Interim Report

Consumer Acceptance of Automotive Crash Avoidance Devices

A report of qualitative research

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Table of contents

Page

EXECUTIVE SUMMARY 1

Objectives and method 1

Safety counts in new vehicle purchase decisions, but it's generally not a *primary* consideration 3

General reactions to the new safety concepts were positive 4

"Crash avoidance systems" were viewed favorably 6

Personal experience motivated positive reactions to drowsy driver detection 7

The appeal of adaptive cruise control is more limited 7

For older drivers, "vision enhancement" was a big hit 8

CHAPTER 1. THE NATURE OF THIS RESEARCH 11

Introduction 11

The objectives of this initial phase of the project 13

The crash countermeasures explored in the focus groups 16

An overview of the structure of the focus groups 17

CHAPTER 2. PARTICIPANT RESPONSES 21

People agree about stressful driving situations 21

Most people do some "research" before new vehicle decisions 21

Driving experiences are generally not a *primary* factor in the purchase decisions 23

While some find "option shopping" a chore, safety options are a priority 23

Some observations about the new crash avoidance technologies *in general* 25

People were concerned about the implementation details 25

Respondents perceive that it isn't clear that these concepts will necessarily produce reduced collision or injury rates 26

Older drivers may be an important "lead adopter" group 28

Women constitute another important market segment 29

The presentation format of the concept descriptions matters, but not much 31

Crash avoidance systems were viewed favorably 32

Personal experience motivated positive reactions to drowsy driver detection 33

The appeal of adaptive cruise control is more limited 34

Vision enhancement was a hit with the older drivers 36

Explaining the intersection assistance concept proved problematic 37

Table of contents

Page

APPENDIX A. METHODOLOGICAL DETAILS OF THE FOCUS GROUPS 40

The location and composition of the groups 40

Concept descriptions.....41

Crash Avoidance System.....41

Drowsy Driver Detection 42

Vision Enhancement Package.....42

Adaptive Cruise Control.....42

Intersection Assistance Option 42

Concept description formats.....43

APPENDIX B. PARTICIPANT RESPONSES FOLLOWING THE DISCUSSIONS.....49

Executive summary

Objectives and method

This report summarizes the lessons drawn from a series of eight focus groups carried out in July and August, 1997. The groups were conducted as part of a larger project, undertaken on behalf of the *USDoT Intelligent Transportation Systems Joint Program Office*, to appraise the potential customer acceptance for key ITS products and services directed at individual consumers.

This particular component of the study was undertaken with the funding and participation of the USDoT's *National Highway Traffic Safety Administration* (NHTSA), and was concerned exclusively with in-vehicle crash avoidance technologies. We studied the following safety problems and the ITS countermeasures under development to address those problems

- Rear object crashes (back-up warning devices);
- Run-off-the-road crashes (application of lane trackers);
- Lane change/merge crashes (application of side object detection systems);
- Rear-end crashes (application of front-object detection systems);
- Drowsy drivers (application of driver monitoring systems);
- Vision under degraded conditions, such as darkness, poor weather, or glare (vision enhancement systems);
- Intersection crashes; *and*
- Adaptive ("intelligent") cruise control.

Almost all of the product concepts explored in the focus groups were "safety services" identified in the federal government's *Intelligent Vehicle Initiative* (IVI).

The focus groups had two principal objectives:

- To improve our understanding of the initial reactions of new vehicle purchasers to these crash avoidance product concepts; *and*
- To help develop improved content and methods for a proposed subsequent *quantitative* survey of new vehicle purchasers.

Executive summary

There are four primary research questions that this overall project – the focus groups and the anticipated quantitative survey – is seeking to answer:

- Is there a relationship between respondents' personal exposure to critical incidents – such as crashes or near misses – and their interest in purchasing in-vehicle safety-related products in general, and crash avoidance countermeasures in particular?
- What types of information (content? mode of presentation? timing?) might most effectively influence positively the car buyers' safety product purchase decisions?
- What is the importance to new vehicle purchasers of safety options relative to other (convenience and comfort) features?
- What *basic* design and implementation guidance about countermeasures emerges from discussions with potential consumers?

Eight discussion groups were conducted, using a variety of different criteria for respondent selection. Two groups were conducted in each of four locations, chosen to reflect various climatological, demographic, and (possibly) attitudinal differences. All respondents had, within the previous two years, participated significantly in decisions about the purchase or lease of a new vehicle, and the composition of the groups was stratified by other potentially influential factors:

- Two groups were made up exclusively of "*older drivers*," aged 65 or older [*Fort Lauderdale* and *St. Louis*].
- One group was of *women* only [*St. Louis*].
- One group was restricted to people who had acquired new "*high-end vehicles*," with a cost of at least $35,000 [*Los Angeles*].
- Two groups [in the *Boston* area] were stratified by whether the respondents did mostly *urban* or *suburban/rural* driving; *and*
- The remaining two groups were not stratified but drawn from the general population [*Fort Lauderdale* and *Los Angeles*].

Each focus group discussed *three* of the new concepts.[1] Each concept was communicated using a printed explanation, which (in most groups) was made to

[1] The "intersection assistance option" (warning of potential crashes at problem intersections) was discussed in only one (Boston) group. The "vision enhancement package" was discussed

appear as an extract from a consumer-oriented publication intended for new vehicle purchasers. After reading aloud the explanation (with participants following on their own copy), the moderator first offered to clarify any unclear words or phrases and then asked respondents to write down their answers to a few simple opinion questions. When the immediate *individual* responses to the concept had been recorded in this way, the group discussed their understanding of the idea, what they liked, and what they disliked.

Focus groups, like other qualitative market research methods, are inherently limited in the nature of the information they generate, and the substantive findings should be regarded as *indicative* rather than authoritative. There's no guarantee that the opinions expressed in the discussions are quantitatively representative of the viewpoints of larger populations. And the participant responses are solely their *first impressions* immediately after learning about product category concepts that are largely outside their personal experience. These opinions could change markedly – either positively or negatively – after significant "hands on" experience in using the product over a period of time, or if market penetration were to reach a critical mass. However, in many new vehicle purchases, people might or would be exposed to such products for the first time.

Safety counts in new vehicle purchase decisions, but it's generally not a *primary* consideration

Most people do some research before purchasing a new household vehicle, but the methods and sources for this research are primarily those involving a relatively low level of effort. The most frequently mentioned influences on the choice of vehicle (and optional features) were

- prior personal experience with the make or model, or word-of-mouth recommendations from family or friends (this despite the industry's conventional wisdom that an interest in variety discourages repeat buying);
- dealership visits, to see (and test drive) vehicles of interest, check sticker prices, talk with salespeople, and pick up promotional literature; *and*

only in the two groups of older drivers. All other concepts were each discussed in at least five of the groups.

- consumer-oriented publications, of which *Consumer Reports* was the one familiar to most people.

We were interested whether the respondents' experience of "uncomfortable" or "stressful" driving situations played a major role in deciding what type or model of vehicle to buy. There was a good deal of consensus on what made for stressful driving: primarily bad weather, heavy traffic and congestion, and reckless or inconsiderate drivers. A minority of people worried about night driving or certain maneuvers (lane changing, cross-traffic turns, etc.), and older drivers often volunteered awareness of declining visual powers.

