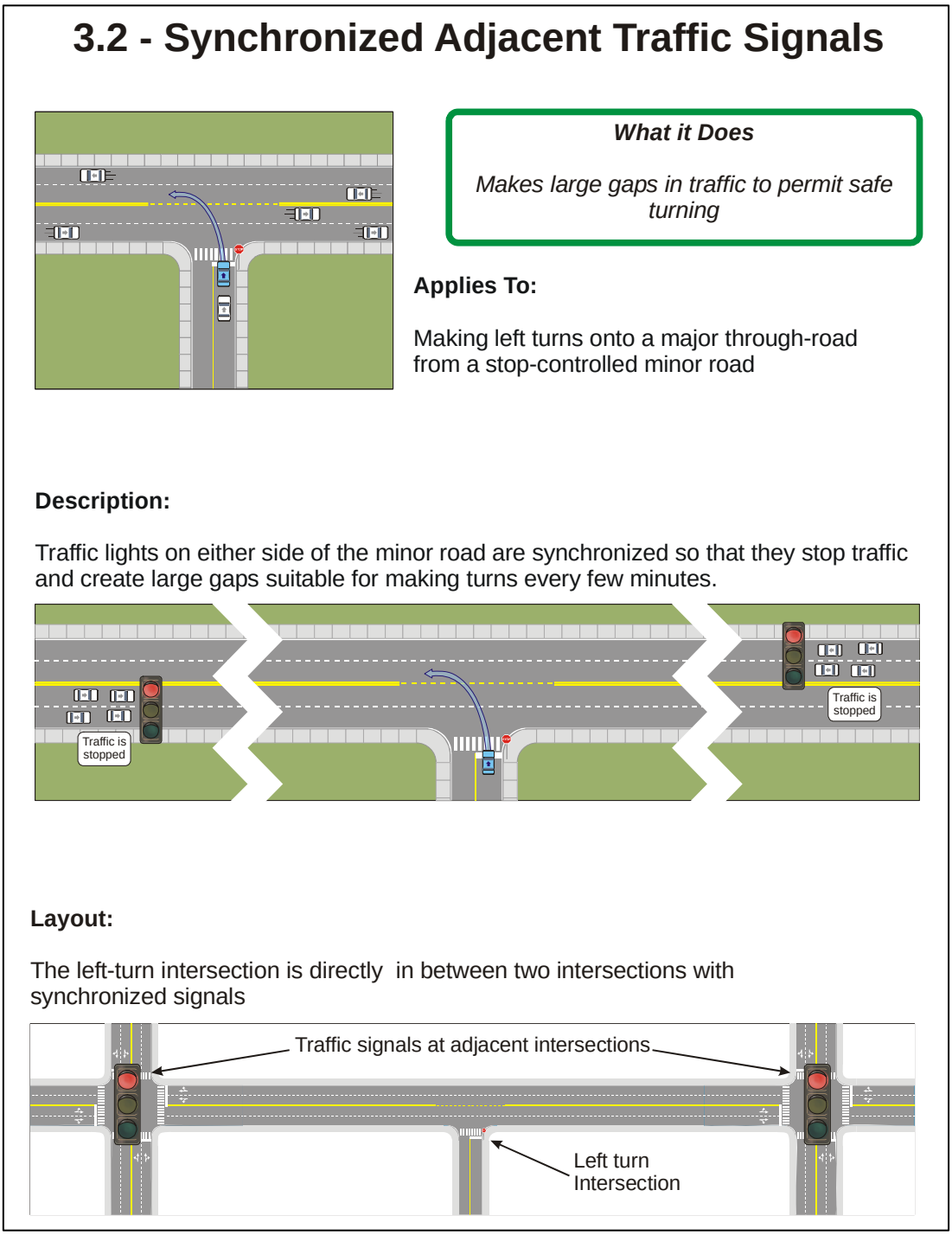

Figure 15. Graphics and text used to describe countermeasure 3.2: Synchronized adjacent traffic signals.

Would Implementing This Countermeasure Improve Safety?

About three-quarters of the respondents across all groups thought that this was an effective approach and that it would improve safety at the intersection. Many thought it would be very helpful and some mentioned places where they had it or they needed it. Many drivers also preferred synchronized traffic signals to the automatic gap warning system. In terms of implementation, many drivers thought it would be even better if sensors judged when it was needed so the traffic would not get needlessly backed up or stopped.

- *"This is better than flashing on the gap. It's idiot proof. There is no opportunity for someone to ignore the signal."—Washington, DC*
- *"You should have a light here, but if you can't afford it, it seems like a cheap way to help everyone out."—Seattle, WA*
- *"This would help me and it is safer."—Chicago, IL*
- *"I like it if the lights are already in place."—Seattle, WA*
- *"It would be better if there was a sensor."—Washington, DC*

Some respondents wondered why you could not just have a light at this intersection. A few others indicated that drivers would still have to be aware of people turning on red lights at the adjacent intersections or coming from driveways and other side streets.

- *"There is still some ambiguity. It seems more complicated than putting in a stop light." —Seattle, WA*
- *"If you do that why don't you just have a light right at the intersection?"—Washington, DC*
- *"A stoplight would be quicker."—Chicago, IL*
- *"This makes sense. I'm a little worried about those making a right on red but it is a big improvement."—Chicago, IL*

Countermeasure 4.1: Intersection Rumble Strips

Countermeasure 4.1 was described to the focus group participants using the graphics and text shown below in figure 16.

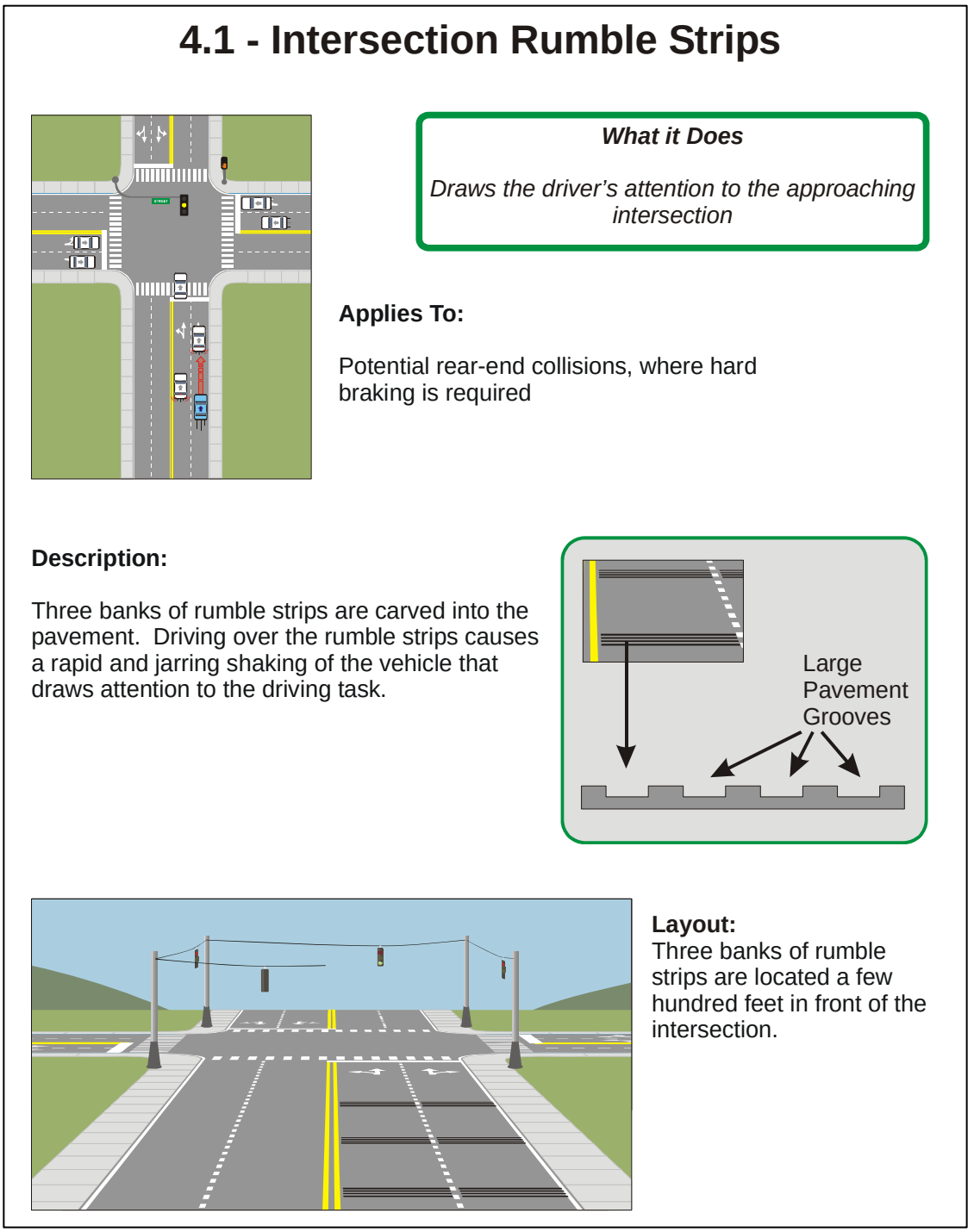

Figure 16. Graphics and text used to describe countermeasure 4.1: Intersection rumble strips.

Would Implementing This Countermeasure Improve Safety?

About half of the drivers across all groups thought this would be an effective countermeasure and that it would improve safety. The other half of the respondents did not think this would be an effective countermeasure because the potential problems outweighed the benefits (see next section). Some of these drivers did not think it addressed the problem in scenario 4 because fatigue and distraction are not the primary problems.

- *"I think they work, and they'd call attention to the light."—Washington, DC*
- *"It makes you cautious, and you slow down, either way.—Chicago, IL*
- *"These are effective as you don't want to hear the sound."—Washington, DC*
- *"I don't like this—coffee all over. These are only good for when you are falling asleep." —Chicago, IL*
- *"I thought drivers already know there are lights at intersections. I don't think being tired is part of the problem"—Seattle, WA*

However, many respondents across all groups, even those that did not like them, thought intersection rumble strips would help drivers refocus their attention on the road and on the intersection ahead.

- *"This is good in a situation when you are not paying attention."—Washington, DC*
- *"These are good to alert people to the light/intersection coming up."—Washington, DC*
- *"The idea is to wake up."—Chicago, IL*

What are Some of the Implementation Issues?

Many drivers noted that they would not be necessary at every intersection but that they would be helpful at dangerous intersections. Most respondents felt that if they were at every intersection people would get used to them.

- *"These are good but only at high-incident areas."—Chicago, IL*
- *"They wouldn't work if you get used to it."—Seattle, WA*
- *"It would make me slow down, but if they were at every light, I'd get used to it." —Washington, DC*

Many people who were familiar with rumble strips at the end of freeways, at tollbooths, and on the side of highways thought that they were better for those purposes than for intersections because they are infrequently encountered there. Some were concerned because they make people slow down which they should not always do in intersections, especially when the light is green. A few mentioned that this approach might slow down traffic or make it more congested. A couple thought it was implicitly telling drivers that it is acceptable to be distracted.

- *"These are more effective on the side of the road for when you fall asleep." —Washington, DC*
- *"It helps when the speed limit changes like at the end of freeways."—Seattle, WA*
- *"It could be dangerous when the light is green if you have to slow down every time." —Washington, DC*

- *"It's telling you it's okay to be distracted."—Chicago, IL*

What are Some of the Advantages and Disadvantages?

No advantages were mentioned other than the safety-related benefits described above.

Many respondents also said this approach would be very annoying because the rumble strips are loud and would rattle their cars or make them think they had gotten flat tires. Others were concerned about the wear and tear on their cars and tires.

- *"I think they are annoying."—Washington, DC*
- *"People in neighborhoods with these wouldn't be able to sleep."—Chicago, IL*
- *"I would worry about wear and tear and it would be annoying."—Seattle, WA*
- *"I hate it. When I look at this I see $400 for new tires."—Chicago, IL*

Countermeasure 4.2: Improved Skid Resistance

Countermeasure 4.2 was described to the focus group participants using the graphics and text shown below in figure 17.

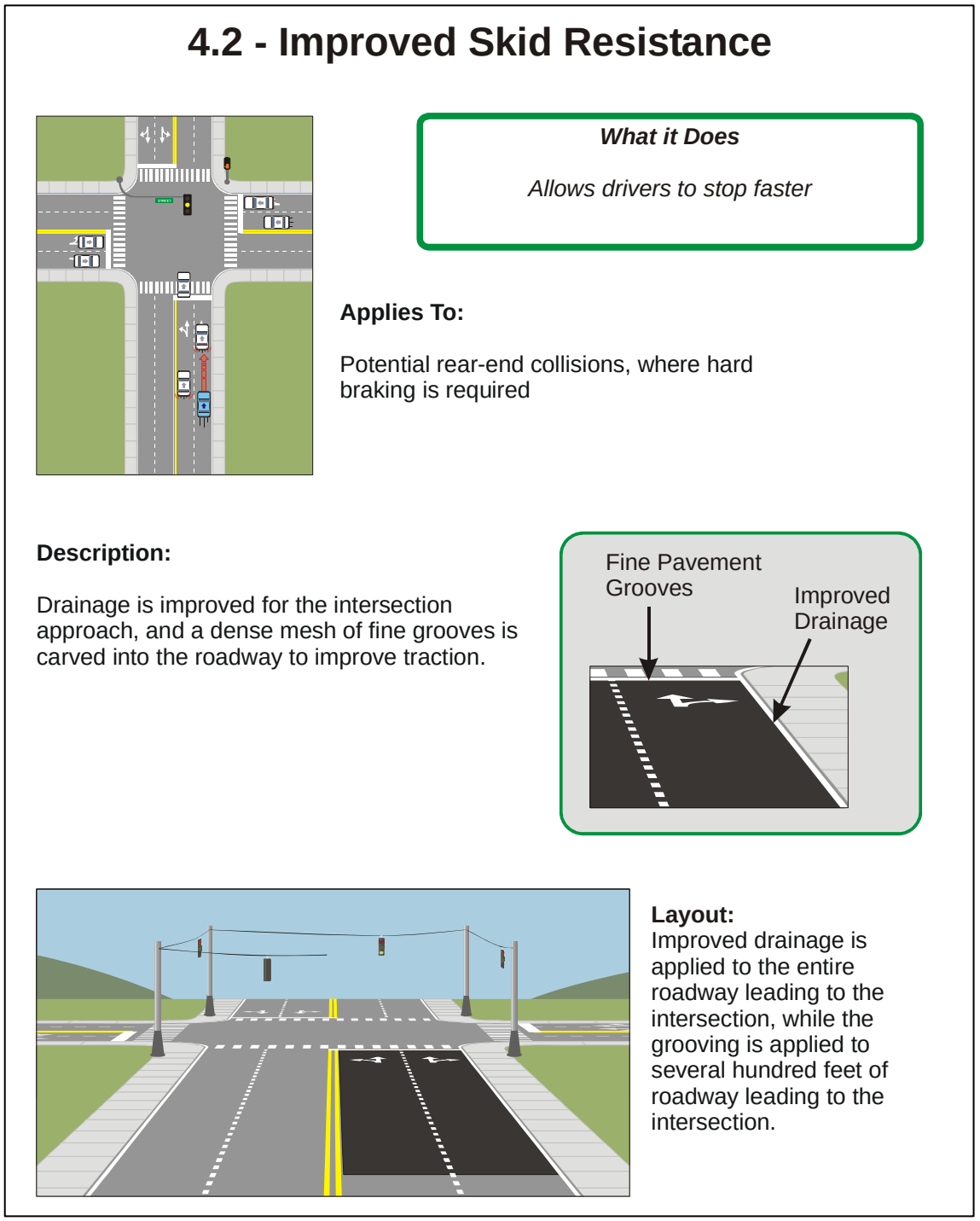

Figure 17. Graphics and text used to describe countermeasure 4.2: Improved skid resistance.

Would Implementing This Countermeasure Improve Safety?

Most drivers across all groups thought improved skid resistance would be effective and would improve safety. Some drivers thought they should be everywhere. With the exception of many older Washington drivers, most respondents preferred this solution to rumble strips and thought that it would be more effective in improving safety. One respondent noted that rumble strips would help them change behavior and skid resistance would be better for overall safety. Many thought a combination of intersection rumble strips and improved skid resistance would be the most effective.

- *"I think this would be great. No matter how well you design the intersection, things happen."—Chicago, IL*
- *"They should have had this a long time ago. I really like this one."—Chicago, IL*
- *"Rumble strips only alert you. These will make you stop."—Washington, DC*
- *"I like a combination: rumble strips in the back to alert you then intersection skid resistance to help you stop."—Washington, DC*

What are Some of the Implementation Issues?

A few respondents noted that it would be important that this countermeasure be consistently implemented so that drivers could tell when it is present in case they must rely on it. Also, many respondents thought that this should not be at every intersection, but only at dangerous ones.

- *"You would need to be consistent with it. I wouldn't want to expect it to be there when it's not."—Seattle, WA*

Some noted that the skid resistant treatment would have to start back far enough so that it would be available for all the drivers that needed to stop. Otherwise, lead vehicles with skid resistance would stop more quickly than following vehicles without skid resistance, making rear-end collisions more likely.

- *"Depends on how long it would be."—Seattle, WA*
- *"This should not be everywhere. Just long enough distance from lights not to have problems."—Washington, DC*
- *"It will shorten reaction time. What if cars stop too fast and get hit from behind?" —Washington, DC*

What are Some of the Advantages and Disadvantages?

Some drivers thought this would work well under slippery conditions including rain, oil on the surface of wet Seattle, WA, streets, and ice and snow in all three locations.

- *"This would be good to have in ice or snow."—Washington, DC*
- *"Not just the rain but the oil on the surface of the streets causes more accidents. This would help."—Seattle, WA*
- *"Does it work in snow and rain?"—Chicago, IL*

A few were concerned that people might come to rely on this and would falsely shorten their perception of what their reaction time is.

- *"It reinforces bad behavior."—Seattle, WA*
- *"It's good…as long as it doesn't make people complacent."—Chicago, IL*
- *"When you are talking about baby sitting drivers, you can see how crazy things are getting."—Washington, DC*

TAKE-HOME SURVEY RESULTS

Introduction

This subsection presents the results from the take-home surveys distributed to the focus group participants at the conclusion of each focus group session and then mailed back within (typically) 5 to 7 days of the original focus group session. The basic approach to developing the take-home survey and analyzing the resulting data was to use the integrated behavioral model (IBM) as an organizing framework for identifying and exploring the attitudes, beliefs, and other factors that underlie intersection behavior. Researchers have used IBM as a theoretical framework for addressing personal decisions in, for example, public health, seatbelt use, and susceptibility to social pressure. (See references 10, 11, 12, and 13.) IBM offers a valuable tool for thinking about beliefs, attitudes, intentions, and behaviors by drivers as they approach and navigate through an intersection. The model contains several levels of associations whose influence on behavior become more direct as the factors move from left to right as shown in figure 18. The model is useful to structure activities in this project, since the factors and constructs contained in the model give a comprehensive approach to understanding the factors associated with whether or not drivers engage in certain unsafe or risky behaviors at intersections. The analysis focused on drivers' decision to go or not go through the intersection in a dilemma-zone situation, where they would have to speed up or be going quickly to make it through before the light turns red, or have to brake relatively hard to stop in time.

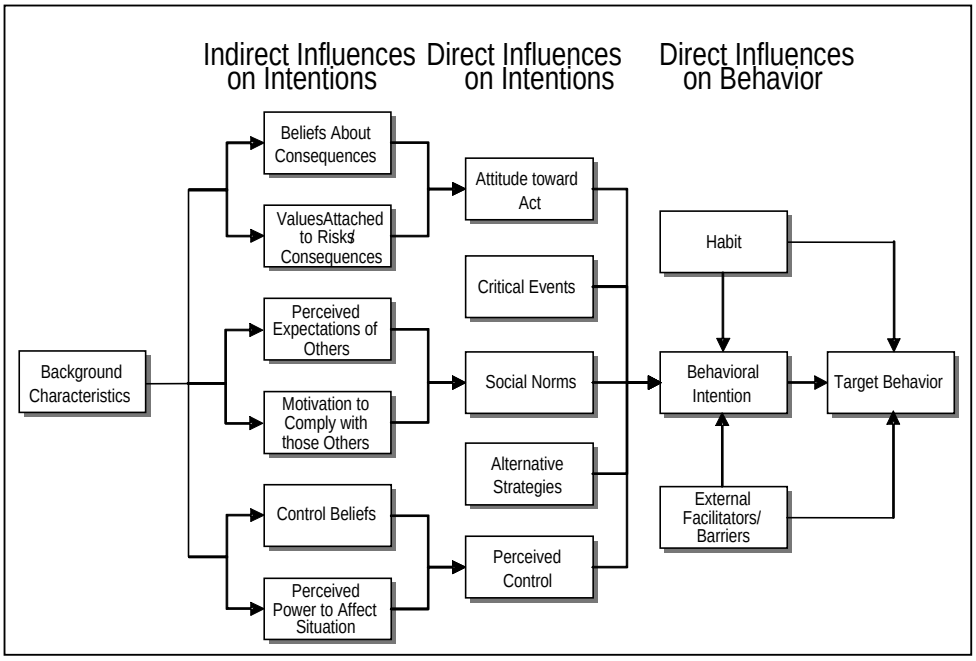

Figure 18. The integrated behavioral model (IBM).

A total of 84 participants returned completed take-home surveys, yielding an overall response rate of 70 percent (see table 5 below). Returns were generally balanced among the different demographic groups, with response rates being the lowest among younger participants (although the young group ended up with the most returns overall because there were twice as many participants—separate male and female groups—in this category).

Table 5. Number of take-home surveys returned from each participant group as a function of location, and age/gender characteristics.

AGE/GENDER CHARACTERISTICS	LOCATION		
	Washington, DC	Chicago, IL	Seattle, WA
18- to 35-year-old females,	5	6	6
18- to 35-year-old males	5	6	4
35- to 55-year-old males and females	7	8	9
65+-year-old males and females	11	8	9

Survey Results

Descriptive statistics and simple correlations were computed for responses to all Likert scale questions, and frequency-of-response was tabulated for all open-ended questions.

A summary of key Likert scale questions responses pooled across gender, age, and location is shown in figure 19 below.

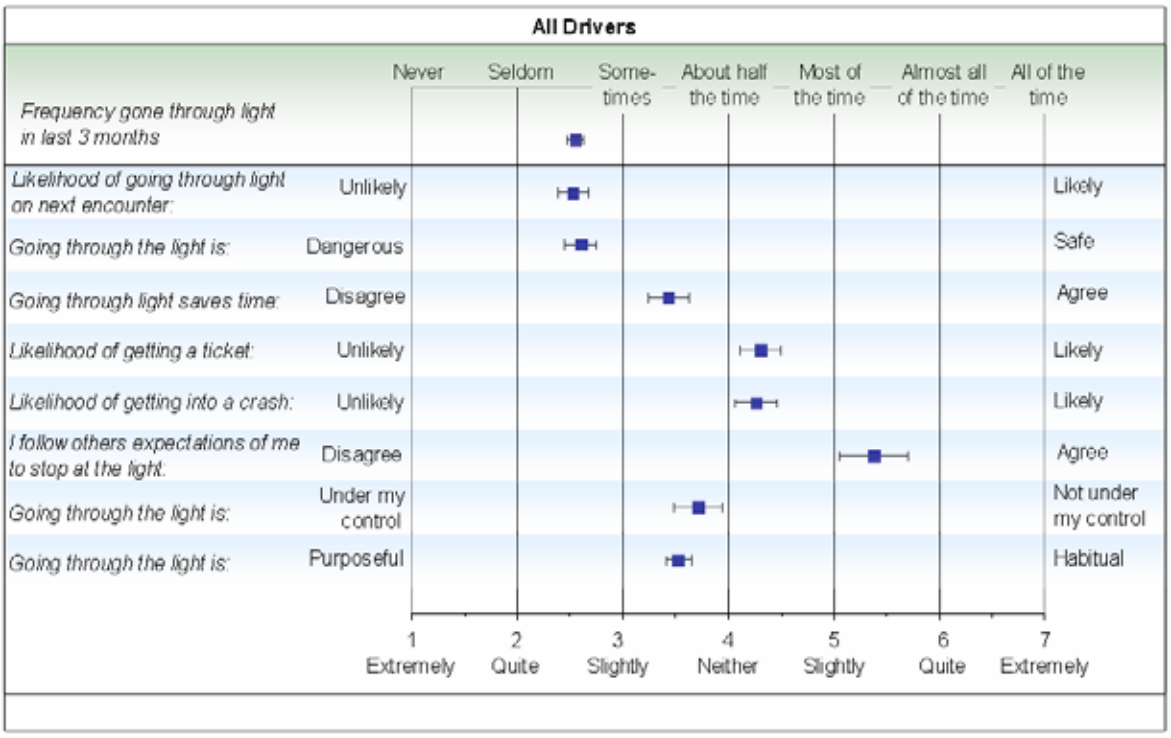

Figure 19. Summary of key scale responses pooled across gender, age, and location.

The following sections present responses to individual questions. Our initial reviews of the results for the Likert scale questions revealed no meaningful or consistent differences as a function of gender or location, but some interesting and consistent trends as a function of age. Thus, where applicable, results for these questions are broken down based on driver age.

Self-Reported Behavior (Question 1)

As seen below in figure 20, most drivers reported that they entered the intersection on a late yellow/early red light only "seldom" or "sometimes." The likelihood of going through the light decreased slightly as driver age increased.

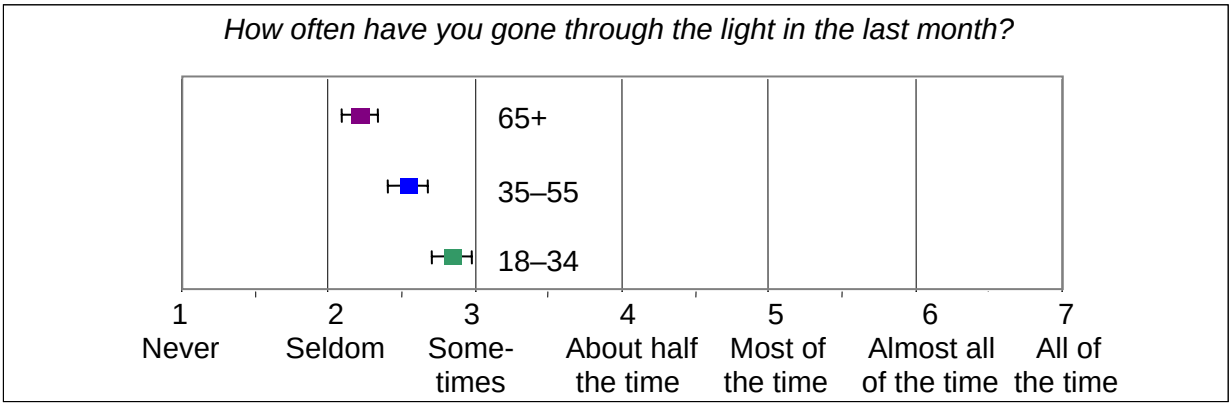

Figure 20. Responses to question 1 as a function of driver age.

Behavioral Intention (Question 2)

As shown below in figure 21, drivers' intentions to enter an intersection on a late yellow/early red light the next time they encounter that situation were very similar to their reported behavior in question 1. The rated likelihood ranged from "slightly" unlikely to "quite" unlikely. The likelihood of entering the intersection on a late yellow/early red light decreased slightly as driver age increased.

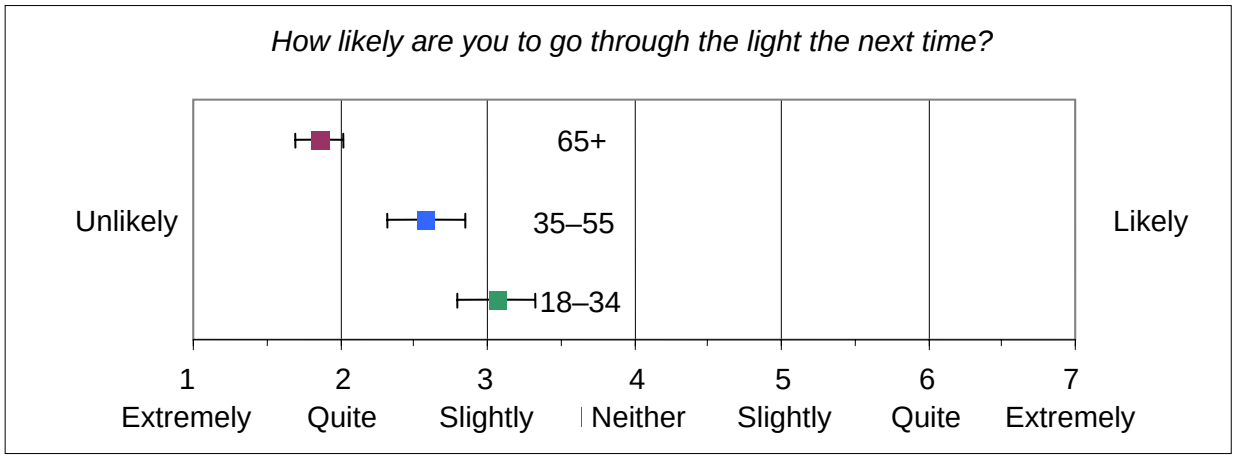

Figure 21. Responses to question 2 as a function of driver age.

Attitude Toward the Act: Beliefs and Consequences (Questions 3, 4, 5, 12a, and 12b)

Four Likert scale questions and one open-ended question addressed driver attitudes, beliefs, and views regarding the consequences of entering an intersection on a late yellow/early red light.

Figure 22 below shows the responses to question 3 as a function of driver age. As seen in the figure, younger and middle-aged drivers had almost identical responses to the question and

responded that entering the intersection was “slightly” dangerous, while the older drivers’ responses were closer to “quite” dangerous.

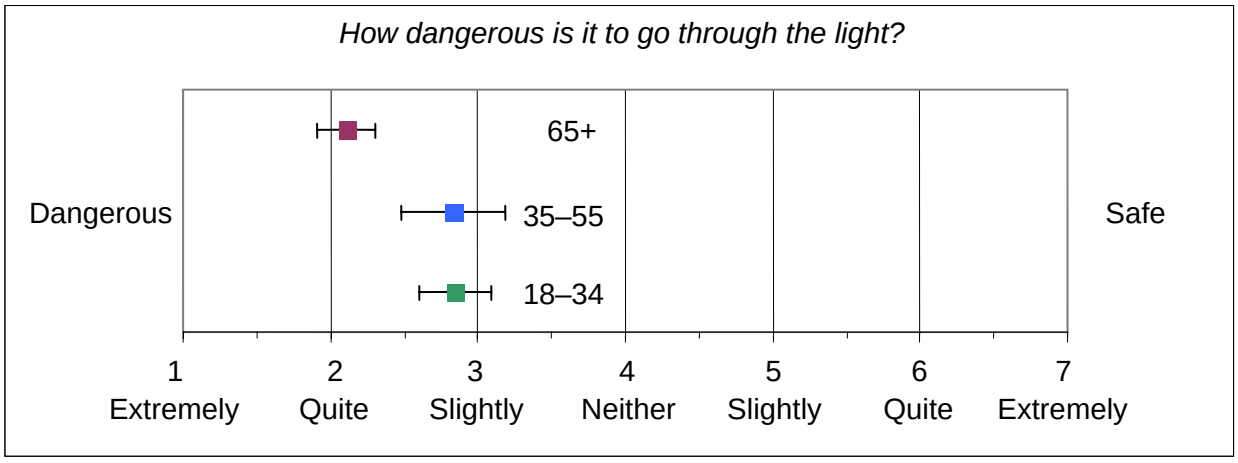

Figure 22. Responses to question 3 as a function of driver age.

As seen below in figure 23, age seemed to be a prominent factor in driver opinions regarding the timesavings associated with crossing an intersection on a late yellow/early red light. Specifically, while the younger drivers responded neutrally to the question, older drivers were progressively more likely to disagree that it saves time, with the 65 and older age group’s mean response falling almost halfway between “slightly” disagree and “quite” disagree.

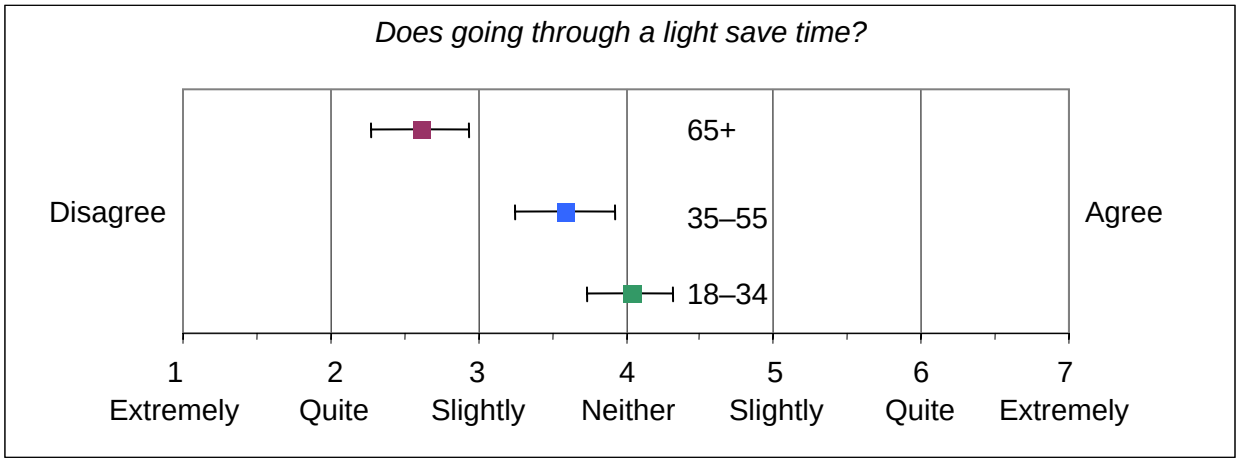

Figure 23. Responses to question 4 as a function of driver age.