But except in a few cases, such considerations do not appear to rank high among the factors influencing choice of vehicle or optional features. People *are* interested strongly in vehicle safety records and safety features, but this interest isn't associated in their minds with specific driving problems or with doing a lot of homework on safety options or crash test records *per se*. Rather, they expect safety considerations to be incorporated into the reviews and recommendations of the consumer publications that they consult. And recent highly visible controversies about air bag-related injuries and ABS effectiveness have left a few people ambivalent or negative about specific safety features.

New vehicle buyers vary in the level of interest they invest in selecting optional features. There could well be demographic or socioeconomic differences in this regard, but only one was suggested strongly by the discussions: older drivers, even those with quite modest incomes, appear to be attracted by "top of the line" and "fully loaded" vehicles.

General reactions to the new safety concepts were positive, particularly among older drivers

With the exception of the "intersection assistance option" – which was not understood well, primarily because of some vagueness at this stage of development about where and how it might work – all of the other concepts were well received in general. In each group there were usually several people excited and enthusiastic about the concepts, with only one or two feeling slightly or strongly negative.

Older drivers were particularly enthusiastic. Many volunteered that they were aware of their declining driving skills (particularly vision). They are more sensitive than younger people to issues of personal safety and security. These factors, combined with the increasing numbers of older drivers and their propensity for buying "fully equipped" vehicles, have led us to suggest that older drivers may form an important "lead adopter" group for these new technologies.

Consistent with evidence from other sources, women seemed somewhat more concerned about safety matters than the men, and more willing to admit to personal vulnerability. At the same time, they appeared to be more skeptical of the new technology than were the men. Women also expressed more *parental* concerns than did the men.

Notwithstanding their generally positive reactions to the concepts, respondents made it clear that they have doubts whether adoption of these good ideas will unambiguously lead to net societal benefits. Recent media treatment of air bag and ABS controversies was always raised. Or the manufacturers might not get the design details right, and as a result it is possible that driving might be impaired in some circumstances. In each of the groups, someone invariably wondered whether some drivers might become more reckless because of an added feeling of safety. Relatedly, the parents of teenagers were torn: these concepts would make it safer for their children to drive, but might over-reliance on such technologies lead to their acquiring poorer "manual" driving skills?

Warning mechanisms and system integration may be critical to consumer acceptance

The focus group participants were told to ignore monetary cost considerations at this stage ("*assume that it's available at a price level that's quite acceptable to you*"). Similarly, we tried to focus on the *main features* of each concept rather than on implementation *details* such as the precise nature of warning signals ("*The . . . warnings used have been chosen to be effective for the majority of drivers . . .*"). But it was apparent that for a significant portion of the respondents, the acceptability of a concept might hinge on how well such details were implemented. What would the warning be? Would it be distracting, alarming, or noticeable in a noisy car? Would its meaning be unambiguous?

These sorts of concerns were particularly noticeable for our one integrated product concept – the "crash avoidance system" which combined some mix of front, rear, and side object detection systems, along with lane tracking. Participants worried whether warnings provided by the countermeasures might amount to "too many lights and sounds," particularly when combined with all of the other instruments in the vehicle. Some people thought these factors might make them *less* aware of exactly what was happening, slowing their reaction times or even reducing their ability to react altogether. It was apparent that the *integration* of various separate warning systems into a user interface that presents a clear and unambiguous message to a (possibly stressed) driver is obviously a critical element of consumer acceptance.

"Crash avoidance systems" were viewed favorably

Consistent with the *Intelligent Vehicle Initiative*'s emphasis on an integrated, user-friendly system, we packaged several different crash warning technologies into what was described to respondents as a "*crash avoidance system*," or CAS. This would warn the driver of impending collisions (with other vehicles, with pedestrians, or with objects) when backing up, changing lanes, merging, or when approaching a stopped or slowly moving vehicle, and it would trigger an alert if the vehicle appears to be running off the road. It was made clear that different CAS packages (comprising different combinations of front, rear, and side detection, and lane tracking) might be available for different vehicles.

This family of countermeasures appeared to be easily understood, and quite believable without needing any detailed explanation of the various technologies involved. Participants could relate the product capabilities to their own driving experiences. Their main concerns about the collision avoidance concept related to the nature of the warning signals (particularly where it would be necessary to distinguish clearly and quickly between different types of possible crash) and the reliability of the system.

Rear object (back-up) detection was the most popular CAS function, particularly among older drivers who saw its greatest usefulness in busy parking lots. Side object (and "blind spot") detection was the next most popular. Less important – but still positively endorsed by the respondents – were front collision detection and run-off-the-road warning.

Personal experience motivated positive reactions to drowsy driver detection

Many focus group participants had at some time felt drowsy behind the wheel, and some had personal associations with crashes caused by driver drowsiness. Drowsy driver warning systems consequently were well received by the respondents, and particularly by the older ones. Such systems were felt to be particularly valuable for night driving and for long trips.

However, people had a lot of questions about how such systems would work and, consequently, how reliable they would be. Would it be necessary to wear something (if so, that was seen as a negative aspect)? Would ocular-based detectors work with glasses, contact lenses, or dark sunglasses? How about different sized drivers? And might there be a lot of false alarms? In summary, most people were favorably or enthusiastically disposed to the *idea*, but somewhat skeptical about whether in practice it would work as advertised.

The appeal of adaptive cruise control is more limited

Of the concepts explored in five or more focus groups, adaptive cruise control was the one that received least enthusiasm. First, a significant fraction of respondents never or rarely use the conventional cruise control on their vehicles, and for some of them this reluctance derived from a measure of nervousness about "surrendering control." This was the only concept discussed that involved system *control* of vehicle functions, not just a *warning*.

Particular concerns related to how *effective* the necessary sensing and control functions would be, and how *smoothly* and *predictably* the vehicle might respond to (say) lane weavers or sudden stops by the vehicle in front. The uncertainty about when it would be necessary or advisable for the driver to brake was one of most troubling aspects of the concept.

Adaptive cruise control was thought to be of greatest value in the same types of situations for which participants were currently using their conventional cruise controls: long trips, or driving at night.

Research among neophyte consumers like these will be important to the market success of ACC

The doubts and concerns about adaptive cruise control contrast somewhat with the reports of favorable user reactions among people who have had an opportunity to drive ACC-equipped vehicles for several days. It suggests that "hands on" experience may allay some of the initial fears fairly quickly.

So the marketing and public information challenge will be to present the product to consumers in a way that *bridges the gap* between the initial lukewarm reactions to the abstract concept and the more enthusiastic reactions after a few days' use. The evidence from our research – both these focus groups and the anticipated follow-on survey – should more closely simulate the reactions of the uninformed consumer entering the dealer's showroom than will the opinions of people after they have been chosen to test out the technology for a week or two. Given the tendency to unenthusiastic first reactions, obtaining insights that can help in developing appropriate marketing and educational themes and strategies is a very important objective of this continuing research.

For older drivers, "vision enhancement" was a big hit

The "vision enhancement package" – comprising primarily lighting and windshield improvements – was discussed only with the two stratified groups of older drivers. These groups had earlier identified declining visual powers as a cause of stressful driving, and so this concept met an acknowledged need. It was thought to be particularly valuable at night, in bad weather, and in daytime glare.

The basic vision enhancement description, used with the Fort Lauderdale group, spoke only of windshield improvements and enhanced headlights. These were easily understood, and credible. There was a small amount of concern whether there might be any potential interference with vision under normal (as distinct from particularly taxing) driving conditions.