As seen below in figures 24 and 25, all drivers were somewhat neutral regarding the likelihood of getting a ticket or getting into a crash as a result of running a red light, although the 65 and older drivers rated either outcome as a bit more likely than either the 18–34 group and the 35–55 group.

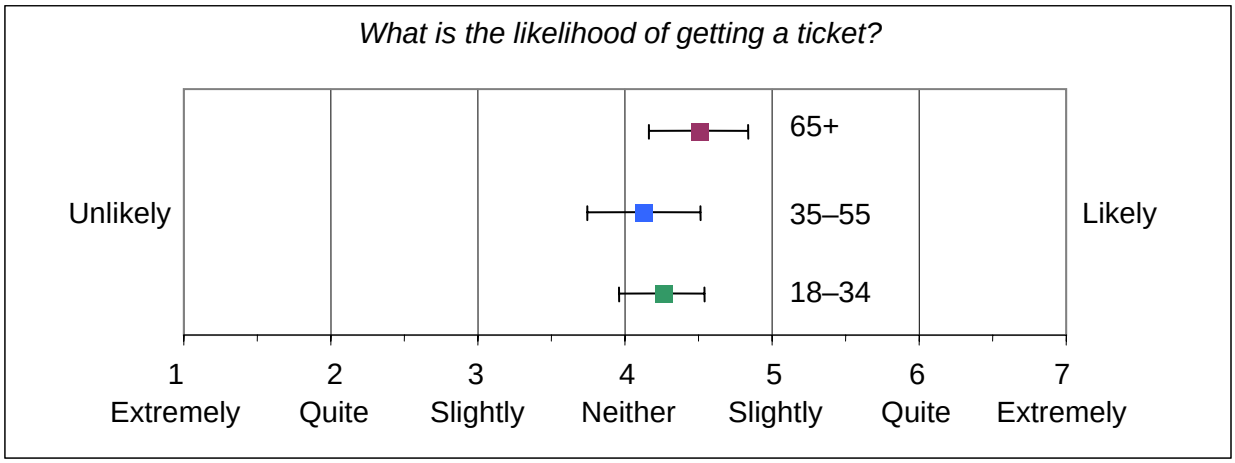

Figure 24. Responses to question 12a as a function of driver age.

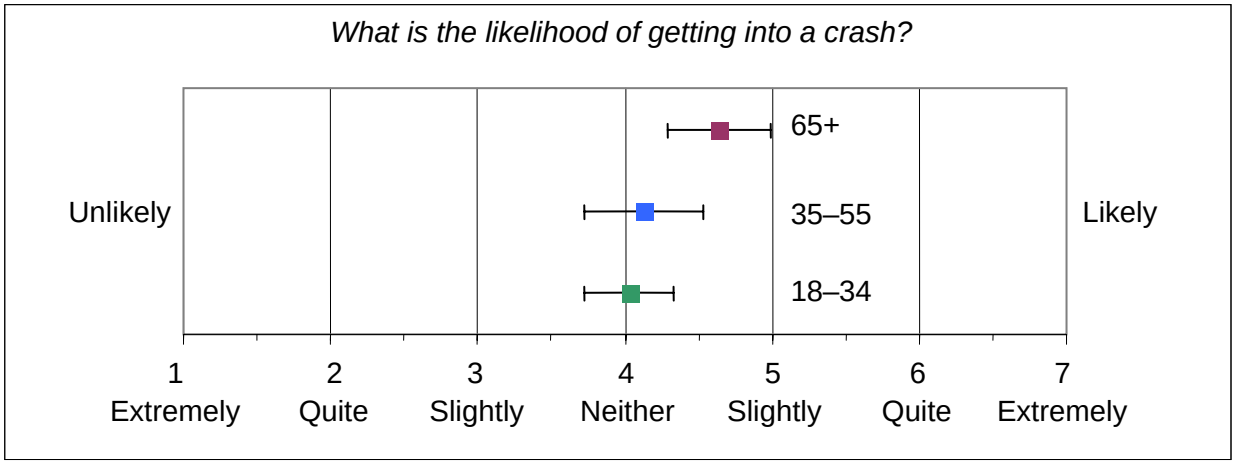

Figure 25. Responses to question 12b as a function of driver age.

Table 6 shows the results from question 5. The most commonly mentioned negative outcomes of entering an intersection on a late yellow/early red light were getting into a crash and getting a ticket. A comparison of these responses to those from questions 12a and 12b suggests that the drivers believed that, while getting a ticket or getting into a crash is, at most, only slightly likely, they still believe that these are the most likely negative outcomes. The most commonly mentioned benefits of doing this were to avoid hard stops/skids, avoiding rear-end crashes, and reducing travel time.

This list indicates many of the key beliefs that influence drivers' decisions on whether or not to go through a late yellow/early red light. For the most part, this list confirms that the survey was correctly focused on attitude-related factors such as getting tickets, getting in crashes, and reducing travel time as being most likely to influence intersection driving behaviors. However, the list also indicates that there are additional driver beliefs (e.g., avoiding hard stops and rear-end crashes) that influence their decisionmaking at intersections.

Table 6. Results from question 5: "Can you think of any other benefits or negative results of going through an intersection on a late yellow/early red light?"

NEGATIVE OUTCOMES / BENEFITS	FREQUENCY	PERCENT OF ALL RESPONDENTS N=84	PERCENT OF THOSE WHO ANSWERED THIS QUESTION N=59
NEGATIVE OUTCOMES			
Can get into a crash	31	36.9	52.5
Can get a ticket	16	19.0	27.1
Is stressful	2	2.4	3.4
Might end up blocking the intersection	2	2.4	3.4
Might hit pedestrian	2	2.4	3.4
Won't reduce travel time	1	1.2	1.7
Anger/annoy pedestrians	1	1.2	1.7
Bad example for younger passengers	1	1.2	1.7
Cause someone else to get a ticket	1	1.2	1.7
BENEFITS			
Avoid hard stops/skidding	11	13.1	18.6
Avoid rear-end crash	10	11.9	16.9
Don't have to wait at light/reduces travel time	7	8.3	11.9
Provides more protection during left turns	3	3.6	5.1
Allows you to avoid blocking traffic	3	3.6	5.1
Avoids engine/tire damage	2	2.4	3.4
Allows you to get out of the way of emergency vehicles	1	1.2	1.7
Reduces traffic backup behind you	1	1.2	1.7
To keep packages from tipping	1	1.2	1.7

Social Norms (Questions 8 and 9)

Two questions addressed social norms. One question asked what people who are important to them (social referents) think about how participants should act in this scenario, and the other

asked how much weight participants give to those opinions. Previous research indicates that this topic is most clearly interpreted as a weighted combination of these two aspects of social norms, which reflects the *impact* that social norms have on participant behavior.[14] To this end, responses to the first question were rescaled (by subtracting 4 and dividing the result by 3) to change the range from 1 to 7 into −0.5 to +0.5. Consequently, responses reflecting views that drivers should run the light had negative numeric values, and those reflecting views that drivers should stop had positive numeric values. Additionally, responses to the second question were rescaled (by subtracting 1) to change the range from 1 to 7 into 0 to 6. Multiplying the rescaled numbers together produced a value (ranging from −3 to +3) that was negative or positive, based on whether or not the driver should run the light, and it had a magnitude that reflected the combination of both the referent's strength of opinion and the participant's inclination to comply with that opinion.

As seen below in figure 26, the impact of social norms generally increased with age. Older drivers were more likely to be impacted by social norms and to follow others' expectations than younger drivers.

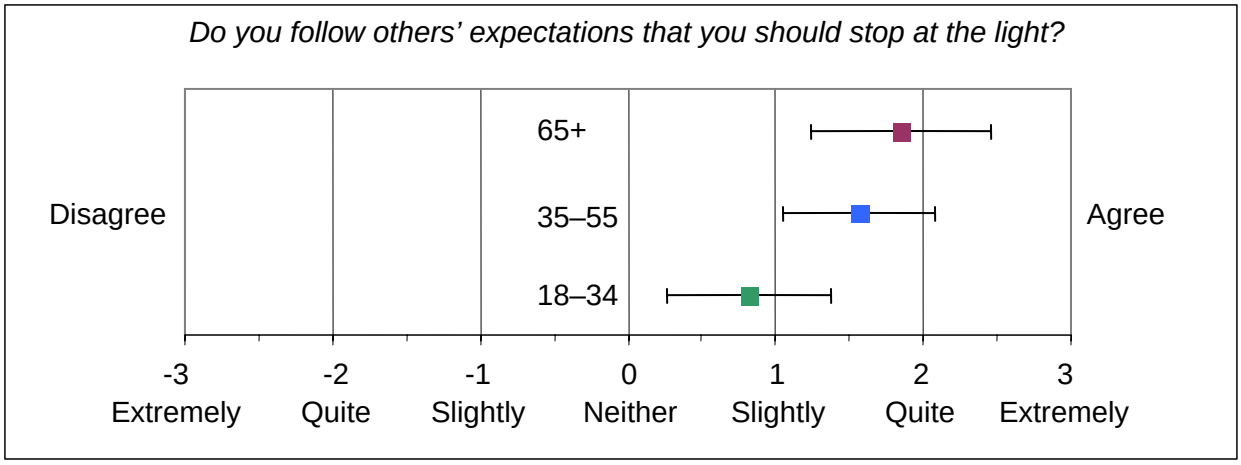

Figure 26. Responses to combined questions 8 and 9 as a function of driver age.

Perceived Control (Questions 10 and 11)

Two questions addressed driver's perceived control in this scenario. The first was a Likert scale question, and the second was an open-ended question that asked drivers to list some of the reasons why going through the intersection might not be under their control. As seen in figure 27, the results suggest that drivers were generally neutral about their perceived control, with older drivers reporting that their decision was very slightly more under their control than younger or middle-aged drivers. Table 7 lists the reasons why drivers thought that going through the intersection was not under their control. As seen in the table, the two most frequently listed reasons were: (1) a vehicle behind them following too closely, and (2) slippery road conditions.

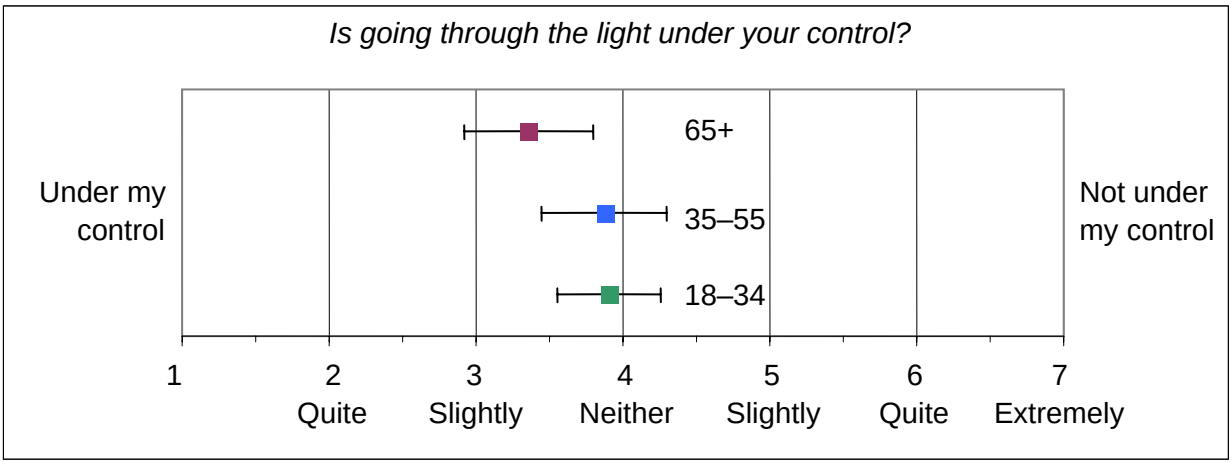

Figure 27. Responses to combined question 10 as a function of driver age.

Table 7. Results from question 11: "If you said that it is not under your control in the previous question, what makes you go through the intersection on a late yellow light?"

RESPONSES	FREQUENCY	PERCENT OF ALL RESPONDENTS N=84	PERCENT OF THOSE WHO ANSWERED THIS QUESTION N=33
Following vehicle is too close	15	17.9	45.5
Slippery conditions	12	14.3	36.4
Short yellow duration	6	7.1	18.2
Didn't notice light/view obstructed	4	4.8	12.1
Avoid being stuck in intersection	4	4.8	12.1
Traffic conditions	2	2.4	6.1
Need to make up time	2	2.4	6.1
Already in intersection turning left	1	1.2	3.0
To get out of way of emergency vehicles	1	1.2	3.0
Short distance to intersection	1	1.2	3.0
No other cars in intersection	1	1.2	3.0

Habit (Question 6)

As seen in figure 28 below, going through the intersection was more likely to be a purposeful or deliberate act rather than a habitual one—although just minimally so. Middle-aged drivers were slightly more likely to describe their actions as deliberate than the other groups.

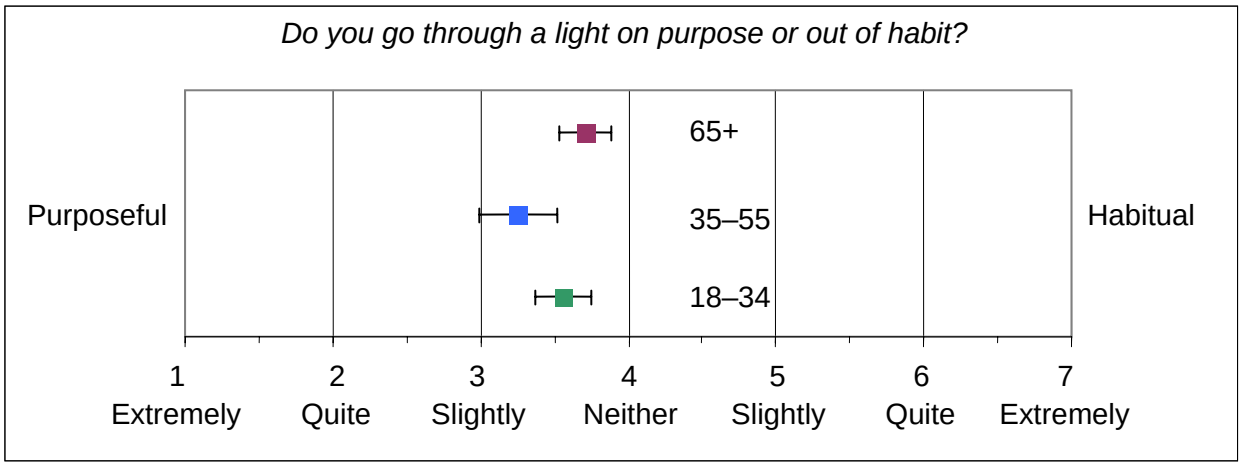

Figure 28. Responses to combined question 6 as a function of driver age.

Critical Incidents (Question 7)

Table 8 below provides the results from question 7, where drivers were asked to provide information about their intersection crash history. Younger drivers reported being involved in slightly more intersection crashes in past year or past 5 years than the other groups.

Table 8. Results from question 7: "Have you been involved in a traffic crash at an intersection in the last year, 5 years, ever, or never?"

	PAST YEAR		PAST 5 YEARS		EVER		NEVER	
	N	%	N	%	N	%	N	%
Younger	2	6	4	13	5	16	21	66
Middle-aged	0	0	3	13	7	29	14	58
Older	0	0	4	14	5	18	19	68

Note: Row totals do not add up to 100% because of rounding error.

CORRELATIONS AMONG ELEMENTS OF THE INTEGRATED BEHAVIORAL MODEL (IBM)

Table 9 below shows the correlations between self-reported intersection behaviors (question 1) and intentions (question 2), and the many beliefs, attitudes, and habits that influence both behavior and intentions. The correlations indicate which of the factors were more likely to be associated with the decision to enter an intersection on a late yellow/early red light. In the table, correlations significant at the $p < 0.05$ level are highlighted in bold. Table 9 shows that all of the

attitude-related measures and impact of social norms were significantly correlated with both self-reported behavior and intention, but that perceived control, habits, and critical incidents were not. Specifically, respondents who believed that entering an intersection on a late yellow/early red was dangerous and likely to lead to a crash or a ticket were more likely to stop at the intersection. These respondents were also more likely to disagree with the statement that going through the late yellow/early red light saves time. Additionally, those respondents who admitted to being influenced by people important to them were more likely to stop on a late yellow/early red if those referents believed they should stop. Thus, the best predictors of a driver's decision to enter an intersection on a late yellow/early red light were their attitudes about this behavior and its consequences, as well as compliance with others' expectations for driving behaviors at intersections.