With the St. Louis group, the concept description was expanded to mention infrared sensors and a heads-up display superimposing the infrared images over the direct view through the windshield. With this enhancement, the technological aspects became significantly harder to understand or visualize, and this increased

the concerns and dampened the enthusiasm. Nonetheless, all but two of the St. Louis respondents indicated an interest in having vision enhancement on their next new vehicle, were it available.

Executive summary

1
The nature of this research

Introduction

The work described in this report was conducted as part of a larger study, sponsored by the US Department of Transportation's Intelligent Transportation Systems Joint Program Office (JPO), concerning user acceptance for ITS consumer products and services. The study is being conducted by Charles River Associates Incorporated and subcontract firms, and directed and managed by Jane Lappin and John O'Donnell of USDoT's Volpe National Transportation Systems Center.

Certain safety devices and systems in private vehicles constitute an important set of ITS "consumer products." This report concerns several such devices (or "crash avoidance countermeasures") that are currently in various stages of development and testing. The work was conducted with funding and active participation from USDoT's National Highway Transportation Safety Administration (NHTSA).

The safety problems under study in this research, and the ITS countermeasures under development to address those problems, are the following:[1]

- Rear object crashes (back-up warning devices);
- Run-off-the-road crashes (application of lane trackers);
- Lane change/merge crashes (application of side object detection systems);
- Rear-end crashes (application of front-object detection systems);
- Drowsy drivers (application of driver monitoring systems);
- Vision under degraded conditions, such as darkness, poor weather, or glare (vision enhancement systems);
- Intersection crashes; *and*
- Adaptive ("intelligent") cruise control.

It is the intention of the JPO and NHTSA to explore consumer interest in acquiring and using such devices, particularly as OEM-installed options in the context of new vehicle purchase decisions. The phase of the project reported here represents

[1] These concepts are described in more detail later in the chapter. Most of the concepts have recently been identified as driver assistance "services" targeted for development, integration, and promotion as part of USDoT's *Intelligent Vehicle Initiative* (IVI).

qualitative research undertaken as the initial step towards designing at least one subsequent *quantitative* survey of new vehicle purchasers.

There are several reasons why the National Highway Traffic Safety Administration wishes to learn about potential user reactions to in-vehicle ITS safety devices prior to several of them being available for field testing by members of the general public. The agency's role includes "helping with the information consumers need to make good safety choices when choosing a new car."[2] Consequently, there is a strong interest in better understanding the potential reactions of new car purchasers to innovative in-vehicle safety devices, and also the purchaser thinking that underlies related decisions *currently* being made in choosing new cars and optional equipment. Obtaining insights into consumer *perceptions* of the relative risks of various types of collisions can help prioritize the government's research and regulatory programs. These insights should also indicate the possible demand-side barriers to the widespread or rapid adoption of safety improvements in new vehicles.

The technologies and products covered in this research are in various stages of development, testing, and transition from the test track to the marketplace. This transition is a particularly critical stage for auto safety-related products. There is a risk that a new product may be a significant factor involved in future crashes, perhaps because the manufacturer has an inadequate understanding of how the product will perform (technically) when stressed, or of how the multiplicity of different consumers will actually behave when using it. If the early deployment experiences are bad because the product was brought to market prematurely, it is likely that consumers will steer clear of the product for a long time (even despite correction of the deficiencies), and continued product research and development will be cut back. This is the risk of releasing such products before developing a full understanding of (among other things) relevant consumer attitudes, interests, and perceived needs.

There are four primary research questions that this overall project – the focus groups together with the anticipated quantitative survey – is seeking to answer:

- Is there a relationship between respondents' driving experience (and knowledge of others') – in terms of the frequency and severity of their

[2] NHTSA Administrator Dr. Ricardo Martinez, May 14, 1997.

exposure to critical incidents such as crashes or near misses – and their interest in purchasing specific categories of auto safety-related products in general, and crash avoidance countermeasures in particular?

- What types of information (and method of presentation) should be presented at the time of the car purchase decision (for example, in the dealership showroom) to influence positively the car buyers' safety product purchase decisions?
- What is the importance to new vehicle purchasers of safety options relative to other convenience and comfort features?
- What *basic* design and implementation guidance about countermeasures emerges from discussions with potential consumers?

The work reported here involved a series of eight *focus groups*, conducted both with samples of the "general public" and with groups stratified to focus on market segments of particular interest (such as the elderly, women, and heavy travelers).

The objectives of this initial phase of the project

Market research concerning new products that differ in significant ways from any product already on the market inevitably presents significant challenges. Product concepts often need to be presented to respondents in verbal or visual images, which may differ significantly from the actual hands-on *experience* of using the product. No matter how good the product sounds "on paper," there is always the possibility that there may be something about it, or about the way it must be used, that significant numbers of consumers may find unacceptable in practice. Or, indeed, the opposite may prove true.

For this reason, "concept research" will always remain inferior to *test marketing* or *operational tests* of the new ideas – engaging consumers in a direct, first-hand experience of using the new product – as a means of obtaining reliable indications of long-run customer acceptance. Nonetheless, there are many situations where potential user input is necessary and valuable before the concepts have reached a stage in their development that they are available for ordinary consumers to test them out.

Qualitative research – talking with a relatively small number of people in considerable depth as distinct from counting simplified responses from larger, more

representative samples of the general population – is a necessary first step towards understanding public reactions to new product concepts that differ significantly from anything now available in the marketplace. Such research typically serves two types of purposes, *substantive* and *methodological*.

From the *substantive* viewpoint, qualitative research is typically used to gain a basic understanding of the existing behaviors and attitudes that will help shape consumers' interest in learning about, considering, and possibly purchasing the new product. It often helps to form (or refine) working hypotheses about those behaviors and attitudes and how they are likely to influence the acceptability of the product. It can also help generate hypotheses about key market segmentation variables. Such hypotheses may be tested, in a more statistically defensible manner, in subsequent quantitative research, using samples that are considerably more representative (by virtue of both their design and larger size) of the target populations.

Some of the questions being addressed by this research – for example, the relationship between past driving experiences and level of interest in crash countermeasures – are less issues for the qualitative phase of the work than they are for the quantitative survey. Nonetheless, qualitative work may still expose attitudes and sensitivities that will be important to bear in mind while shaping the survey questions.

From a *methodological* viewpoint, the qualitative work often has several objectives:

- The development of appropriate *methods of communicating product concepts* to survey respondents. "Appropriate" here implies finding a balance among several considerations:
  - conveying clearly the full function and potential of the concept;[3]
  - simulating, to the extent possible, the context of the new vehicle purchase process, while minimizing the likelihood of response biases; *and*

[3] Note that several of the product concepts under consideration here are (like airbags) akin to buying insurance or peace-of-mind. They will be bought largely without any direct personal experience of them, with an expectation and hope that the purchaser won't need to use them, but that they will be exceedingly valuable if and when they are needed.

  - being suitable (if at all possible) for incorporation into such "low engagement" (and consequently, relatively low cost) survey techniques as self-completion questionnaires and telephone interviews.
- The identification of *potential market segments* of likely early adopters or other groups that have particular interest in ITS-based collision countermeasures.
- The identification of the *key features or attributes* that are most important in consumers' evaluations of the product concepts.

Like all small-sample qualitative research, the substantive findings should be regarded as *indicative* rather than authoritative. Identifying the *range* of relevant viewpoints is usually regarded as more important then obtaining a sense of *how prevalent* those viewpoints might be. There is no guarantee that the opinions expressed in the discussions are quantitatively representative of those of larger populations. Moreover, the participant responses represent solely their *first impressions* after having been exposed to product category concepts that are largely outside their personal experience. These impressions could change markedly – either positively or negatively – after significant direct experience in using the product over a period of time, or if the market penetration were to reach a critical mass.

Even if customer reactions do change significantly with increased personal exposure to the product, the first reactions gauged in early "concept testing" focus groups may better approximate those of the relatively uninformed or inexperienced purchaser entering the store (or dealership showroom). Initial purchasers of these products will be encountering them as options on new vehicles, with no personal or word-of-mouth experience to guide them; they will be reliant exclusively on manufacturers' claims and media comment. The attitudes of neophyte purchasers may, however, evolve after the new product is introduced (from those discovered now), not least because of favorable or unfavorable reactions or reviews by respected opinion-forming sources. This research reveals where consumer opinion *begins*, not necessarily where the market will *end up*.

The primary benefits of qualitative data collection for new product categories are *to help develop methods for deployment in subsequent sample surveys, and to help structure the hypotheses to be investigated in those surveys*.

The nature of this research

The crash avoidance countermeasures explored in the focus groups

The focus groups were designed to examine several major categories of crash countermeasures of particular interest to NHTSA staff, in order to complement ongoing technological and human factors research by the Office of Crash Avoidance Research. "Concept descriptions" were developed in such a way as to touch on the basic *functionalities* of each of these general categories, while at the same time representing the actual types of product offerings now under development. Consistent with the *Intelligent Vehicle Initiative*'s emphasis on an integrated, user-friendly system, we grouped several different crash warning technologies into "packages" of similar functions, meant to mirror the way in which the automotive industry packages optional vehicle features.

The product concepts examined in one or more of the groups were:

- A *crash avoidance system*, that would warn the driver of impending collisions (with other vehicles, with pedestrians, or with objects) when backing up, changing lanes, merging, or when approaching a stopped or slowly moving vehicle, and it would sound an alert if the vehicle appears to be running off the road;
- A *drowsy driver detection system*, that would detect early signs of drowsiness and provide a warning to the driver when about to fall asleep at the wheel;
- *Adaptive cruise control*, an enhancement to conventional cruise control that automatically adjusts the vehicle speed to maintain a constant safe distance from the vehicle immediately ahead;
- A *vision enhancement package*, based primarily on advanced headlamps and windshield glass, to provide increased visibility in darkness, poor weather, and glare conditions, with the added possibility of an infrared image projected on the windscreen in a "head-up display"; *and*
- An *intersection assistance option*, that would detect unsafe conditions at intersections and warn the driver of potential collisions with other traffic at the intersection.

With the exception of adaptive cruise control, all of these countermeasures are limited to providing a *warning* to the driver, not exercising any *control* of the vehicular functions. And with the exception of the intersection assistance option, all involve systems that are autonomous to the vehicle.

An overview of the structure of the focus groups

Key details about the planning, design, and administration of the focus groups are provided in Appendix A. The discussion here is intended as a brief synopsis.

Exhibit 1 summarizes the locations, dates, and composition of the eight groups. Generally, two groups were held successively in the same evening (or late afternoon), at the same purpose-dedicated facility. The firm operating the facility recruited the participants, using specifications and screening questionnaires provided by CRA.

In all cases, the respondents had to have participated significantly in decisionmaking regarding the purchase or lease of a new vehicle within the previous two years. They were not questioned about automotive safety matters in the recruitment screening, nor were safety aspects mentioned specifically at that stage. There's no reason to believe that our respondents were any more or less sophisticated about vehicle safety than other members of the general public.

CRA developed the verbal concept descriptions and the moderator's guides, in close consultation with NHTSA and Volpe staff and the moderator. Both the descriptions and the agenda evolved somewhat during the course of the four sets of groups, capitalizing on the progressive learning, and stressing issues that were thought to be particularly germane to the composition of each group. However, most of the group discussions included all of the following elements, explored in varying levels of detail:

1. Participant introductions around the table.
2. A brief discussion of the participants' driving patterns, including the typical driving trips that participants make for such purposes as commuting, business-related travel, shopping, tourism, or visiting friends and relatives locally or in other cities.
3. A discussion of the new vehicle purchase decision, specifically with respect to the types of information sources consulted and the optional features selected. In the later groups, this element was preceded by a discussion of the driving situations that participants found particularly *stressful* or *uncomfortable*, and how these situations may have entered into the vehicle purchase decision.

The nature of this research

Exhibit 1. Summary of the focus groups

ID	Location and date	Major stratification	Composition of the group	Number of participants
1	Framingham, MA [Boston suburbs] 07/01/97	Suburban / rural driving	• All purchased or leased a new vehicle in last two years • All subject vehicles were driven at least 4 days/week in small town or rural area • 7 with children under age 16 at home • 4 with car or station wagon costing $30,000+, minivan, or sport utility vehicle	10
2		Urban driving	• All purchased or leased a new vehicle in last two years • All subject vehicles were driven in the center of Boston region for any purpose) at least 4 days a week • 7 with children under age 16 at home • 7 with car or station wagon costing $30,000+, minivan, or sport utility vehicle	10
3	Ft. Lauderdale, FL 07/31/97	Elderly drivers	• All purchased or leased a new vehicle in last two years • All age 65 or older • All drove at least 5,000 miles per year • 4 made trip by car outside Florida in last year • 5 had trouble driving in certain conditions • 2 with car or station wagon costing $30,000+, minivan, or sport utility vehicle	10
4		General population	• All purchased or leased a new vehicle in last two years • All drove at least 10,000 miles per year • 5 age 18-39, 4 age 40-64, 1 age 65+ • 2 with children under age 16 at home • 2 with car or station wagon costing $30,000+, minivan, or sport utility vehicle	10
5	Marina del Rey, CA [Los Angeles suburbs] 08/06/97	General population	• All purchased or leased a new vehicle in last two years • All drove at least 10,000 miles per year • 4 age 18-39, 2 age 40-64, 1 age 65+ • 3 with children under age 16 at home • 2 with car or station wagon costing $35,000+, minivan, or sport utility vehicle	7
6		High-end vehicle purchasers	• All purchased or leased a new vehicle costing $35,000+ in last two years • All drove at least 10,000 miles per year • 3 with children under age 16 at home	10
7	Frontenac, MO [St Louis suburbs] 08/13/97	Elderly drivers	• All purchased or leased a new vehicle in last two years • All age 65 or older • 5 male, 5 female • All drove at least 5,000 miles per year • 6 had trouble driving in certain conditions • 3 with car or station wagon costing $30,000+, minivan, or sport utility vehicle	10
8		Female drivers	• All purchased or leased a new vehicle in last two years • All female • All drove at least 10,000 miles per year • 4 age 18-39, 4 age 40-64 • 5 with children under age 16 at home • 3 with car or station wagon costing $30,000+, minivan, or sport utility vehicle	8

4. The presentation and discussion of each of a series of three crash avoidance product concepts (in turn), to explore participant understanding, immediate reactions, and the perceived "goods" and "bads" of each concept. After reading through the description of a concept, respondents first wrote down individual answers to a small set of questions (*What one question do you most want answered? What do you like most about this? What do you dislike most?* etc.) before discussing such questions as a group.
5. A discussion of potential purchase behavior response to the concepts, and a cross-concept comparison and synthesis.