Both actual behavior and intentions were investigated in this study because intention is often used as a surrogate for a direct measure of behavior when there may be reason to believe that the behavior measure itself is inaccurate (e.g., due to recall limitations) or potentially biased (e.g., subjects do not want to admit illegal or dangerous behaviors). In the present study, the original questions on reported behaviors and intentions (questions 1 and 2 from above) yielded similar results and were highly correlated ($r = 0.583$, $p < 0.001$). Also, as seen in the table below, they showed the same overall pattern of correlation with the other variables.

Table 9. Correlations and *p*-values (italicized) between reported intersection behaviors and intentions, and the factors that influence them.

	DANGER LEVEL?	SAVES TIME?	TICKET LIKELIHOOD	CRASH LIKELIHOOD	SOCIAL NORMS	PERCEIVED CONTROL	HABIT	CRITICAL INCIDENT
Behavior	**0.502**	**0.482**	**−0.229**	**−0.294**	**−0.362**	−0.030	0.013	−0.038
p-values	*<0.001*	*<0.001*	*0.036*	*0.007*	*0.001*	*0.787*	*0.903*	*0.733*
Intention	**0.369**	**0.382**	**−0.293**	**−0.356**	**−0.247**	0.011	−0.041	−0.064
p-values	*0.001*	*<0.001*	*0.007*	*0.001*	*0.024*	*0.922*	*0.712*	*0.562*

Note: Significant correlations are highlighted in bold.

Table 10 provides correlations between behavior and intentions, and gender/age characteristics of the participants. These demographic variables showed significant correlations between age group and both self-reported behavior and intention, but not between gender and these measures.

Table 10. Correlations and *p*-values (italicized) between reported intersection behaviors and intentions, and gender/age characteristics of the focus group participants.

	GENDER	AGE GROUP
Behavior	−0.054	**−0.363**
p-values	*0.628*	*0.001*
Intention	−0.099	**−0.378**
p-values	*0.369*	*<0.001*

Note: Significant correlations are highlighted in bold.

Additional analyses on the demographic variables indicated that driver age was also significantly correlated with ratings of how dangerous entering the intersection is ($r = -0.216$, $p = 0.049$) and with ratings that it saves time ($r = -0.337$, $p = 0.002$). This analysis confirms the trends based on age identified in the previous sections, and emphasizes the need to treat these groups differently in future investigations of this issue.

CHAPTER 4. CONCLUSIONS

This section presents the conclusions from the focus group sessions and from the take-home surveys. As seen above in the Results chapter and appendix D (summary tables of key results), this investigation produced a considerable amount of mostly qualitative data. These results are primarily because of the range of driving scenarios and engineering countermeasures investigated during the focus groups, the number and variability (i.e., gender, age, and location differences) of participants in the study, the open-ended nature of many of the questions, and participants' willingness to share their opinions openly. In short, there were almost as many unique answers to the questions asked of the focus group participants as there were focus group participants. Such an abundance of data presented the project team with some challenges such as identifying patterns, trends, or specific responses that can justifiably be called out as "conclusions" from the study. Appendix D represents an attempt by the project team to distill and summarize the focus group participants' responses into some cohesive and interpretable form. The conclusions presented below continue this process, with a decision to focus on highlighting results that reflect the behaviors, attitudes, habits, etc., of all or most of the focus group participants about several key questions.

In keeping with the flow of the actual focus group sessions and with the results presented in chapter 3, the conclusions are organized according to the four intersection scenarios that have been the focus of this investigation: (1) red-light running, (2) left turns at busy intersections, (3) turning left onto a major road with moderate traffic, and (4) rear-end crashes.

For each of the four scenarios, we present our conclusions in the form of answers to three key questions that reflect the technical objectives for the focus groups:

- What are drivers most likely to do in this scenario?
- Why do drivers engage in these behaviors?
- What engineering countermeasures have the most promise for improving traffic safety?

SCENARIO 1: RED-LIGHT RUNNING

Scenario 1 was described to the focus group participants using the graphics in figures 2 and 3 with the following verbal description: "*Approaching a signalized intersection at speed, the light turns yellow. The driver is far enough away from the intersection that he/she can stop if he/she brakes hard, but is likely to enter the intersection on an early red if he/she accelerates.*"

What are drivers most likely to do in this scenario?

For this scenario, the focus group sessions indicated that almost all older drivers would stop at the intersection, while many to most middle-aged and younger drivers would go through the intersection. Results from the take-home survey confirmed this general trend. Interestingly, the drivers who indicated that they would go through the light acknowledged that they would do so in a deliberate and purposeful manner based on the current circumstances; i.e., they recognized

the risks associated with running a red light under the circumstances described above, yet would often choose to do so anyway.

Why do drivers engage in these behaviors?

For older drivers, stopping is their planned, default driving behavior in this situation. For middle-aged drivers, going through the light is their default strategy, unless they thought that the vehicle in front of them was going to stop. For younger drivers, traffic and driving conditions, being in a rush, and the behaviors of a lead vehicle are all factors that contribute to their going through the light. For most drivers, additional factors that influence their behavior in this scenario include the status of cross traffic, obstructions, roadway conditions (e.g., visibility, traction), congestion levels, and the presence of pedestrians. Younger drivers are generally less likely to go through the light if their parents are in the car with them.

From the take-home surveys, it seems that drivers' decisions to go through on a late yellow/early red light are primarily based on attitudes/beliefs and the impact of social norms. This encouraging preliminary finding means these factors can be addressed by typical public awareness and similar advertising campaigns. The factors that are more difficult to change, such as habits and experience with critical incidents, had no impact in driver decisionmaking.

What engineering countermeasures have the most promise for improving traffic safety?

Opinions about red-light cameras (countermeasure 1.2) were strongly influenced by both prior experience and age. In the Washington, DC, and Chicago, IL, focus groups (where there are red-light cameras in operation) older drivers did not feel that they improved safety while younger males did feel that they improved safety. In the Seattle, WA, focus groups (where there are no red-light cameras), this trend was reversed. All subjects believed that implementation of red-light cameras should be done fairly with the specific aim of improving safety, not generating revenue.

Opinions about high-visibility traffic lights (countermeasure 1.2) were mixed, with older drivers believing that they would improve safety, and younger drivers (males in particular) believing that they would not help or did not apply to them. Many drivers thought that this countermeasure would work best in suburban or rural areas because it might otherwise get lost in all of the other downtown lights and other traffic control devices.

Opinions about the likelihood of advance traffic light warning signs (countermeasure 1.3) improving safety were very mixed. Most subjects thought that this countermeasure would be most helpful in high-speed areas (i.e., rural and suburban areas).

Opinions about intersection collision warning systems (countermeasure 1.4) were very positive, with many drivers—across all age groups and locations—expressing the opinion that such a countermeasure would definitely aid drivers' ability to stop before entering a potentially dangerous intersection. Some concerns were expressed regarding drivers' knowledge of the system and if it would provide warning information in time for drivers to safely stop. Many drivers expressed concern that this countermeasure was aimed at the law abiding driver, not the red-light runner. However, most drivers preferred this approach to an in-vehicle only approach.

SCENARIO 2: LEFT TURNS AT BUSY INTERSECTIONS

Scenario 2 was described to the focus group participants using the graphics in figures 4 and 5 with the following verbal description: "*Stopped in the middle of an intersection, waiting to make a left turn on a busy street; an oncoming car is also waiting to turn left and makes it difficult to see other vehicles approaching in the next lane. There is no dedicated turning lane and no dedicated turn signal; cars are waiting behind to also turn left (or go straight).*"

What are drivers most likely to do in this scenario?

For this scenario, the focus group session data were mixed, with many drivers avoiding this situation altogether (e.g., by taking a different route or making a series of extra right turns). About half of the subjects would wait for the light to change before making the turn and some of the younger drivers indicating that they barge their way into the oncoming lane, thereby forcing other drivers to slow down or stop.

Why do drivers engage in these behaviors?

Many drivers clearly did not trust their ability to judge traffic gaps. When drivers choose to make this maneuver, they are inclined to wait until the safest possible moment, and then accelerate quickly through the intersection. Many drivers expressed concerns about the presence of pedestrians, bicyclists, and low traction conditions, and take these factors into account when making decisions about whether to turn or not. Overall, this maneuver is seen as difficult so many drivers have developed set behavioral strategies that, in their view, reduce the likelihood of a crash.

What engineering countermeasures have the most promise for improving traffic safety?

Opinions about protected left-turn lights (countermeasure 2.1) were very positive, with almost all drivers expressing the opinion that these are very effective at improving safety and expressing the wish that they were available at all busy intersections.

SCENARIO 3: TURNING LEFT ONTO A MAJOR ROAD WITH MODERATE TRAFFIC

Scenario 3 was described to the focus group participants using the graphic in figure 6 with the following verbal description: "*A vehicle is stopped on a minor road with a stop sign, waiting to turn left onto a major road (that has no stop sign); a consistent flow of vehicles going at high speeds is crossing in both directions on the major road.*"

What are drivers most likely to do in this scenario?

For this scenario, the focus group sessions indicated that drivers exhibited very mixed behaviors. Slightly more than half of the drivers indicated that they would make the turn as best as they could; slightly less than half of the drivers indicated that they would first turn right, and then find their way back to their original route.

Why do drivers engage in these behaviors?

This scenario is visually demanding, as most drivers alternate their scanning between the left-going and the right-going traffic, while estimating gaps and keeping an eye out for pedestrians and bicyclists.

What engineering countermeasures have the most promise for improving traffic safety?

Opinions about automatic gap detection devices (countermeasure 3.1) were not consistently positive. Interestingly, many Washington, DC, drivers were receptive to this idea and thought that it would be helpful, while almost all drivers from Seattle, WA, and Chicago, IL, did not think that this countermeasure would improve safety. Many drivers might not trust the system and would prefer to make their own gap judgments or rely on other countermeasures. Many drivers were concerned about system accuracy.

Opinions about synchronized adjacent traffic signals (countermeasure 3.2) were generally positive, with well over half of the drivers expressing the opinion that this countermeasure would improve safety.

SCENARIO 4: REAR-END CRASHES

Scenario 4 was described to the focus group participants using the graphic in figures 7 and 8 with the following verbal description: *"Approaching an intersection at speed, the car in front stops suddenly when the light changes to yellow; the driver needs to slam on the brakes to avoid a rear-end collision."*

What are drivers most likely to do in this scenario?

For this scenario, drivers select following distances according to some predetermined heuristic—like a 2-second rule—that leaves sufficient space between their vehicle and a lead vehicle. Most drivers try to anticipate a lead vehicle's actions using cues such as the status of traffic signals, brake lights, or other signs that the vehicle is slowing down. If drivers believe that they will not be able to slow down in time to avoid a crash, many will change lanes or even drive onto a curb or the roadway shoulder.

Why do drivers engage in these behaviors?

More than a third of the focus group participants had been involved in a rear-end near-miss because of a variety of reasons, including tailgating, distraction, making faulty assumptions about other vehicles, or excessive speed.

What engineering countermeasures have the most promise for improving traffic safety?

Opinions about intersection rumble strips (countermeasure 4.1) were decidedly split among the focus group participants, with about half expressing the opinion that they would improve safety and about half believing that they would not improve safety if placed at every intersection. Most drivers thought that they would lose their effectiveness if placed at every intersection because

drivers would get used to them; many believed that the noise and vibration would become annoying.

Opinions about the improved skid resistance countermeasure (countermeasure 4.2) were positive, with most focus participants expressing the opinion that they would improve safety and would be preferable to rumble strips. Many believed that a combination of the rumble strips and the improved skid resistance countermeasure would be the most effective intervention.

FUTURE RESEARCH DIRECTIONS

The focus group discussions reported here yielded much useful information on driver behavior and attitudes about intersection driving and to possible safety countermeasures. However, this research has also revealed a number of additional questions that might benefit from future research. The discussion below presents the specific research questions that flow directly from the focus group results. These questions are presented along with the rationale or issues discussed in the focus groups that directly motivated the questions. Also, table 11 provides additional information about the research questions, including candidate methodological approaches for feasibly addressing each one, in addition to general statements about the types of benefits the new research could produce.

Red-Light Running

1.1 Red-Light Camera

Most of the participants were in favor of posting signs indicating where the cameras were located. However, many also mentioned that whether or not they drive cautiously often depends on whether or not they think that there is a camera at a particular intersection.

1. *What is the effect of providing warnings about camera locations on red-light running behavior?*
2. *If cameras are moved around or decoy cameras employed, how does the countermeasure effectiveness vary as a function of the likelihood that a camera is actually located at the intersection?*

Some participants mentioned as a drawback the possibility of causing more rear-end crashes as drivers abruptly slow or stop upon seeing the camera. This point has also been used as an argument against red-light cameras elsewhere.[15,16]

3. *How do drivers respond when they expectedly and unexpectedly see a camera at an intersection? How does this response change over time (repeated exposure)?*

1.2 High-Visibility Traffic Lights

Older drivers seemed to be the only participants that said that this countermeasure would help improve safety. Given that older drivers are less likely to run red lights, this countermeasure may not be as cost-effective as other countermeasures.[4,5] On the other hand, there are several other reasons for addressing older driver safety issues.[17] For example, older drivers are more

likely to sustain more serious injuries in crashes than younger drivers, and also that improvements targeted at older driver also benefit the general driving public.

4. *What are the aspects of standard traffic signals that make them most difficult to see?*
5. *How much of an improvement can increased signal visibility make on older driver detection and response to the traffic signals?*

1.3 Advance Traffic-Light Warning Signs

Almost all of the drivers mentioned that they felt that this countermeasure would be more effective in areas where traveling speeds were higher.

6. *For what speed ranges do drivers find the warning information to be useful (e.g., how does the likelihood that they will use the warning information change with their travel speed)?*

Some younger males indicated that they might use the warning information to speed up to make it through the intersection if they were close enough.

7. *Can the willingness to use warning information to adopt more aggressive behavior be mitigated by properties of the advanced warning, such as warning timing or placement location?*

More generally, several drivers (especially older drivers) indicated that as they approach an intersection, they search for cues indicating that the light may change. Advanced warning signs provide this information in a form that is more accurate and easier to obtain, which reduces cognitive/attention demands on drivers.

8. *How much of a reduction in workload, attention, and cognitive demands do advance warning signals provide in comparison to manually identifying whether or not a light is about to change?*

1.4 Intersection Collision-Warning System

Many participants indicated that they thought that the system involved too many different types of lights and could be overwhelming or distracting to some users.

9. *Can the same effectiveness in getting drivers to stop be achieved with other signal configurations that use fewer lights and components?*

Left Turns at Intersections

2.1 Protected Left-Turn Lights

The results of the focus group did not provide suggestions for future research in this area.

Left Turns at Stop-Controlled Intersections

3.1 Automatic Gap Detection

System trust was the primary concern raised by most drivers.

10. *Does exposure to the system (e.g., seeing it work accurately) lead to increased trust that the system works, or the opposite conclusion that the warning information is irrelevant?*
11. *Does driver trust in the system appropriately change to compensate for adverse conditions (e.g., low traction, low visibility, etc.)?*

Some drivers were also concerned that drivers might become complacent and rely on the warning information rather than visually checking the actual gaps.

12. *Does the presence of a gap detection system affect gap checking behavior (e.g., number of glances at rightward traffic)?*

Drivers from Washington, DC (where pedestrian countdown signals are more common) thought that a gap advisory version of the gap detection system would be more effective.

13. *What is the relative effectiveness of gap detection and gap advisory systems in terms of driver trust/complacency, ease of understanding the information, and the degree to which drivers compensate for adverse conditions?*

3.2 Synchronized Adjacent Traffic Signals

The results of the focus group did not provide suggestions for future research.

Rear-End Crashes

4.1 Intersection Rumble Strips

Most drivers felt that the rumble strips would cause them to refocus their attention on the roadway, but other factors such as habituation would reduce effectiveness.

14. *How do both attentive and distracted drivers respond when traversing an intersection rumble strip (e.g., Where do they look? How much do they slow down? etc.)?*
15. *How does this response change over time with increased exposure and increased likelihood of encountering rumble strips at an intersection?*

Many drivers had concerns about car damage and the noise that the rumble strips might cause.

16. *Can alternative (more subtle) implementations of the rumble strip be equally effective in drawing attention to the roadway?*

4.2 Improved Skid Resistance

Some participants were concerned that other drivers might come to rely on improved skid resistance and inappropriately generalize their improved stopping ability to other untreated locations.

17. *Over time, how does experience with improved stopping capabilities at a specific treated intersection affect driver car-following and overall stopping behavior at known treated intersections and other intersections in general?*

Table 11. Research questions, candidate research approaches, and benefits from focus group results.

Research Issue	Research Approaches	Benefits of Conducting Research
Red-Light Running		
1.1 Red-Light Cameras		
1) What is the effect of providing warnings about camera locations on red-light running behavior?	Driving Simulator Studies Field Observation/Testing Additional Focus Groups	Improved driver acceptance of countermeasure Improved countermeasure effectiveness
2) If cameras are moved around or decoy cameras used, how does the countermeasure effectiveness vary as a function of the likelihood that a camera is actually located at the intersection?	Driving Simulator Studies Field Observation/Testing	Improved countermeasure effectiveness Reduced costs of implementation
3) How do drivers respond when they expectedly and unexpectedly see a camera at an intersection? How does this response change over time (repeated exposure)?	Driving Simulator Studies Crash Data Analyses	Address arguments against using the countermeasure Further information on countermeasure effectiveness
1.2 High Visibility Traffic Lights		
4) What are the aspects of standard traffic signals that make them most difficult to see?	Driving Simulator Studies Test-Track Studies Additional Focus Groups	Improved countermeasure effectiveness
5) How much of an improvement can increased signal visibility make on older driver detection and response to the traffic signals?	Driving Simulator Studies Test-Track Studies	Improved countermeasure effectiveness
1.3 Advance Traffic-Light Warning Signs		
6) For what speed ranges do drivers find the warning information to be useful (e.g., how does the likelihood that they will use the warning information change with their travel speed)?	Driving Simulator Studies Test-Track Studies	Improved countermeasure effectiveness
7) Can the willingness to use warning information to adopt more aggressive behavior be mitigated by properties of the advanced warning, such as warning timing or placement location?	Driving Simulator Studies Additional Focus Groups	Improved countermeasure effectiveness
8) How much of a reduction in workload, attention, and cognitive demands do advance warning signals provide in comparison to manually identifying whether or not a light is about to change?	Driving Simulator Studies	Further information on countermeasure effectiveness Reduce driving-task demands
1.4 Intersection Collision-Warning System		
9) Can the same effectiveness in getting drivers to stop be achieved with other signal configurations that use fewer lights and components?	Driving Simulator Studies Test-Track Studies	Improved countermeasure effectiveness

Table 11. Research questions, candidate research approaches, and benefits from focus group results (continued).

Research Issue	Research Approaches	Benefits of Conducting Research
Left Turns at Intersections		
2.1 Protected Left-Turn Lights		
None		
Left Turns at Stop-Controlled Intersections		
3.1 Automatic Gap Detection		
10) Does exposure to the system (e.g., seeing it work accurately) lead to increased trust that the system works, or the opposite conclusion that the warning information is irrelevant?	Driving Simulator Studies Test-Track Studies	Improved countermeasure effectiveness
11) Does driver trust in the system appropriately change to compensate for adverse conditions (e.g., low traction, low visibility, etc)?	Driving Simulator Studies	Further information on countermeasure effectiveness
12) Does the presence of a gap detection system affect gap checking behavior (e.g., number of glances at rightward traffic)?	Driving Simulator Studies Test-Track Studies	Further information on countermeasure effectiveness
13) What is the relative effectiveness of gap detection and gap advisory systems in terms of driver trust/complacency, ease of understanding the information, and the degree to which drivers compensate for adverse conditions?	Driving Simulator Studies Test-Track Studies	Further information on countermeasure effectiveness Improved driver acceptance of countermeasure
3.2 Synchronized Adjacent Traffic Signals		
None		
Rear-End Crashes		
4.1 Intersection Rumble Strips		
14) How do both attentive and distracted drivers respond when traversing an intersection rumble strip (e.g., Where do they look? How much do they slow down? etc.)?	Driving Simulator Studies	Further information on countermeasure effectiveness
15) How does this response change over time with increased exposure and increased likelihood of encountering rumble strips at an intersection?	Driving Simulator Studies	Further information on countermeasure effectiveness
16) Can alternative (more subtle) implementations of the rumble strip be equally effective in drawing attention to the roadway?	Driving Simulator Studies Field Observation/Testing Test-Track Studies	Improved driver acceptance of countermeasure

Table 11. Research questions, candidate research approaches, and benefits from focus group results (continued).

Research Issue	Research Approaches	Benefits of Conducting Research
4.2 Improved Skid Resistance		
17) Over time, how does experience with improved stopping capabilities at a specific treated intersection affect driver, car-following, and overall stopping behavior at known treated intersections and other intersections in general?	Driving Simulator Studies	Further information on countermeasure effectiveness

Application of This Methodology to Other Scenarios or Safety Issues

While the previous section discussed how specific issues raised in the focus group may warrant further investigation using other empirical approaches, another avenue for future research is to use focus groups to investigate additional intersection scenarios. More specifically, although the present research addressed scenarios that had the highest crash rates, other scenarios may also warrant attention because of their association with high-severity crash situations, such as crashes involving pedestrians and bicyclists. For example, uncontrolled intersections have the highest rates of pedestrian crashes and high rates of bicyclist crashes.[18] In addition, four-way stop-controlled intersections, and right turns at signalized intersections may also be worth investigating because they often put drivers in direct conflict with pedestrians and bicyclists. Additional focus group research involving these intersection scenarios could provide important insight regarding how drivers anticipate and plan maneuvers (or fail to do so) when pedestrians or bicyclists are present.

Another potential application of focus group methodology is to investigate what is required to make red-light cameras more acceptable to drivers. More specifically, different patterns about driver attitudes towards the cameras varied based on factors such as driver age and exposure to the cameras. Also, drivers showed clear misperceptions about how cameras work, why they are there (e.g., for revenue purposes only), in addition to having opinions on what is a fair way to use the cameras. A more focused investigation could determine what is required in terms of the implementation, education, and management of red-light cameras to make them more acceptable to drivers as safety devices.

Finally, the preliminary application of the integrated behavioral modeling (IBM) approach for looking at a substitute for red-light running showed initial promise as a method to understand the attitudinal and behavioral factors that lead drivers to run red lights. In particular, this approach identified several factors based on driver attitudes towards red-light running and social norms that were correlated with a substitute for red-light running. This finding holds promise because these factors can be addressed using public education campaigns (unlike other factors such as habit or past crash experience). Thus, a more thorough application of the IBM approach has promise for identifying the key strategies and messages for educating and persuading drivers to adopt safer driving behaviors.

APPENDIX A. PARTICIPANT SCREENER

PRELIMINARY RESPONDENT SCREENER FOR FOCUS GROUPS

Note to Recruiter: *Group 1 will consider only male drivers under the age of 35; Group 2 will consider only female drivers under the age of 35; Group 3 will consider drivers of both sexes between the ages of 35 and 55; Group 4 will consider drivers of both sexes over the age of 65. Recruit 12 respondents for a maximum of 10.*

Hi, my name is ( ) and I'm calling about a study sponsored by the Federal Highway Administration of the U.S. Department of Transportation. All persons selected for the study will be paid $75 for participating in a two-hour group session. During the session, you will be asked to talk about yourself, your driving behaviors and motivations in intersections, and your attitudes and feelings about other drivers when they encounter intersections.

It is important to be honest both when you are answering our questions today and, if you agree to participate, when you are sharing in one of our groups. Please understand that all of our questions are strictly for research purposes and there are no right or wrong answers. The group will be scheduled on (2004) and will be held at (p.m.). Before I continue, are you interested in participating? (If yes, continue; if no, thank and terminate).

Now, I have to ask you several questions to determine if you are eligible to be part of the study. *OR I need to obtain some information from you to determine your eligibility for the study.*

1. What is your age?
   - ( ) under age 18; thank and terminate
   - ( ) 18–35; consider for Group 1 (male), Group 2 (female)
   - ( ) 35–55; consider for Group 3 (both male and female)
   - ( ) 56–64; thank and terminate;
   - ( ) 65+; consider for Group 4 (both male and female)

2. Have you participated in a focus group or other research study in the past six months?
   - ( ) no; continue
   - ( ) yes; thank and terminate

3. How long have you lived in the area?
   - ( ) more than three years; continue
   - ( ) less than three years; thank and terminate.

4. Do you work for the department of transportation or work in any auto safety-related profession?
   - ( ) no; continue
   - ( ) yes; thank and terminate

5. Do you own an automobile, SUV, or pickup truck?
   ( ) yes; continue
   ( ) no; thank and terminate

6. Have you driven during the past week?
   ( ) yes; continue
   ( ) no; thank and terminate

7. In the past week, have you had to make a left turn at an intersection in which you felt the conditions for turning were a little risky (e.g., a lot of oncoming traffic, or didn't have a full view of the roadway, etc.)?
   ( ) yes; continue
   ( ) no; thank and terminate

8. In the past month, have you either intentionally or unintentionally entered an intersection while the traffic light was red or just turned red? [Note: For older groups use yellow as alternative if needed.]
   ( ) yes; at least 4, no more than 6 per group; continue
   ( ) no; at least 4, no more than 6 per group; continue

9. In the past six months, have you experienced any hazardous driving situations (e.g., crashes, close calls, traffic tickets, etc.) at an intersection?
   ( ) yes; at least 4 per group; continue
   ( ) no; continue

10. Are you married (not separated), widowed, or divorced?
   ( ) yes; at least 4, no more than 6 per group; continue
   ( ) no; at least 4, no more than 6 per group; continue

11. Do you have any children under the age of 20 years old? (omit for group 4)
   ( ) yes; at least 4, no more than 6 per group; continue
   ( ) no; at least 4, no more than 6 per group; continue

Participant's Name: _____

Address: _____

Telephone: _____

Group Assignment: _____

APPENDIX B. MODERATOR'S GUIDE

INTRODUCTION [10 minutes]

Good Evening. My name is Eileen Michaels and I am the moderator for today's discussion. As you were probably told by the person who called you, we will be here for about 2 hours and the purpose of today's group is to talk about a number of topics related to yourselves, driving, and intersections. We are more interested in hearing about your own experiences than those of others you know.

SELF DISCLOSURES: I work for a company that provides research to clients on a wide variety of subjects. I travel around the country talking to groups like yours and giving them opportunities to share their thoughts, ideas and feelings. That's what we'll do here tonight.

Please remember, my job is to report what you have to say back to my client, the Federal Highway Administration of the U.S. Department of Transportation. I have no vested interest in your answers. I am not here to sell you anything and my job will continue regardless of how you answer. Thus, I encourage you to be honest and feel free to offer both positive and negative comments.

BROADER DISCLOSURES: You may have noticed that there is a mirror on that wall. [Substitute Camera for Seattle, WA, Groups]. It is actually a two-way mirror and people from the organization I am working for today are sitting on the other side of the glass to hear what you have to say.

As you also may have noticed, this session is being videotaped. This is not because I want to keep track of "who said what" but more to keep a record of today's information for my report. I do a lot of these groups in many cities and it would be difficult for me to remember the specifics of each group without having something to help verify what I'm reporting. I assure you, the tape will be used for no other purpose.

GROUND RULES: Before we get started, I'd like to go over some ground rules to help me get the information I need and help you get an idea about how focus groups work.

1. Please speak clearly and one at a time so that everyone in the group can hear you. Also, keep your voice level at least as loud as mine is now so that the tape can pick up what you say.

2. Since focus groups are conducted with complete confidentiality, we are using first names only. None of you will be identified by name in my report or anywhere else.

3. You are each being paid for your time to be here because we are interested in what you have to say. Thus, it is important that we hear from everyone. There will be times when you may be the only one in the group that feels a particular way. Please speak up when this occurs as this group represents a larger population. You may not think the same way as anyone in this room, but you may be representing the ideas of thousands of other people that are not here tonight. All opinions are valuable. There are no right or wrong answers.

4. At any time feel free to get up and get additional refreshments or go to the rest room if you would like. Smoking is not permitted inside the session.

Are there any questions? OK, before we begin, let's go around the room and introduce ourselves by giving our first names and a brief description of where we'd be and what we'd be doing if we weren't here right now. I'll go first: I'm Eileen, and if I weren't here I'd probably still be at work, writing up a report on a focus group like this one.

Now that we all know each other, let's get started.

II. GENERAL DRIVING [10 minutes]

A. Warmup Exercises (Flip chart)

Now, we need you to think back a little bit to your early driving days. How did you learn to drive? What type of on-the-road training or driver education did you have? Are there any key things you will always remember about that experience? Any that you still apply to driving today?

If you were teaching a friend or younger brother/sister to drive (child for older groups), what are the most important things you would tell them?

III. DRIVING IN INTERSECTIONS [10 minutes]

Now lets go back to those driving lessons. Discussions about driving can cover many topics but we are most interested in finding out about your driving at intersections. Were there any situations that happened at intersections or instructions that you learned that you still use to this day? Any rules that your instructor impressed upon you that you know you should use but don't? If so, why don't you still use them? What would cause you to use them again?

How many of you have had crashes or near-misses in intersections? What happened? Was it your fault? Did these incidents do anything to change your driving behaviors? In what ways? What about "wake-up call situations" or driving incidents that might have turned out worse?

Have you ever received a ticket or warning for running a red light? Circumstances? Did that change your driving behavior in any way?

IV. INTERSECTION SCENARIO DISCUSSION [Total 60 minutes]

I'm going to describe and show you pictures of different situations that can occur when driving through intersections and then ask you some questions about each. These are representative scenarios for the purposes of discussion.

A. Scenario 1: Red-Light Running [20 minutes]

You are driving alone and approaching an intersection with a traffic light when it turns yellow. You are far enough away from the intersection that you can stop if you brake hard, but are likely

to enter the intersection while the light is turning red if you accelerate. [Note Objectives: What do you do? What are you looking at? What are you thinking?]

[Probe: *What do you do?* OK, show of hands—How many of you would speed up to get through the light? How many of you would stop?]

1. Cognitive decisionmaking aspects to go or stop on late yellow (15 minutes)

What goes into your decision to go/stop? How do you decide what you are going to do?

[Probe: *What are you thinking?* Do you think about it or is it more automatic?]

[Probe: *What goes through your mind?* Are there times when you don't see the light until it is too late?]

Do you ever plan a response as you approach an intersection or do you decide on the fly when you get there? [Probe: Issue slamming on the brakes versus not wanting to stop.]

As you approach the intersection, what are you looking at or monitoring? What information about the situation do you use to make your decision? [Probe: Do you see the light?]

Are there other factors that would make you act differently in this situation? What about factors that make your decision more difficult?

[Probe: *What are you thinking?* What if you had someone in your car? Your child? Your spouse? Friends? Do you act differently with family versus friend(s)? Why?]

Does it change things if you know the light and the intersection?

[Probe: *What are you thinking?* What if you know the light does not stay yellow long or the red stays red too long?]

2. Complicating Factors (5 minutes)

OK. I am going to go through a list of things that might impact your decision go through or stop at the light. For each one tell me if you think it would make a difference. How?

- The presence of oncoming drivers waiting to turn left.
- Heavy traffic congestion and long delays at intersections.
- Poor visibility conditions (e.g., fog, nighttime, etc.).
- Glare from oncoming vehicles. Does glare ever make traffic signals harder to see?
- Poor traction conditions (e.g., rain, icy/snow, etc.).
- Intersection terrain (uphill, downhill, flat).

Anything else I should know about red-light running? OK. Let's get to the next scenario.

B. Scenario 2: Left Turns at Busy Intersections [15 minutes]

You are stopped in the middle of a busy intersection waiting to turn left. An oncoming car is also waiting to turn left, making it hard to see other vehicles approaching in the next lane. There is no dedicated turning lane and no dedicated turn signal. There are also other cars behind you waiting to turn left (or go straight). [Note Objectives: *What do you do? What are you looking at? What are you thinking?*]

1. Cognitive Decisionmaking Aspects (10 minutes)

If you had to break down your thinking about this step by step, how would you describe your actions? [Probe: *What are you doing?* Does anyone creep forward to get a better view? Accelerate quickly? Stay there and wait until the light turns red?]

Do any of you have special techniques or tricks you use to see better?

When you identify a gap what do you do? How do know if you have enough space to make your turn? How would you describe the size of a gap that you are comfortable with? [Probe: Do other things come into play (i.e., weather)?]

What else goes into your decision to turn? [Probe: W*hat are you thinking?* Do you try to judge the speed of oncoming cars? What about the distance to cross?]

Are there other factors that would make you act differently in this situation?

[Probe: *What are you thinking?* What if you had someone in your car? Your child? Your spouse? Friends? Do you act differently with family versus friend(s)? Why?]

Does it change things if you know the intersection?

2. Complicating Factors (5 minutes)

OK. I am going to go through a list of things that might impact your decision to turn. For each one tell me if you think it would make a difference. How?

- The presence of other cars behind you, waiting to turn/go straight.
- Heavy traffic or long delays at intersections.
- The presence of pedestrians/bicyclists crossing in the turn path.
- Poor visibility (e.g., fog or nighttime).
- Glare from oncoming vehicles (probe: Does this make gap judgments harder?).
- Poor traction conditions (e.g., rain, icy/snow, etc.).

- Others?

C. Scenario 3: Turning Left on Major Road with Moderate Traffic [15 minutes]

You are stopped on a minor road with a stop sign, waiting to turn left onto a major road with no stop signs. A steady flow of vehicles is crossing in both directions at high speeds. [Note objectives: What do you do? What are you thinking? What are you looking at?]

1. Cognitive Decisionmaking Aspects (10 minutes)

If you had to break down your thinking about this step by step, how would you describe your actions? [Probe: *What are you doing?* Do you stop at the line? Find a sufficient gap? Probe: W*hat are you looking at?* Creep forward to get a better view? Check for pedestrians crossing? Accelerate quickly?]