To ensure that adequate time could be devoted to the discussion of each concept, only three concepts were explored in each group. In addition, some of the concepts were tested only in focus groups with a composition thought to be particularly relevant to them. Exhibit 2 summarizes the concepts discussed in the different groups.

Exhibit 2. Concepts explored in each focus group

City	ID	Type	First concept	Second concept	Third concept
Boston	1	Suburban/ rural driving	Drowsy driver detection	Intersection assistance	Crash avoidance system
Boston	2	Urban driving	Adaptive cruise control	Drowsy driver detection	Crash avoidance system
Ft. Lauderdale	3	Elderly drivers	Crash avoidance system	Vision enhancement package	Drowsy driver detection
Ft. Lauderdale	4	General population	Drowsy driver detection	Crash avoidance system	Adaptive cruise control
Los Angeles	5	General population	Crash avoidance system	Drowsy driver detection	Adaptive cruise control
Los Angeles	6	High-end vehicles	Adaptive cruise control	Crash avoidance system	Drowsy driver detection
St. Louis	7	Elderly drivers	Vision enhancement package	Drowsy driver detection	Crash avoidance system
St. Louis	8	Female drivers	Drowsy driver detection	Crash avoidance system	Adaptive cruise control

Copies of the final versions of the concept descriptions are included in Appendix A.

2
Participant responses

People agree about stressful driving situations

The focus group participants reported a mix of local and long distance driving that included both work and personal trips. Among those driving to work on a regular basis, both long and short commutes were represented. When asked to characterize their non-commute driving, most respondents mentioned recreational or vacation trips, trips to visit friends, shopping, and transporting children to after-school activities.

The groups had no difficulties in identifying specific driving situations that were considered "stressful," or that made people "feel uncomfortable." The lists of responses were very consistent across the groups, although individual participants would naturally have different opinions about whether specific situations were troublesome to them personally. Bad weather (snow, heavy rain, or fog, depending on the region of the country), traffic and congestion, and reckless or inconsiderate drivers were universal themes, to which almost all participants appeared to resonate. Every group had *some* respondents who were individually uncomfortable with night driving, merging or changing lanes on the freeway, and left turns or other similar maneuvers, but none of these were majority concerns. Older drivers would often volunteer that they were aware of a decline in their visual powers. Driving in "unsafe areas" was also a concern.

People cope with these unpleasant driving situations in a variety of ways, but in general most participants are choosing to deal with the situation as best they can rather than cut back on their driving. Rearranging routes or travel times were common coping mechanisms.

Most people do some "research" before new vehicle decisions

Each of the groups included some discussion of the process by which the respondents chose their most recent vehicle acquired new. They were asked to talk about how they settled on the particular make and model, as well as how they decided the final specification of features and optional equipment. The types of

information sources consulted were also discussed, as well as general impressions about which sources provided the most credible or "objective" information.

Most of the participants read *Consumer Reports* or a similar consumer-oriented publication at some stage in their pre-purchase research. A small number of respondents in each group also reported using the World Wide Web, in many cases to get general information about a variety of makes and models. The enthusiast or "car" magazines, as well as other periodicals such as *Popular Science*, were used by some as a source of performance or feature information. Relatively few people said that they consult the automotive articles in general newspapers.

In addition to the information obtained from these documentary sources, past personal experience or the word-of-mouth advice of family and friends also figured heavily in many purchase decisions. The popular wisdom in the automotive industry is that an interest in variety tends to discourage repeat buying. However, our groups always contained two or three people who chose their vehicles because of a positive past personal experience with that marque or model, either on their own part or that of a family member or close friend.

Information obtained from dealerships, whether in the form of brochures and literature or conversations with salespeople, was also considered a primary and authoritative source of information, particularly since many respondents made a test drive of more than one vehicle. Documentary material from dealers was thought to be less even-handed than that from more independent sources, however.

When asked specifically about the best sources for reliability and safety information, the consensus was that *Consumer Reports* was the most credible and objective. The AAA and the Insurance Institute for Highway Safety were also mentioned as credible sources. Few people sought out crash test result information *specifically*; rather, they expected or knew that those results would be factored into the recommendations of the consumer publications.

There were one or two people across the groups who admitted to making essentially on-the-spot, intuitive decisions about vehicle choice, or whose choice had been strongly influenced by the ability to obtain a "special deal" through personal relationships. By and large, however, most respondents gave the

impression of having invested some time and thought into the vehicle choice decision.

The major impression gained from the discussions of vehicle and options choice decisions is that consumers regard automotive purchases as major investments that merit doing at least *some* homework. However, fairly "low engagement" methods of obtaining information predominate: visits to dealers (and "test drives"), *Consumer Reports* and similar vehicle purchase guides that can be picked up at a newsstand, word-of-mouth, and so on. It wasn't clear, from these discussions, whether dissemination (through more high-engagement sources) of more detailed, high-content information about new safety options would be sought out or valued by many purchasers.

Driving experiences are generally not a *primary* factor in the purchase decisions

There seemed to some agreement that consideration of coping with "uncomfortable driving situations" (or other characteristics of their driving patterns) did factor into the participants' choices about their new vehicles, but for most people it was not seen to be a *primary* determinant of their decisions. For example, some people chose a minivan or sport utility vehicle in part so as to sit high above the road and have good sight lines. Those making long trips or long commutes may have chosen vehicles specifically for their comfort. Some participants mentioned that many of their trips involved driving the kids around, that this was sometimes stressful, and had selected larger and heavier new vehicles specifically to make that easier.

But for the most part, vehicles were chosen more on the basis of such factors as price, appearance, associated status, reputation for reliability, previous experience with the make or model, or certain vehicle-specific attributes such as performance or carrying capacity. In a few cases, safety was a primary determinant of choice:

> *"I bought my car mostly for safety reasons; I totalled my previous car [while driving in bad weather] and so I was ready for all-wheel drive."*

While some find "option shopping" a chore, safety options are a priority

By comparison with the *vehicle* choice decision, fewer of the participants appeared to have invested as much thought into decisions about *optional features*, preferring to choose from among "what's on the lot" than to shop around or wait for a vehicle meeting some well-considered specification. In any case, increased feature bundling in recent years has served to reduce and simplify the set of options available on domestic cars, following the way that vehicles manufactured overseas have been marketed for years.

The focus group discussions suggested that there may well be demographic or socioeconomic differences in the consumers' level of interest in specifying vehicle options. Attitudinally, there appeared to be some segmentation into those who were motivated to put some thought into options, and others who didn't really care, for whom that was just too much detail to worry about, once an acceptable vehicle had been found at an acceptable price. We formed no strong hypotheses about whether these attitudes correlated with sex, income, or education, but we did observe an apparent *age*-related effect. We were struck (in the Florida group of older drivers, in particular, but in other groups also) by the number of older respondents, even those with quite modest incomes,[1] whose attitudes to choice of model or options were characterized by remarks like

> *"I always go for the top of the line now,"*
> *"I want to have everything on it."*

Where people did have specific options in mind, *safety-related features* (primarily passenger-side airbags and antilock brake systems) featured high on the list. There is a limited level of understanding of relatively new features like traction control and ABS, and (as we subsequently detail) some ambivalence about the value of both ABS and airbags. We were particularly interested in the motivations to acquire ABS because until quite recently that was primarily an *optional* feature on most cars, although within the most recent model years it has become standard equipment on a number of models. For most of the respondents who had ABS on their most recent vehicle there was no perceived choice, but nonetheless, each group appeared to have a small number of people for whom ABS had been an absolute requirement. This determination appeared to have been shaped more by the recommendations of consumer publications than by any detailed appreciation of what ABS does. It appeared again that *endorsement (or criticism) of safety*

[1] Of course, the reported *income* levels may not necessarily correlate strongly with actual *wealth*.

options by a respected information or opinion source has the potential to influence more consumer choices than either a good understanding of the technology or high-level technical explanations.