When you look for a gap, how do you know it is large enough for you to go?

What size gap are you comfortable with? Do other factors come into play? Do other circumstance make the decision to turn more difficult? [Probe: *What are you thinking?* Speed, distance to cross, etc.?]

How would things be different if you were making a right turn? What about going straight through?

Are there other factors that would make you act differently in this situation?

[Probe: W*hat are you doing?* What if you had someone in your car? Your child? Your spouse? Friends? Do you act differently with family versus friend(s)? Why?]

Does it change things if you know the intersection?

2. Complicating Factors (5 minutes)

Like the last one, I am going to go through a list of things that might affect your ability to judge gaps in traffic or your decision to make the turn. Again, tell me if or how they would make a difference.

- The presence of other cars behind you, waiting to turn/go straight.
- Heavy traffic or long delays at intersections.
- The presence of pedestrians/bicyclists crossing in the turn path.
- Poor visibility (e.g., fog or nighttime).
- Glare from oncoming vehicles (Probe: Does this make gap judgments harder?).
- Poor traction conditions (e.g., rain, icy/snow, etc.).

- Others?

D. Scenario 4: Rear-End Crashes [15 minutes]

Here's a situation we've all been in. You are approaching an intersection at full speed when the car in front of you stops suddenly when the light changes to yellow. What do you do? Let's assume you need to slam on the brakes in order to avoid a collision. [Note objectives: *What do you do then? What are you thinking? What are you looking at?]*

1. Cognitive Decisionmaking Aspects (10 minutes)

Have you ever been in a situation like this in which you actually crashed into the vehicle in front of you? Any near-misses? What caused it? Do you think anything could have been done to avoid it? [Probe: *Are you surprised versus not able to stop?*]

Do you ever do anything before a situation like this develops? How might you see it coming? Is there anything you can do to anticipate slowing or stopping in the vehicle ahead of you? Can you tell by other factors [traffic light, brake lights, other cars, signs, etc.]? How important are these indicators?

How closely do you typically follow other vehicles? How would you compare your own habits to other drivers'? What makes you drive closer to or further away from other vehicles? Do you think this makes a difference?

Are there other factors that would make you act differently in this situation?

[Probe: *What are you doing?* What if you had someone in your car? Your child? Your spouse? Friends? Do you act differently with family versus friend(s)? Why?]

Does it change things if you know the intersection?

2. Complicating Factors (5 minutes)

Do any of these factors make a difference in how close you follow or your ability to predict when the vehicle in front of you will slow or stop? If yes, how?

- Vehicle type.
- Heavy traffic or long delays at intersections.
- Poor visibility (e.g., fog or nighttime).
- Headlight glare from oncoming vehicles. [Probe: Glare from other causes.]
- Poor traction conditions (e.g., rain, icy/snow, etc.).
- Whether the intersection is on a hill or flat.

- Others?

V. COUNTERMEASURES [Total 25 Minutes]

Now I will show you some images with ways to improve or prevent some of the four intersection situations we have been talking about. You will recognize these pictures from earlier, with added changes.

In each case we will discuss your thoughts about:

1) Whether it helps solve the problem.

2) Whether it will improve safety.

3) Advantages and disadvantages.

[Moderator's Note: remain sensitive to whether respondents clearly match scenarios to appropriate countermeasures.

A. Red-Light Running [13 minutes]

1) Red-light cameras.

2) Advanced warning signs with active flashers (that indicate the light is about to turn yellow).

3) Increasing traffic light visibility.

4) Intersection collision warning systems

In-vehicle warning system: What if instead of warning lights in the intersection, your car came equipped with a warning light in the dashboard that flashed and provided an alarm sound. Would this be more or less effective in getting you to stop in time? Why? [Probes: What are the advantages and disadvantages of each approach? Could the dashboard warning be more distracting or confusing than helpful?]

B. Left Turns at Busy Intersections [7 minutes]

1) Protected left-turn signals (define).

C. Left on Major Road with Moderate Traffic [5 minutes]

1) Automated systems that inform driver of the suitability of gaps

2) Synchronized adjacent traffic signals that create gaps

D. Rear-End Crashes [5 minutes]

1) Intersection rumble strips to draw attention to the intersection.

2) Improve traction from skid-control surfaces or better drainage.

[Probe: Not stopping fast enough versus not paying attention.]

Now, I am going to leave all of these up here and I will have { NAME } get you to look at each of these one more time and see if you have anything to add about these countermeasures or other ideas you might have to discuss the driving scenarios we talked about today. { NAME } If you could please record the responses of the group, I am going to confer with my client and be right back.

VI. CLOSE [5 Minutes]

Thank you again for taking the time to come out and talk with us this evening. Before you go, I want to let you know that along with your stipend you will be given a take-home survey. Please fill it out and send it into us, while it is all still fresh in your mind. Before closing, are there any additional thoughts you'd like to offer about the topics we discussed? [If not, conclude the session, if so, briefly allow additional thoughts to come forward.] The person at the front desk will give you your stipend for participating tonight.

APPENDIX C. TAKE-HOME SURVEY

Instructions

Please circle the number that best represents your answer to each question. For questions 2 and beyond, please notice the italicized words on either end of the number scale. The numbers and words on each side of the "4" modify these words.

The Scenario

These questions are about the driving situation discussed in the group where the light turns yellow just as you approach an intersection. Specifically, you have enough time to stop if you brake quickly; otherwise, the light is likely to turn red while you are in the intersection unless you speed up quite a bit. For simplicity, we will refer to this situation as going through on a late yellow/early red throughout the survey.

What is your age?_____ **What is your gender?_____**

1) During the last 3 months, how often have you gone through an intersection on a late yellow/early red light?

1	2	3	4	5	6	7
Never	Seldom	Sometimes	About half the time	Most of the time	Almost all of the time	All the time

2) How likely is it that you will go through the intersection the next time you encounter a late yellow/early red light?

Unlikely	1	2	3	4	5	6	7	*Likely*
	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	

3) How dangerous do you think it is to go through an intersection on a late yellow/early red light?

Dangerous	1	2	3	4	5	6	7	*Safe*
	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	

4) How much do you agree with the following statement: Going through an intersection on a late yellow/early red helps you get where you are going faster?

Disagree	1	2	3	4	5	6	7	*Agree*
	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	

5) Can you think of any other benefits or negative results of going through an intersection on a late yellow/early red light?_____

_____

_____

6) Is going through an intersection on a late yellow/early red something you do on purpose, or just something you do out of habit because you always do it that way?

Purposeful	1	2	3	4	5	6	7	*Habitual*
	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	

7) Have you been involved in a traffic crash *at an intersection* in the last:

1	2	3	4
Year	5 Years	Ever	Never

8) How much do you agree with the following statement: Most people who are important to me think that I should stop on yellow lights?

Disagree	1	2	3	4	5	6	7	*Agree*
	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	

9) How much do you agree with the following statement: In general, I want to do what people important to me think I should do?

Disagree	1	2	3	4	5	6	7	*Agree*
	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	

10) How much is your decision to go through the intersection on a late yellow/early red light directly under your control versus something that you don't control because of other factors, such as the length of the yellow light, traffic conditions, slippery roads, other drivers, steep hills, etc.?

Under my control	1	2	3	4	5	6	7	*Not under my control*
	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	

11) **If you said that it is not under your control in question 10, what makes you go through the intersection on a late yellow light?**_____

12) How likely do you think it is that the following will happen if you go through a late yellow light?

Get a traffic ticket for running a red light:

Unlikely	1	2	3	4	5	6	7	*Likely*
	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	

Crash into another car:

Unlikely	1	2	3	4	5	6	7	*Likely*
	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	

Can you think of any other things that might happen if you go through a late yellow/early red light?_____

_____

_____

Thank you for completing the questionnaire.

Please mail it back to the researchers using the postage-paid envelope provided.

APPENDIX D. TABULAR SUMMARY OF THE FOCUS GROUP RESULTS

RESULTS TABLES TERMINOLOGY

For each scenario and countermeasure, the participants discuss a set of questions or themes. Key discussion points and opinions for each of these questions or themes are presented in table format after the text. Tables are organized into three columns containing information about:

1. **Group**: The first column lists the set of respondents (based on age group or geographic location) that predominately held the opinion expressed.

2. **Opinion**: The middle column summarizes the opinion or response.

3. **Strength**: The last column presents an approximation of the proportion of respondents from the indicated group (first column) that shared the opinion.

Group identification

The group column uses the following terms individually or in combination to indicate which set of participants held a particular opinion.

Older	Respondents in the *older* groups from all locations
Middle-aged	Respondents in the *middle-aged* groups from all locations
Young females	Respondents in the *young female* groups from all locations
Young males	Respondents in the *young male* groups from all locations
All	The opinion was generally held by all groups and no sub-set of groups stood out in terms of the number of participants sharing that opinion
Younger	Respondents in *both* the *young male* and *young female* groups from all locations
City name	Respondents from all groups at the indicated focus group location (Washington, DC, Chicago, or Seattle)

Strength Quantification

The strength of opinion was described using the following ordinal scale:

One < Few < Some < About Half < Many < Most < Almost All

These measurements should be taken as a general approximation, and in many cases are based on the focus group moderator's impression of how many focus group participants shared a particular opinion. Where possible, the video recordings were used to generally confirm these magnitudes.

In some instances, more specific measurements are indicated (e.g., 1/3, 1/5, etc.). These measurements are based on more direct measurements, such as hand counting, or by specifically asking each participant.

In a few instances in which the same opinion was shared by different proportions of individuals from each group, the following syntax is used in the Group and Strength columns:

Table 12. Syntax for Group and Strength columns.

Group	Opinion	Strength
Group1 / Group2		Magnitude 1 / Magnitude 2

In this case, which group goes with which magnitude is indicated by the order of the terms relative to the "/" marks. In the example above, Group 1 goes with Magnitude 1, and Group 2 goes with Magnitude 2.

Scenario 1: Red-Light Running

Approaching a signalized intersection at speed, the light turns yellow. The driver is far enough away from the intersection that he/she can stop if he/she brakes hard, but is likely to enter the intersection on an early red if he/she accelerates.

Table 13. What are drivers most likely to do in this situation (scenario 1)?

Group	External Factor	Strength
Older	• Stop at the intersection.	Almost all
Middle-aged	• Go through.	About half
Young female	• Go through.	About half
Young male	• Go through.	Three-quarters
Young male	• Go through, even if the light just turned red instead of yellow.	Some

Table 14. What factors influence driver decisions to stop (scenario 1)?

Group	Factors That Incline Drivers To Stop	Strength
Older	• Stopping is their default strategy.	Most
Older	• They make an automatic assumption that the lead vehicle will stop (even if this is unlikely).	Most
Older	• The longer the light is yellow, the more inclined they are to stop.	Some
Middle-aged	• The possibility of crashing into the lead vehicle if it decides to stop suddenly.	Many
Middle-aged	• If they think that there could be red-light cameras or police in the area.	Some
Young female	• Often use predetermined criteria based on several factors including roadway type (urban/rural), traffic volume, and pedestrian density.	Many
Young female	• If lead vehicle looks like it will stop or turn right.	Many
Young male	• If the lead vehicle looks like it will stop or turn at the last minute.	Many
Young male	• Getting a ticket.	Many
Young male	• Having to speed up too much to get through.	Some
Young male	• Rush-hour synchronized traffic signals because they would just have to wait at the next light if they went through the current one.	Some

Table 15. What factors influence driver decisions to go through (scenario 1)?

Group	Factors That Incline Drivers To Go Through	Strength
Older	• The risk of getting stuck encroaching into the intersection if they cannot stop in time.	Some
Older	• Not wanting to get rear-ended if they did stop.	Many
Middle-aged	• Going through is the default strategy, unless they think that they do not have enough time to get through.	Some
Young female	• Often used predetermined criteria based on several factors including roadway type (urban/rural), traffic volume, and pedestrian density.	Many
Young female	• Being in a rush.	Many
Young female	• Sparse traffic/off hours (evening/early morning).	Some
Young female	• Frustration at traffic volume.	Some
Young female	• If the vehicle behind them is following too closely.	Some
Young male	• If the lead vehicle is going through.	Many
Young male	• If they would otherwise have to slam on their brakes to stop.	Many
Young male	• Being in a rush.	Many
Young male	• Rush-hour synchronized traffic signals because if they miss the current light it will make them miss the timing for the next several lights.	Some

Table 16. What are some additional external factors that influence driver decisions (scenario 1)?

Group	External Factor	Strength
Middle-aged and younger	• Having passengers in their car, especially children.	Many
All	• Type of person driving the car in front or behind them (specifically, whether they appear likely to go or stop on a yellow light).	Some
All	• Age, type, and/or cost of vehicle in front.	Some
All	• Transporting a dog (that is not restrained).	Some

Table 17. Do drivers anticipate and plan a response for a dilemma-zone situation as they approach an intersection, or do they react on the fly to the yellow light and the corresponding driving conditions (scenario 1)?

Group	Response	Strength
Older	• Likely to plan ahead and anticipate a response.	Most
Middle-aged	• Likely to rely on "gut" or instant decision without any prompting.	Most
Younger	• Likely to plan ahead and anticipate a response.	Many
Younger	• Likely to rely on "gut" or instant decision without any prompting.	Some

Table 18. What other information do drivers use when making decisions regarding going through or stopping (scenario 1)?

Group	Other Information	Strength
All	• Pedestrian signal status to anticipate the light change.	Some
Middle-aged and younger	• Familiarity with intersection, specifically if they know it is a long light or has a long yellow phase.	Many
Older	• Lane markings (if they become solid).	One

Table 19. Is going through the light ever a deliberate act (scenario 1)?

Group	Frequency and Reason Why	Strength
Young males	• Sometimes, just to "try to make it" or based on mood (aggressive, frustrated, or rushed).	About half
Young females	• Sometimes, just to "try to make it" or based on mood (aggressive, frustrated, or rushed).	About a quarter
Older	• Sometimes, just to "try to make it" or based on mood (aggressive, frustrated, or rushed).	Few
Middle-aged and younger	• Sometimes, to avoid slamming on the brakes or being rear-ended.	Many

Table 20. Is it ever the case that drivers do not notice the signal until it is too late to do anything but continue through the red? Do drivers ever try to stop in this case (scenario 1)?

Group	Frequency and Reason Why	Strength
Young males	• Rarely—but if distracted, they just go through.	Some
Other than young males	• Rarely—decision to go is based on their assessment of how safe it is to stop.	Some

Table 21. Complicating factors (scenario 1).

Group	Factor	Strength
	Other Vehicles	
All	• They are concerned about oncoming vehicles turning left across their path.	About a quarter
Other than young males	• They are concerned about cross traffic ready to enter the intersection at speed as soon as their light turns green.	Many
	Congestion	
All	• Heavy congestion is a reason for not running lights.	Many
All	• Long delays are a reason for running the light.	Many

Table 21. Complicating factors (scenario 1) (continued).

Group	Factor	Strength
	Weather	
Chicago	• Ice and snow are a reason for caution but also for running the light if it means avoiding skidding or losing control.	Some
Seattle	• Slick oil with rain is a reason for caution but also for running the light if it means avoiding skidding or losing control.	Some
	Poor Visibility	
Older/middle-aged	• Poor visibility at night and in bad weather leads drivers to be more cautious and slow down.	Many/Some
All	• Vision obstructions from trees, buildings, etc., make drivers more cautious.	Many
	Glare	
Older	• Glare from certain types of lights (e.g., halogen) is problematic.	Some
Seattle, WA, younger	• Glare from sun during the day can be problematic.	Some
	Poor Traction	
All	• Poor traction makes drivers more likely to go through the intersection rather than risk skidding or losing control of their vehicle.	Many
	Terrain	
Seattle	• Hills can obstruct their view.	Some
Seattle	• Hills would prompt those driving a stick-shift to go through a light to avoid having to stop uphill.	Some
	Other Factors	
All	• The presence of pedestrians would prompt caution, especially at night when they are harder to see.	Many
Middle-aged and younger	• The presence of red-light cameras or police would prompt drivers to be more cautious.	Some
	• Proximity to school zones leads drivers to use "extreme caution" at intersections.	Some
All	• Their vehicle type and that of the lead driver has different effects based on the vehicle's ease of stopping (e.g., less with SUV), how much it obstructs vision, and how new or expensive it is.	Some

Table 22. What are driver attitudes regarding red-light running (scenario 1)?

Group	Attitude	Strength
All	• Those involved in intersection crashes or near-misses view red-light running as being much more dangerous than other drivers did.	Some
Older	• It is a serious problem and something that too many people do without regard for the consequences.	Most
Middle-aged	• Although they typically run yellow lights and sometimes red lights, they do not view their actions as contributing to the problem of true red-light running—that is something others do.	Many
Younger	• It is more of a monetary than safety issue, with their primary concern to avoid traffic tickets.	Most
Younger	• Avoiding getting a ticket is like a game, which prompts them to avoid intersections where they are more likely to get a ticket.	Many

Table 23. What do drivers believe are the consequences of running red lights (scenario 1)?

Group	Consequence	Strength
All	• Tickets and expensive fines.	About half
All	• Getting into a crash and causing injuries to pedestrians, passengers, themselves, or other drivers.	About half
Middle-aged and young females	• Injuries to passengers.	Some
Older	• Injuries to themselves.	Some
All	• Being “at fault” and liable for any crashes.	Some

Table 24. Do drivers' beliefs about the consequences come into play in their decision process (scenario 1)?

Group	Impacts of Consequences	Strength
All	• The potential for crashes, hitting pedestrians or getting hit by other drivers makes drivers more cautious and causes them to alter their driving.	Many
Older	• They are not influenced by the possibility of getting a ticket.	Most
Middle-aged and younger	• The presence of cameras and police would cause them to slow down and be more careful.	Many
Young males and females	• Getting a ticket had previously produced only a transient improvement of their safety behaviors, and they often adapt by avoiding intersections where they think they might get a ticket while continuing to run red lights at other intersections.	Most
Younger	• They view red-light tickets as simply the cost of driving and would not try to change their behavior.	Few
All	• The possibility of hitting pedestrians and especially children causes them to be more cautious and slow down.	Many
Middle-aged and young females	• The are most concerned about the impact of their actions on the safety of their passengers, especially young children.	
Older	• Concerns about being "at fault" in a potential crash causes them to drive more safely.	Some

Table 25. How does experience with critical events (e.g., crashes, near-misses) impact their decisions, attitudes, beliefs, etc. (scenario 1)?

Group	Impacts of Experience	Strength
All	• Impacts were strong but very situation-specific, with increased caution not generalizing to other situations.	Many
All	• Serious crashes involving family or friends cause them to be more cautious in similar situations.	Some
Older	• They are less likely to see themselves as being "at fault," which makes them less likely to change their behavior.	Some

Table 26. To what extent is red-light running behavior impacted by perceived social norms (scenario 1)?

Group	Impacts of Social Norms	Strength
Older and middle-aged	• They are neither concerned about nor influenced by social norms.	Most
Younger	• They could be influenced by peers to run a red light.	Few
Younger	• They become more cautious and less likely to go through the light if they are driving with their parents.	Many
Middle-aged women	• They become more cautious with their older children in the car because they want to serve as a good role model.	Few

Table 27. To what extent is the act of going through the light under their control (scenario 1)?

Group	Aspects of Perceived Control	Strength
All	• Going through the light is not under their control.	Many
All	• What they perceive to be deliberately short yellow-phase durations makes it beyond their control.	Many
Older	• Other vehicles coming up behind them too quickly make it beyond their control.	Many
Chicago, IL, and Seattle, WA	• Slippery roadway conditions make it beyond their control.	About half
Younger	• They are the most likely to take responsibility for their red-light-running behavior.	Some

Table 28. To what degree, if any, does habit (e.g., "I don't think about it, I just always do it that way") affect whether or not drivers run a red light (scenario 1)?

Group	Impact of Habit	Strength
All	• Going through a red light is viewed as something *not* done simply out of habit.	Almost all

Scenario 2: Left Turns at Busy Intersections

Stopped in the middle of an intersection, waiting to make a left turn on a busy street; an oncoming car is also waiting to turn left and makes it difficult to see other vehicles approaching in the next lane. There is no dedicated turning lane and no dedicated turn signal; cars are waiting behind to also turn left (or go straight).

Table 29. What are drivers most likely to do in this situation (scenario 2)?

Group	Action	Strength
All	• Wait for the light to change to yellow or red to get some protection from oncoming traffic.	About half
Older and middle-aged	• Avoid the left turn altogether by going straight, turning right, or planning a different route.	About half
Young females	• Avoid the left turn altogether by going straight, turning right, or planning a different route.	Some
Young males/ females	• Barge their way into the oncoming lane and force oncoming vehicles to slow.	About 1/4 / Few
All	• Wait for the oncoming vehicle to turn, then go if there is no other oncoming traffic.	

Table 30. What steps do drivers take in making the turns (scenario 2)?

Group	Action	Strength
	Intersection Entry	
All	• Advance directly to the middle of the intersection without hesitation, regardless of how much traffic is coming.	Most
All	• Wait at the stop line until there's no traffic coming, then inch forward.	Few
	Vehicle Positioning Within the Intersection	
Older, middle-aged, and young females	• If they were going to turn, they would inch forward but stay straight in their lane.	Most
Young males	• Position themselves in the lane of opposing traffic or slanted toward opposing traffic (yet protected by the oncoming turning vehicle).	Most
Young females and middle-aged	• Position themselves in the lane of opposing traffic or slanted toward opposing traffic (yet protected by the oncoming turning vehicle).	About a quarter
	Decision to Turn	
All	• They prefer to wait until no traffic is coming and there are no cars in sight.	Most
All	• Look for an acceptable gap in oncoming traffic.	About half
All	• Wait until the light changes yellow or red.	About half
	Acceleration	
All	• Check for pedestrians before initiating the turn.	Almost all
All	• Accelerate quickly to get out of the intersection as soon as possible.	Almost all
All	• They feel uncomfortable when they go because they are concerned that they missed something or misjudged the gap.	Many

Table 31. How do drivers decide (what steps are involved) whether or not a gap in traffic is sufficient (scenario 2)?

Group	Response	Strength
	How Decision Is Made	
All	• It depends on the speed and distance of oncoming traffic.	Most
All	• They watch oncoming cars go by and try to gauge the time it takes to close the distance between themselves and the oncoming cars.	Some
All	• They judge the gaps until they feel comfortable with enough distance to make a move.	Some
All	• It is a "gut" decision.	Some
	Factors That Directly Affect Gap Judgment	
All	• Familiarity with the intersection increases the likelihood that they will accept a smaller gap.	Some
Older/young males	• The presence of passengers makes them more cautious and more willing to wait longer for a safe gap.	Many/ Some

Table 32. What other information or considerations come into play (scenario 2)?

Group	Action	Strength
All	• They take advantage of the oncoming vehicle making its left turn to get a better view of oncoming traffic.	Most
All	• They watch out for oncoming vehicles potentially going straight through from behind the oncoming turning vehicle, even when light is yellow or red.	Some
All	• They look for turn signals in oncoming traffic behind the oncoming turning vehicle to make sure there will be no conflict when they try to turn—however, they do not always trust the signal.	Some

Table 33. What are some of the strategies that drivers use in this situation (scenario 2)?

Group	Action	Strength
All	• They try to make eye contact with oncoming drivers.	Some
All	• They look through the windows of the cars to see if they can get a better view.	Some
All	• They make sure they are out far enough into the intersection so the other cars will see them and have to let them go when the light turns yellow or red.	Some
All	• They get passengers to "spot" for them.	Some

Table 34. Complicating factors (scenario 2).

Group	Factor	Strength
	Other Vehicles	
All	• They do not care about the cars behind them; however, about half still have strategies for addressing following vehicles in one way or another.	About half
All	• They ignore following vehicles that start honking.	About half
Older/young females	• They are concerned about following vehicles and go out of their way to accommodate them (e.g., by moving up far enough so that following vehicles can pull out and go straight).	Many
All	• Oncoming vehicles behind the turning vehicle are a source of concern and lead to extra caution in case they try to get through the intersection in conflict with the driver's vehicle.	Many
	Congestion	
All	• Congestion prompts drivers to go through the light to avoid waiting through another light cycle.	Some
	Pedestrians and Bicyclists	
All	• They always check crosswalks.	Many
Older	• They also watch for skateboarders, roller bladers, and scooters.	Some
Older and middle-aged	• They are concerned about pedestrians and bicyclists not following the rules, and being difficult to see at night.	Few
	Night Driving	
All	• Reduced visibility causes them to be more cautious and willing to wait longer to be sure that it is safe to go through the light.	Many
All	• They are more careful because of the increased number of drunk drivers on the road during this time.	Some
All	• Night driving also has benefits because oncoming vehicle headlamps can be seen from farther away.	Some

Table 34. Complicating factors (scenario 2) (continued).

Group	Factor	Strength
	Glare	
Older	• Glare from oncoming lights at night makes them more cautious.	Some
Younger	• Glare from oncoming lights reduces their ability to judge the speed of the oncoming traffic, sometimes making vehicles appear closer or further away than they actually are.	Some
All	• Having the sun in their eyes causes them to be more conservative in their gap judgments.	Some
	Terrain	
Seattle	• Being on a hill would prompt them to wait for the light to turn red because they are less visible to oncoming traffic.	Some
	Low-Traction Conditions	
All	• They are more cautious in the rain, ice, and snow because oncoming traffic would have a harder time stopping.	Many
Young males in Washington, DC	• They do not think that weather is a factor unless it impacts visibility.	Most
	Vehicle Type	
All	• Turning in this scenario depends on the type vehicle that both you and the oncoming driver are driving.	Many
All	• Drivers of small cars have greater difficulty seeing the roadway (especially if the oncoming vehicle is a large SUV) and therefore have to be more cautious.	Some
All	• Driving powerful cars with quick acceleration would make them more likely to accept smaller gap sizes.	Some
All	• Drivers of large vehicles find this situation easier to deal with because they have a better view of the roadway.	Some

Scenario 3: Turning Left onto a Major Road with Moderate Traffic

A vehicle is stopped on a minor road with a stop sign, waiting to turn left onto a major road (that has no stop sign); a consistent flow of vehicles going at high speeds is crossing in both directions on the major road.

Table 35. What are drivers most likely to do in this situation (scenario 3)?

Group	Action	Strength
All	• Make the turn.	More than half
All, especially older and young females	• Abandon the left turn and make a right turn instead, followed by the necessary adjustments to get back on course.	Less than half

Table 36. What steps do drivers take in completing the action (scenario 3)?

Group	Action	Strength
	Viewing Traffic	
All	• They check for pedestrians and creep forward slightly to get a better view.	Almost all
All	• They do not go any further than the crosswalk until they had a chance to assess the situation and get a sense of the speed and timing of the traffic.	Many
	Gap Judgment	
All	• They alternate between looking in both directions, starting with the right-going direction.	Most
All	• They look at right-going traffic exclusively until there is a safe gap then look towards left-going traffic.	Few
	Strategies for Turning	
All	• If there is a gap on the left but none on the right, they pull out after the first right-going car goes by and wait in the inside right-going lane until there is a sufficient gap in left-going traffic.	Almost half
All	• They pull out into the outside right-going lane so that other cars would have to let them in.	Some
All	• They wait until there are sufficient gaps in both directions.	Almost half
All	• They wait (or hope) for a nearby traffic light to stop traffic in either direction so that they could have a larger gap.	Some
	Making the Turn	
All	• They go into the *outside* left-going lane to avoid the car in the inside left-going lane coming up behind them too quickly.	About half
All	• They wait until they are certain that they could at least get in "clear" past the inside left-going vehicle.	About half
All	• They go into the inside left-going lane and then quickly signal and get over into the outside lane.	Some
All	• They accelerate as quickly as possible to get up to speed with the car in the inside left-going lane.	Some

Table 37. What is the decisionmaking process (scenario 3)?

Group	Action	Strength
	Information-Gathering Strategies	
All	• They alternately look back and forth and judge gaps in both directions, starting with vehicles in the right-going outside lane then the left-going inside lane, spending about equal time on each direction.	Most
All	• They look exclusively at right-going traffic until there is a safe gap, and then look at left-going traffic for a safe gap, and also double-check the gap in right-going traffic before going.	Some
All	• They split up the task by going into the middle of the roadway as an interim step, which allows them to focus on only one direction at a time.	Some
All	• They focus on the car in the inside left-going lane, once they determine that the gaps in both directions are sufficient.	Most
All	• They also focus on the car in the outside left-going lane, either because they want to get out of the way of the left-going inside vehicle or to turn directly into that lane.	Some
	Decisionmaking	
All, but especially young males	• They make a "gut" decision to turn, based on experience and by factoring in speed and distance conditions, in addition to their car's ability to accelerate.	Some
All	• They become less patient as time passes and are more likely to make rash decisions.	Some
All, but especially older and young females	• They think through the decision to turn and are very cautious, factoring in speed and distance conditions, in addition to their car's ability to accelerate.	Some
All	• They assume that other vehicles will slow down to avoid conflicts, but they also often looked for confirmation of that assumption before acting.	Some
All	• They are concerned that crossing traffic might change lanes.	Few

Table 38. How do drivers decide (what steps are involved) whether or not a gap in traffic is sufficient? What factors are relevant (e.g., speeds, distance to cross, weather) (scenario 3)?

Group	Factor	Strength
All	• They identify a safe gap based on speed and distance.	Many
All	• They instinctively know how fast cars typically go, and based on that, they wait for a gap that they feel they can make it into.	Many
Middle-aged	• They look beyond the nearest vehicles for safe gaps farther down the road.	One
All	• They look for larger gaps in left-going traffic because it takes them longer to get there.	Some
All	• Visibility factors, nighttime, glare, and hills affect gap judgments.	Many
All	• Being impatient makes them more likely to make bad judgments about acceptable gap size and the distance of approaching cars.	About 1/5

Table 39. What size gaps are drivers comfortable with (scenario 3)?

Group	Size	Strength
All	• No vehicles in sight.	Few
All	• One-car length.	Few
All	• Somewhere between one-car length and no vehicles in sight.	Most
Young males	• They are generally willing to accept smaller gaps than other drivers.	Many

Table 40. What external factors make the task of deciding when to turn more complicated/difficult or more demanding (scenario 3)?

Group	Factors	Strength
All	• The presence of additional lanes in each direction because drivers have to watch for cars changing lanes.	Many
All	• Obstructions along the curb make it harder to see (e.g., parked cars or vans, buses, buildings, shrubbery), and sometimes force them to inch out further than they are comfortable with.	Many

Table 41. Complicating factors (scenario 3).

Group	Factor	Strength
All	**Other Vehicles** • The presence of other drivers behind them is not a significant factor in this scenario.	Many
All All	**Congestion** • They are willing to wait a relatively long time for a safe gap. • The longer they wait, and the more impatient they become, the more likely they are to make bad judgments about the acceptable size of gaps and the distance of approaching cars.	Many About 1/5
All	**Pedestrians and Bicyclists** • They are more concerned about pedestrians and bicyclists in the crosswalk that they would be turning into than the one right in front of them because drivers feel that it is easy to see them there.	Most
All All	**Night Driving** • They have mixed views about the impacts of nighttime because, while it makes it harder to judge the gap, it is also easier to see oncoming cars from far away. • They feel that twilight is the worst time because other cars are hard to see and they do not often put on their lights.	Most Many
All All	**Glare** • They will wait longer due to headlight glare in the country but not in the city, where glare is not as bad. • If glare from the sun is bad they might not make the turn at all.	Many Some
All All	**Low-Traction Conditions** • They are concerned about slippery conditions, including whether oncoming traffic will be able to stop or slow down. • They are concerned about having problems accelerating, skidding, or “fishtailing” if they make the turn too quickly.	Many Some

Scenario 4: Rear-End Crashes

Approaching an intersection at speed, the car in front stops suddenly when the light changes to yellow; the driver needs to slam on the brakes to avoid a rear-end collision.

Table 42. How many drivers have been involved as the following vehicle in a rear-end crash or had a near-miss at an intersection (scenario 4)?

Group	Number	Strength
All	• They have been involved in crashes or near-misses as both the lead vehicle and the following vehicle.	More than 1/6
All	• They have been involved in a near-miss as either the lead vehicle or the following vehicle.	More than 1/3

It should be noted that although drivers responded with the frequencies presented above when directly asked about their involvement in rear-end crashes/near-misses, a far greater proportion of participants discussed these issues as if they had also encountered these situations.

Table 43. What were the circumstances that caused the incident to happen (scenario 4)?

Group	Circumstance	Strength
	Not Paying Attention	
All	• They admit to not paying close enough attention to the road or car ahead.	Some
Younger	• They have had near-misses or collisions as a result of using a cell phone or playing with the radio.	Many
	Tailgating	
All	• They experienced crashes or near-misses when driving too close to the car in front of them.	Some
	Making Faulty Assumptions About the Traffic Flow	
All	• They have gotten into rear-end collisions as a result of incorrect assumptions made about the traffic flow, such as that a lead vehicle will go through the intersection when it stops instead or by getting cut off by other vehicles.	Some
	Going Too Fast	
All	• They have had rear-end collisions because they did not slow down soon enough after a lead vehicle slowed abruptly.	Some
Middle-aged and younger	• They have had rear-end collisions because they were late and did not sufficiently slow down as they approached the intersection.	Some

Table 44. How closely do respondents typically follow other vehicles? What factors determine how closely drivers follow other vehicles (scenario 4)?

Group	Response	Strength
	How Closely They Follow	
All	• Their chosen following distance is based on rules of thumb, such as the 2-second rule or other heuristics.	Many
Older and young females	• They generally leave "ample" room between themselves and the lead vehicle.	Many
	Deciding Factors	
All	• The distance at which they follow other vehicles depends on the types of vehicles that they and others are driving.	Some
All	• They leave more space when driving an SUV or other vehicle that stops more slowly.	Some
Young males	• They leave more space when driving a new car.	Few
All	• The fact that they will be liable if they rear-end the lead vehicle prompts them to leave more space.	Many

Table 45. What are some strategies for avoiding rear-end conflict situations (scenario 4)?