Some observations about the new crash avoidance technologies *in general*

People were concerned about the implementation details

There was generally a positive reaction to most of the crash avoidance concepts presented and discussed in the focus groups. Respondents appeared to understand what was being described to them, and in most cases they applauded the concepts as "good ideas." As is common in such groups, in which the participants are charged explicitly to think about *dis*advantages as well as advantages, they generated a number of negative points as well as positive ones.[2] There were indeed some people whose net evaluation of a specific concept was that it might harm rather than help, or that "it's just not for me." For the most part, however, reactions were positive, and in some cases enthusiastic.

The concept descriptions had been crafted to focus primarily on the *general functionality* of each concept, and to de-emphasize both the costs and the "human factors" details. For example, before discussing a concept or giving initial *individual* reactions to it by answering questions on paper, the participants were told

> *"I'd like you to assume that the new feature would be available as a manufacturer-installed option when you next decide to purchase a new vehicle. Also, I don't want us to spend any time wondering whether you'll be able to afford this new option, so let's assume that it's available at a price level that's quite acceptable to you."*

[2] This is one of the advantages of in-depth qualitative research over surveys involving a lower level of engagement. In telephone or mail surveys of new concepts, with precoded answers, people may give unduly enthusiastic responses without thinking through potential negative aspects. When invited to brainstorm possible disadvantages, the responses become more questioning and skeptical that the new product will actually live up to its description.

Similarly, when the concept involved a warning to the driver, the printed description included sentences like

> *" . . .The types of sound and/or visual warnings used have been chosen to be effective for the majority of drivers . . ."* ***or***
>
> *" . . A warning – one that the majority of drivers find effective and acceptable – is given . . ."*

However, it was apparent that such details could *not* be ignored. For a significant proportion of the respondents, the nature of the *driver warning* (in particular) would strongly influence their evaluation of the overall concept. What specific form would it take? Would it be distracting? Unambiguous? Would it be noticeable, in a car full of kids, or with the radio on? Could there possibly be adequate time to react in many collision situations?

Respondents perceive that it isn't clear that these concepts will necessarily produce reduced collision or injury rates

In each of the groups, at least one person raised issues to suggest (in one way or another) that in-vehicle safety enhancements that individually sound sensible might not lead to any actual safety improvements, or that the expected outcomes are ambiguous rather than clearly positive. These points fell into one or more of three distinct categories:

- Awareness of recent controversies over the effectiveness of air bags and ABS systems, and a resultant skepticism that government-mandated safety features will necessarily result in net benefits;
- Awareness that the practical implementation of these broad concepts would inevitably involve design tradeoffs, and the designers could "get it wrong"; *and*
- Concern about what traffic safety professionals refer to as *behavioral adaptation* – that when the concepts are implemented, there may be both near-term and longer-term behavioral adjustments to the systems that could mean that they would not achieve the intended benefits.

Within the six months or so prior to the focus groups, there had been significant press mention (linked to Congressional hearings) of air bag-caused injuries of infants and other people, and discussion of suggestions to change the US

standards. Similarly, there had been media discussion of research suggesting a minimal or even negative impact of ABS on crash statistics. Respondents mentioned recent prime-time television documentaries on these issues, and such debate had led a few participants to an adamant desire *not* to have ABS on their new vehicles, or to have their passenger airbags deactivated.

The concerns expressed about design details had two main components:

- *The nature of aural or visual warning mechanisms*. This was clearly an issue for many participants, even those who were quite enthusiastic about the concepts in principle. Some thought a loud warning could be startling or distracting, even to the point of *causing* an accident. Others thought it might be unclear what information was being conveyed by the warning, and that it therefore might compromise the ability of the driver to react appropriately to avoid a crash.
- *Potential loss of situational awareness*. There was also some perception that the warnings or other signals provided by the countermeasures might amount to "too many lights and sounds," particularly when combined with all of the other instruments in the vehicle. Some participants worried about possible distraction from the driving task. They thought the countermeasures might make them *less* aware of exactly what was happening, slowing their reaction times or even reducing their ability to react altogether. The *integration* of various separate warning systems into a user interface that presents a clear and unambiguous message to a (possibly stressed) driver is obviously a critical element of consumer acceptance. In addition, there were several *concept-specific* concerns about driver awareness.[3]

The concerns expressed on the behavioral adaptation issue also had two different themes. In the immediate term, some people thought that the increased sense of protection afforded by the positive safety features of the products might cause some drivers to grow complacent and compensate with less safe driving practices (such as believing that the risks of drinking and driving were reduced). Over the longer term, the widespread use of these concepts might lead some, particularly

[3] For example, many respondents viewed *adaptive cruise control* as removing a large amount of control from the driver, and several older drivers thought a "head up display" in the *vision enhancement package* might make it more difficult to see other parts the roadway. These matters are discussed in greater detail later, as the reactions to the individual concepts are presented.

young or inexperienced drivers, to "rely too much on the technology" rather than acquire or refine the necessary "manual" driving skills. The end result could be that technologies intended to reduce the risks of crashes might have minimal or even negative impacts.

Older drivers may be an important "lead adopter" group

The older drivers in our focus groups appeared to be significantly more interested in the crash countermeasure concepts than were the younger respondents. This was the case not only with the participants in the two stratified older driver groups, but also with their peers in the other groups as well.

Without being asked specifically about it, many of the people aged 65 or older (and a few participants in their fifties) *volunteered* that they were aware of a decline in their faculties relevant to driving tasks. At the simplest level, this might be just an acknowledgment that it is now harder for them to get in and out of vehicles than it used to be. Many were aware of eyesight and attention declines, the most frequently mentioned forms of impairment. Other problems involved difficulties in turning the head to look over the shoulder, and increased reaction times.

The discussions revealed, as might be expected, that these drivers tend to be more aware of and sensitive to issues related to their personal safety or security than were younger people. They were therefore correspondingly more receptive to the safety features of the countermeasure concepts, and more likely to perceive a direct benefit to themselves from the potential use of these products.

A general desire for a feature-packed vehicle was also characteristic of these older respondents, at all income levels. Even among owners of mid-range vehicles, the tendency was to buy a car that was "fully loaded." This perhaps reflects a need to compensate for a reduced level of mobility, or it could simply indicate a desire at that age not to "worry the details" in purchasing cars, or to enjoy life as fully as possible.

In either case, there was little evidence that these participants saw the concepts as "just another gimmick" rather than a desirable feature. Given these factors – a heightened awareness of the potential benefits of the concepts, and an interest in

having fully-equipped vehicles – the older drivers appeared less skeptical than other respondents about the ability of the technology to work as described. It seemed less necessary for them to understand exactly how it will work before forming an opinion.

It seems likely that older drivers – particularly (but not necessarily limited to) the most affluent ones – could prove to be *lead adopters* for these technologies. Elderly consumers are rarely considered lead adopters of new products, and particularly not for high technology ones. But if our focus group participants are typical, this may be an exceptional case where the products meet an acknowledged need in a way that does not require a large measure of technological sophistication by the user.

The new safety product packages will need to take into account the special needs and limitations of older drivers. The keys to success with this demographic group would appear to be *simplicity of operation* on the one hand, and *functional reliability* on the other. Certainly, with the projected numbers of "baby boomers" moving towards retirement age, there may be no market size disadvantage to regarding people aged 50 or older as the group to lead the way into the adoption of these new concepts.

Women constitute another important market segment

The group discussions yielded hints of other market segmentations on demographic or socioeconomic lines, although none were as clearly defined as the relative enthusiasm shown by the elderly.

We conducted one group (in St Louis) exclusively of women, on the hypothesis that the discussion might reveal additional insights not heard in the mixed sex groups.[4] However, there was little evidence from that group that women have viewpoints that they were reluctant to advance in the mixed sex discussions.[5] Perhaps the most pronounced difference between the men and women participants

[4] We wondered whether a common perception of greater male preoccupation with (and authority concerning) automotive matters would lead some women in the mixed groups to be reticent about their concerns.

[5] It should be remarked that the moderator was male, which may have influenced the situation, but he disclaimed any knowledge of automobile mechanics.

is better characterized as a *parental* distinction rather than a *gender* one *per se*. A lone adult driving infants or young children raises several issues. There's a particular concern with *responsibility* and careful, defensive driving, on the one hand; on the other, there may well be *driver distractions* and *disciplinary* issues, too. Women talked about these matters much more than the men, because they had much greater experience with this situation. For some of them, this factor had been a primary influence in their opting for a minivan or sport utility vehicle.

Because of the screening criteria we had used to select the participants, all of the women had played a significant role in the selection of their most recently acquired vehicle. Relatively few of them had taken the lead in negotiating and closing the deal, however.

The focus groups generated a number of other hypotheses about possible sex-related differences. But none were as pronounced as the issues relating to driving children, and it wasn't clear how far these observations might be confirmed by quantitative research among the general population. In general, the women tended to be somewhat more sensitive to safety issues than the men, and this is consistent with evidence of a greater female interest in automotive safety options purportedly found in a 1995 *J.D. Power and Associates* study.[6] At the same time, the women may have been more practical – they appeared more skeptical of new technology, and wanted to know that it would produce a worthwhile benefit. One or two of them said that they did more pre-purchase research than their male partners, whom they characterized as more likely to be guided by intuition.

The men (except for older drivers) expressed less concern with risk and personal vulnerability than did the women. Those women with teenaged children were a little conflicted about the safety concepts; such improvements would help calm fears about teenaged drivers on the one hand, but on the other they were concerned that the technology might reduce the basic driving skills acquired and used by their children.

[6] J.D. Power and Associates' *1995 APEAL Feature Contenting Report*℠, as summarized in that company's newsletter, *The Power Report of Automotive Marketing*, of November 1995. Of various new technology features explored in that quantitative survey (sample design and size unspecified), "women and men expressed the same level of interest in all but the safety-related technology."

The presentation format of the concept descriptions matters, but not much

A methodological objective of this research was to learn how best to present and explain these new product concepts to respondents in future quantitative surveys. What *words* (or pictures) convey the essence of the concepts correctly, unambiguously, and economically, without so lauding them that respondents feel an obligation to respond favorably? What *context* will help to enhance the credibility of the message?

In the first pair of focus groups, we concentrated solely on the *wording* of each concept description, presented simply on a plain sheet of paper. We also explored what sources of information were thought to be most authoritative for learning about the functionality and advisability of new vehicle features. For the second pair of focus groups we made small changes in the wording, and presented the concepts in two different contextual formats (still on a single sheet of paper per concept).[7]

Both contexts aspired to appear like an extract from a "consumer-oriented" publication, since this had been reported to be the most trusted method of obtaining information. The first was apparently a page from the mythical *Automotive Digest* "New Car Buyers' Guide, 1998," from a section headed *Equipping Your Car*. It had the appearance of (say) a reference guide published annually. The second was a page from an article in the July 1997 issue of the equally mythical *Consumer News*. The article had a somewhat up-beat headline and introductory paragraph, with an author's byline. In both, the relevant concept description appeared (with identical wording) as a highlighted sidebar or paragraph, with the rest of the text ghosted in the background.

Each group was shown some concept descriptions in one format and the rest in the other. They were asked to say where these pages might have come from, and to comment on their relative "believability." While the groups thought that both forms had an independent, consumer orientation and had authority because of that, they consistently chose the second over the first as the version they preferred marginally. It isn't clear that this preference derived from any significant differences in the credibility of the two different "sources" or in the type of article that each purported to be. Rather the comments hinged more on small matters of

[7] Copies of both versions, in the form used for the final set of groups, appear in Appendix A.

graphic design: a somewhat unintelligible picture of nighttime traffic in the first format, a much busier page for the second format, and so on. The *uniformity* of the slight preference for the second version over the first convinced us that it would be sensible to use this format in subsequent research, but the degree and nature of the preference suggested that it may be feasible to improve the format further.

Crash avoidance systems were viewed favorably

Front, rear, and side object detection technologies were presented to the respondents as a "package," which was called a "crash avoidance system," or CAS. Either in the wording of the concept description itself or in the accompanying comments of the moderator, it was made clear that different CAS packages (comprising different combinations of front, rear, and side detection) might be available on different vehicles (distinguished by manufacturer, marque, or price level, say).

In general most of the participants thought that this product concept was a good idea, and they expressed interest in having the option on their next new vehicle. It was apparent that they immediately understood the potential benefits of the system to themselves, and many were able easily to relate the capabilities of the system to general driving circumstances where they would be useful, if not to specific experiences that they had themselves encountered.

There were some concerns, as expected, about how the technology would work. Some skepticism was expressed as to how the system could provide a suitable and timely warning without being overly distracting to the drivers or producing false alarms. Questions were also raised as to the reliability of the system, particularly given that one might not be able to tell if it were functioning properly until it sounded an alarm. Many people were concerned about the alarm – specifically whether the driver would be able to determine the nature and location of the problem and react appropriately in time, and whether a loud sound might itself be too startling to the driver.

The concept was described as being able to warn the driver of impending collisions when backing up, changing lanes or merging, or when following a stopped or slow moving vehicle. After a general discussion of the system, participants were asked

to evaluate each of these capabilities separately. Among all groups, the general order of preference was object detection when backing up, side/blind spot detection, frontal collision detection, and finally run-off-the-road (lane tracking) warning. The backing up and blind spot detection were preferred quite strongly to the other two types of warning – only a small number of participants expressed interest in frontal collision detection and the run-off-the-road warning.

Older drivers, in particular, expressed a strong interest in rear object detection, which they saw as particularly helpful in busy parking lot situations.

Personal experience motivated positive reactions to drowsy driver detection

In several of the groups, the earlier discussion of driving experiences and "uncomfortable" driving situations had surfaced (unprompted) the issue of drowsiness while driving. In some cases this was mentioned in the context of *long trips* that people were making, while some participants mentioned it as a reason they don't like to use their *cruise control*.