Group	Action	Strength
	As Following Vehicle	
All	• They hit their brakes as soon as they see any break lights go on in front of them.	Most
All	• They look to see if there are other reasons why the lead car is slowing or stopping (such as the presence of pedestrians or a hazard on the road).	Few
All	• They try to anticipate the situation using a variety of different methods.	Many
All	• They leave more stopping distance in the front of them.	Some
All, but especially older	• They slow down as they approach the intersection.	Some
	As Lead Vehicle	
All	• They look in the rearview mirror at the following car more frequently.	Most
All	• They pump their brakes ahead of time to warn other drivers that they will be stopping soon.	Some

Table 46. How do drivers detect or anticipate when the lead vehicle will slow or stop (scenario 4)?

Group	Action	Strength
All	• They prepare to stop when the light changes and start watching the lead vehicle to see whether it will slow down or speed up to get through the light.	Most
All	• They detect that the car in front of them is stopping because the brake lights capture their attention.	Almost all
Younger	• They sometimes delay their decision to stop (although they will slow down) until they determine whether or not the lead vehicle is going through the intersection.	Many
All	• They use various strategies to anticipate the light change and become more alert or prepare to stop before it does.	Some

Table 47. What are drivers likely to do in response to this situation (scenario 4)?

Group	Action	Strength
All	• They would get into the inside or another lane if possible.	Many
All	• They would go up onto the curb or shoulder if they could not stop on time.	Many
All	• They would already be slowing down as they approached the intersection and would likely be able to stop in time.	Some
All	• They would look behind them to see if they might get rear-ended if they stop too suddenly.	About a quarter

Table 48. Complicating factors (scenario 4).

Group	Factor	Strength
	Lead Vehicle	
All	• They try to gauge how the driver in front of them drives as they go along and try to anticipate how they might behave based on the driver's age and vehicle type.	Some
Younger	• They leave more room if the lead driver appears likely to stop.	Some
All	• They assume that heavier vehicles are likely to go through the light.	Few
	Congestion	
All	• Congestion makes them tailgate more closely during rush hour.	Some
	Poor Visibility	
All	• They do not think that this is a factor because the situation requires attention to their immediate surroundings, which would not be affected by poor visibility.	Some
	Glare	
All	• They leave more space in front of them if glare from the sun makes it hard to see.	Few
	Low-Traction Conditions	
All	• Slippery conditions are not a big factor because they do not think that they have any choice but to try to stop suddenly in this scenario.	Some
All	• They leave more space between themselves and the car in front of them when it was raining.	Few
	Terrain	
All	• They anticipate that it is more difficult to stop while going downhill and start breaking sooner.	Some

COUNTERMEASURES

The following issues were addressed for each countermeasure:

- Would implementing this countermeasure improve safety?
- What are some of the implementation issues?
- What are the advantages and disadvantages of the countermeasure?

Countermeasure 1.1: Red-Light Camera

Table 49. Would implementing this countermeasure improve safety (countermeasure 1.1)?

Group	Opinion	Strength
Washington, DC, and Chicago, IL, older	• They are strongly opposed to red-light cameras and do not feel that they improve safety.	Almost all
Seattle, WA, older	• They think that it is a great safety improvement.	Almost all
Washington, DC, and Chicago, IL, young males	• They think that red-light cameras work and improve safety, based on their direct experience with them or from what they hear or read about them.	Almost all
Seattle, WA, young males	• They are more reluctant to admit that they would improve safety and they did not trust them.	Most
Middle-aged and young females	• They are in favor of the cameras and feel that they help create safer situations since they had changed their own behavior in response to the cameras.	About half

Table 50. What are some of the implementation issues (countermeasure 1.1)?

Group	Issue	Strength
All	• For cameras to be effective, drivers would need to be educated about them by either posting signs where they are located or through public service announcement campaigns.	Many
All	• Cameras should only be placed at dangerous intersections or places where many people run red lights.	Some
All	• Cameras would be ineffective with habitual red-light runners or drunk drivers because these drivers blatantly disregard the law and would probably disregard the cameras as well.	Many
All	• They have mixed views on the effectiveness of periodically changing the camera locations.	Many
All	• Cameras might be susceptible to vandalism if they are positioned within reach of the ground.	Few

Table 51. What are some of the advantages and disadvantages (countermeasure 1.1)?

Group	Issue	Strength
	Advantages	
All	• Safety is the primary advantage noted.	Many
All	• Cameras would free up police officers for other activities.	Some
	Disadvantages	
All	• They do not trust cameras to work properly or as described (that they only take a picture of a driver entering the intersection after the light has turned red).	Most
All	• Drivers believe that the yellow-phase duration is timed for maximizing revenue, not safety or traffic flow.	Many
All	• Cameras give the impression that "big brother" is watching you.	Many
All	• If they are wrongly accused, they would be unable to contest it because the photo provides indisputable evidence.	Some
Older	• Younger respondents would benefit and learn more from the effect of being pulled over by actual police officers versus just getting a ticket in the mail.	Many
All	• Cameras could cause more rear-end collisions because people might slam on their brakes if they saw a camera or a flash.	Many
All	• Cameras could slow traffic flow.	Some
All	• There is a possibility of wrongfully getting a ticket if someone else is driving your car.	Some

Table 52. What would it take to make red-light cameras acceptable (countermeasure 1.1)?

Group	Issue	Strength
All	• Fairness is critical—those turning left in the middle of intersections when the light turns red and those making right turns on a red should not get tickets.	Many
All	• Cameras are fine if their goal is to improve safety, but not to raise money, which is what they believe is currently the primary purpose of cameras.	Some
All	• A "three strikes, and you're out program" for drivers that are unfamiliar with the cameras.	Some
All	• It would be helpful if the camera picture could identify the driver so that the vehicle owners could determine if the ticket was the result of someone else driving their vehicle.	Some
All	• There should be a way to contest the ticket because of extenuating circumstances (e.g., slippery roads), which are not adequately captured in the camera picture.	Few
All	• Cameras would be more acceptable in high-priority locations such as intersections near schools.	Few

Countermeasure 1.2: High-Visibility Traffic Lights

Table 53. Would implementing this countermeasure improve safety (countermeasure 1.2)?

Group	Opinion	Strength
Older	• It would be a welcome help to these drivers in addition to being effective for improving safety in general.	Most
Young males	• It would not help since lack of conspicuity was not the reason they go through red lights.	Most
Middle-aged and young females	• It might be helpful.	About half
Middle-aged and young females	• It would not apply to them.	About half

Table 54. What are some of the implementation issues (countermeasure 1.2)?

Group	Issue	Strength
All	• This would work best in suburban or rural areas because it might otherwise get lost in all of the other downtown lights.	Many
All	• It might help in the midst of the other downtown lights.	Few
All	• This would be good at high-crash intersections, but not at all intersections.	Some
All	• This might not be useful when the light was blocked by an SUV or a big truck; increasing the overall number of traffic lights (e.g., in different positions) might be more effective.	Some
All	• There is some concern about the visibility of the yellow light next to the bright yellow background.	Some

Table 55. What are some of the advantages and disadvantages (countermeasure 1.2)?

Group	Issue	Strength
	Advantages	
All	• Safety is the primary advantage noted.	Many
	Disadvantages	
Middle-aged and young males	• The double red might be confusing and seemed expensive.	Some

Countermeasure 1.3: Advance Traffic Light Warning Signs

Table 56. Would implementing this countermeasure improve safety (countermeasure 1.3)?

Group	Opinion	Strength
Middle-aged and younger	• It would be effective overall.	About 1/3
Older	• It would be helpful and improve safety in most situations, especially in high-speed areas.	Almost all
Middle-aged and younger	• It would not be effective because of lack of trust in the accuracy of the warning's timing.	Some

Table 57. What are some of the implementation issues (countermeasure 1.3)?

Group	Issue	Strength
Middle-aged and younger	• Drivers do not trust the sign to accurately take into account their actual travel speeds.	Some
Middle-aged and younger	• Drivers might not see it or might confuse it with other signage (e.g., construction signs).	Some
Middle-aged and younger	• Drivers might ignore the sign once they get used to it.	Some
All	• It would be more effective in rural and suburban areas or on roads where the speed limit is above 56 km/h (35 mi/h).	Almost all
All	• It would be helpful in areas of low visibility, on curves and hills, and in fog or other bad weather.	Some

Table 58. Advantages and disadvantages (countermeasure 1.3).

Group	Issue	Strength
	Advantages	
All	• Safety is the primary advantage noted.	Many
	Disadvantages	
Young males	• Some drivers might actually speed up in response to the warning if they felt they were close enough to go through the intersection before the light changed.	Some
All	• It might give drivers a false sense of security, be distracting/confusing, or be hard to see by the side of the road.	Few

Countermeasure 1.4: Intersection Collision-Warning Systems

Table 59. Would implementing this countermeasure improve safety (countermeasure 1.4)?

Group	Opinion	Strength
Washington, DC	• They think it would work.	About 3/4
Chicago, IL, and Seattle, WA	• They are receptive to the basic idea.	About half
All	• They think that drivers would definitely stop if they saw this.	Many

Table 60. What are some of the implementation issues (countermeasure 1.4)?

Group	Issue	Strength
All	• It has potential in a different form but is "too much" in its current implementation.	Some
All	• Having fewer lights or eliminating the lights embedded in the pavement would be an improvement.	Many
All	• Placing the warning lights before intersections, adding sounds, or using yellow lights might make it more effective.	Some
All	• It would require a big campaign to let everyone know what it is and what drivers should do when they see it.	Some
All	• There would be skepticism over whether the technology actually works and if it would provide an early enough warning to stop in time.	Some
All	• It might be confusing to drivers and they may not know what to do.	Some

Table 61. Advantages and disadvantages (countermeasure 1.4).

Group	Issue	Strength
	Advantages	
All	• Safety is the primary advantage noted.	Many
	Disadvantages	
All	• The signals and flashing lights might "freak out" certain drivers and actually cause more crashes if they stopped short.	Many
All	• They are concerned that so much taxpayer money would be spent addressing the actions of irresponsible drivers and lawbreakers—even if it was to protect others.	Many
All	• This solves the wrong problem and does not address the drivers that would go through the light.	Few
All	• It might make some drivers lazy and more likely to depend on these to look out for them.	Some

Table 62. How does this system compare to an in-vehicle warning system (countermeasure 1.4)?

Group	Issue	Strength
All	• Drivers are less receptive to the idea of having the warning system in their automobiles.	Most
All	• Unlike seatbelts, this countermeasure would not be useful unless everybody has one.	Most
All	• This system would have the same impact in terms of startling some drivers, but at least with the infrastructure-based system, drivers would have a clear indication of why the lights are flashing.	Most
All	• It would increase the costs of their car.	Few
All	• It would be less effective because it might not warn the red-light runner, as is the case with the intersection-based system.	Few
Older	• There should be sound in addition to lights.	Few

Countermeasure 2.1: Protected left-turn lights

Table 63. Would implementing this countermeasure improve safety (countermeasure 2.1)?

Group	Opinion	Strength
All	• These are very effective at improving safety, and drivers would like to see them at all busy intersections.	Almost All

Table 64. What are some of the implementation issues (countermeasure 2.1)?

Group	Issue	Strength
All	• They sometimes have problems if the traffic signal has both a green light and a green arrow at the same time.	Few
All	• The light could be improved by including a sensor that only activates the turn arrow when someone is in the turning lane.	Few
All	• Stopping pedestrians from crossing when drivers had the green arrow would be an improvement.	Few

Countermeasure 3.1: Automatic gap detection

Table 65. Would implementing this countermeasure improve safety (countermeasure 3.1)?

Group	Opinion	Strength
All	• This is a good idea and would improve safety.	About 1/3
Chicago, IL, young females	• It would be helpful and it makes sense.	Almost all
All	• Drivers are concerned about how trustworthy the system is and would prefer to judge gap safety "with their own eyes."	Many
All	• They would prefer other countermeasures, such as traffic light, traffic island, or "suicide" lane.	Some

Table 66. What are some of the implementation issues (countermeasure 3.1)?

Group	Issue	Strength
All	• This approach would be most effective if it only addressed the oncoming traffic from the right and would be confusing if it addressed both directions.	About half
All	• They are concerned that the timing would not work.	Many
All	• They are uncertain if it takes into account different weather conditions and how fast their car can accelerate.	Some
All	• The system should be designed to accommodate the lowest common denominator.	Some
All	• The warning should be accompanied by a continuous or contingent blinking light indicator on the crossing road so that oncoming traffic would be notified that someone might be turning in front of them.	Few
All	• The warning signal should blink when it is safe to turn instead of when it is unsafe.	Few
All	• The sign would be too difficult to read because the text is too small or too verbose.	Few
All	• The flashing yellow is confusing, and drivers might not understand it.	Some

Table 67. What are some of the advantages and disadvantages (countermeasure 3.1)?

Group	Issue	Strength
	Advantages	
All	• Safety is the primary advantage noted.	Many
	Disadvantages	
All	• Drivers might get lazy or dependent upon the sign and not check the actual gap properly.	Some
All	• There is no need for it, or drivers are likely to ignore it in favor of their own judgments.	Some

Table 68. Gap advisory system (countermeasure 3.1).

Group	Issue	Strength
Washington, DC	• They are receptive to the idea and think that it would be helpful.	Many
Chicago, IL, and Seattle	• They think that it would not help or make a difference to drivers.	Almost All

Countermeasure 3.2: Synchronized Adjacent Traffic Signals

Table 69. Would implementing this countermeasure improve safety (countermeasure 3.2)?

Group	Opinion	Strength
All	• It is an effective approach and will improve safety at the intersection.	About 3/4
All	• It would be more effective than automated gap detection.	Many

Table 70. What are some of the implementation issues (countermeasure 3.2)?

Group	Issue	Strength
All	• It would be even better if sensors judged when it was needed so the traffic wouldn't get needlessly backed up or stopped.	Many

Table 71. What are some of the advantages and disadvantages (countermeasure 3.2)?

Group	Issue	Strength
All	**Advantages** • Safety is the primary advantage noted.	Many
All	**Disadvantages** • Drivers would still have to be aware of people turning on red lights at the adjacent intersections or coming from driveways and other side streets.	Few

Countermeasure 4.1: Intersection Rumble Strips

Table 72. Would implementing this countermeasure improve safety (countermeasure 4.1)?

Group	Opinion	Strength
All	• This is an effective countermeasure and it would improve safety.	About half
All	• This is not an effective countermeasure because the potential problems outweigh the benefits (see below).	About half
All	• It would help drivers refocus their attention on the road and on the intersection ahead.	Many
All	• It does not address the situation because fatigue and distraction are not the primary problems.	Some

Table 73. What are some of the implementation issues (countermeasure 4.1)?

Group	Issue	Strength
All	• It would not be necessary at every intersection, but helpful at dangerous intersections.	Many
All	• Drivers would get use to them, and they would lose their effectiveness if they were at every intersection.	Most
All	• Rumble strips are better suited for the sides of highways and the approaches to toll booths because they are more frequently encountered in those situations.	Some
All	• It might make people slow down, which they should not always do in intersections, especially when the light is green.	Some
All	• It implicitly sends the message to drivers that it is acceptable to be distracted.	Few

Table 74. What are some of the advantages and disadvantages (countermeasure 4.1)?

Group	Issue	Strength
	Advantages	
All	• Safety is the primary advantage noted.	Many
	Disadvantages	
All	• It would be very annoying because the rumble strips are loud and would rattle their cars or make them think they have a flat tire.	Many
All	• It will cause additional wear and tear on their cars and tires.	Some

Countermeasure 4.2: Improved Skid Resistance

Table 75. Would implementing this countermeasure improve safety (countermeasure 4.2)?

Group	Opinion	Strength
All	• It would be effective and would improve safety.	Most
All except Washington, DC, older	• It is preferable to rumble strips, and it would be more effective in improving safety than rumble strips.	Most
All	• A combination of intersection rumble strips and improved skid resistance would be the most effective implementation.	Many

Table 76. What are some of the implementation issues (countermeasure 4.2)?

Group	Issue	Strength
All	• It would be important that this countermeasure be consistently implemented so that drivers could tell when it is present in case they must rely on it.	Few
All	• It should not be at every intersection, only at dangerous ones.	Many
All	• The skid-resistant treatment would have to start back far enough so that it would be available for all the drivers that need to stop—otherwise, lead vehicles on the treatment would stop more quickly than following vehicles not on the treatment, making rear-end collisions more likely.	Some

Table 77. What are some of the advantages and disadvantages (countermeasure 4.2)?

Group	Issue	Strength
	Advantages	
All	• Safety is the primary advantage noted.	Many
All	• It would work well on snow and ice.	Some
	Disadvantages	
All	• Drivers might come to rely on it, which might falsely shorten their perception of what their reaction time is.	Few

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