Many of the participants had been in situations where drowsiness was a problem, and some also knew of recent serious accidents caused by the driver's falling asleep at the wheel. These people were therefore easily able to see the benefits of the drowsy driver detection concept, both to themselves and to society as well. Responses were correspondingly positive, particularly among the older drivers.

However, there was a good deal of questioning and skepticism about how drowsy driver detection systems would work. The moderators had been instructed to offer (if necessary) a small amount of additional technical information, but this did not appear to alleviate the concerns and may simply have raised a new tier of questions. Would blink-monitoring systems require the driver to wear something (a frequent concern)?[8] Would they work for people wearing contact lenses or glasses, and particularly dark sunglasses?[9] What about different-sized drivers, or drivers moving their heads? How would lane-keeping monitors work? Wouldn't *false alarms* be a big problem for all of these systems?

[8] If so, this was seen as a negative factor.

[9] This from a Los Angeles group, where such glasses are judged a necessity by many drivers.

Interestingly, only one (Boston) participant volunteered being uncomfortable at the thought of a camera in the vehicle to monitor driver behavior. Indeed, in the one or two groups where the moderator asked specifically about this aspect, the participants did not appear to be concerned. By comparison with their skepticism about the ability of the system to detect drowsiness in a timely fashion without many false alarms, the "intrusion" aspect was of little interest. Of course, if the actual performance of the technology were to remove (or diminish) the feasibility doubts, then the intrusion considerations might rise in relative importance.

Drowsy driver detection was a countermeasure for which the respondents frequently suggested that over-reliance on the system might encourage people to drive when they are in fact in no condition to do so.

The appeal of adaptive cruise control is more limited

Most of the participants had conventional cruise control on their vehicles, but only a fraction of them (perhaps a half, or just less than that) actually use it with any regularity. In most cases, it "came with the car" as standard equipment. Some of the respondents thought that the "loss of control" that they associated with current cruise control systems was at least unpleasant and at most unsafe.

Others simply liked to drive – they liked being involved in basic driving functions, they don't want the task to be taken away from them, and so they weren't much interested in the potential convenience benefits. "Long trips" and relatively light traffic situations provided the most likely contexts for using cruise control, but as the traffic builds up many participants thought that the negatives begin to outweigh the benefits to the driver.

These feelings were even more prevalent in the reactions to the *adaptive cruise control* concept. While it was generally understood that the product would offer additional convenience features to those of the conventional version, any perceived benefit of these features was outweighed for some by concerns about the technology working well. There was a high degree of skepticism that the system could work effectively, perform smoothly enough to be comfortable, and that its functioning would be predictable enough to assure drivers that it was safe to use.

Likewise, while the potential positive safety aspects were pointed out explicitly, in the minds of many of the participants they were far outweighed by the potentially dangerous loss of control that the system seemed to imply. Particularly distracting was the ambiguity of when additional braking input from the driver might be required. It was perceived that the operation of the system might delay the driver's realization that (s)he needed to regain control quickly to avoid a collision (because (s)he might expect the system to slow the vehicle adequately and then realize only some moments later that it was not going to do so). This uncertainty made many people feel very uncomfortable, and a few quite vehemently so. This concept aroused more intensely negative feelings than did the others, particularly (we noted) when it was the *first* concept to be discussed.

There were a few respondents who did like the idea, but they were clearly in the minority. Of those who viewed the concept favorably, it was thought to provide a specific benefit for long trips or driving at night. One participant remarked:

> *"I really like it. One of the reasons I don't use [conventional] cruise control more often is that I'm always having to turn it on and off."*

Research among neophyte consumers like these will be important to the market success of ACC

The relatively negative reactions about adaptive cruise control heard from our focus group participants contrast somewhat with the reported responses of 36 operational test subjects in Michigan who drove an ACC-equipped vehicle for a total of two weeks.[10] The interim findings of this test suggest that the Michigan participants learned fairly quickly how to use the system, and became comfortable using it, even under traffic conditions where they would have disengaged conventional cruise control.

On this evidence, ACC appears to be a technology for which greater "hands on" exposure increases user acceptance and trust beyond that found in their initial reactions to the idea. If further research confirms this, the marketing and public information challenge will be to present the product to consumers in a way that

[10] P. Fancher *et al*. (1997), *Intelligent Cruise Control Field Operational Test (Interim Report)*, Washington (DC): US Department of Transportation, National Highway Traffic Safety Administration, pp. 107-112.

bridges the gap between the initial lukewarm reactions to the abstract concept and the more enthusiastic reactions after a few days' use. The evidence from our research – both these focus groups and the anticipated follow-on survey – should more closely simulate the reactions of the uninformed consumer entering the dealer's showroom than will the opinions of people after they have been chosen to test out the technology for a week or two. Given the tendency to unenthusiastic first reactions, obtaining insights that can help in developing appropriate marketing and educational themes and strategies is a very important objective of this continuing research.

Vision enhancement was a hit with the older drivers

A "vision enhancement package," comprising (in its most basic form) both lighting and windshield glass improvements, was tested only in the two groups comprising older drivers exclusively. The basic package was received quite favorably, with nearly all of the respondents saying they liked the idea and perceiving a direct benefit to themselves. Specifically, they thought it would be very helpful for night driving and in reducing glare, problems that were particularly pertinent to the elderly respondents:

> *"I want it. As you get older, your vision gets a lot more limited, [and] to me, this gives you a longer view and a wider view, and more light."*

Several participants wanted to know more about how the system worked before they could form a solid opinion about it. Any potential interference with normal driving operations that the system might cause (obscuring vision in other areas or at other times, or requiring the driver to wear something, for example) was regarded negatively.

In the St. Louis group (but not in the Fort Lauderdale one) the concept description also mentioned infrared sensors, and at one stage the moderator said,

> *"I want to tell you a little bit more about that. The image from the infrared sensors will be displayed on the inside of the windshield, superimposed on top of the image that you see through the glass. What do you think of that idea?"*

Reactions among the St. Louis respondents to the head-up display feature were mixed. Some thought it would be a positive aspect of the system, helping to clarify what one sees on the roadway. However, more thought that it might be

distracting, and had a hard time believing that even a superimposed image would not somehow impair the existing normal view through the windshield.

Despite such misgivings, all but two of the participants exposed to this concept indicated that they might be likely to purchase the system if it were available for their next new vehicle.

Explaining the intersection assistance concept proved problematic

The so-called "intersection assistance option" – alerting drivers to impending collisions at problem intersections – was the only tested concept that involved roadway infrastructure modifications as well as systems autonomous to the vehicle. The concept was introduced to only one Boston group, the first groups to be conducted. Although the project team (in conjunction with NHTSA staff) had worked hard to devise as specific and clear a concept statement as they were able, it was apparent from the discussion that many people simply could not understand or imagine the concept as it had been described. This occurred despite additional assistance from the moderator in clarifying what the system would and would not do, and in answering many of the questions that arose.

The basic problem was that the concept is in such an early stage of development that many of the operational details are still quite unclear. The concept description therefore remained somewhat generic, and the discussants needed to pin down further practical details before they would feel able to respond intelligently. There are many different types of intersections. Was this a signalized intersection? A "rotary"? Do the other vehicles have priority? Would *all* the vehicles at the intersection be capable of receiving the warning?

Because the participants were unable to visualize the operation of the system, any ideas of how it might improve safety were eclipsed by the distractions of trying to figure out exactly how the system might function. And the vagueness also encouraged a good deal of concern about the nature of the warning mechanism, false alarms, and distractive warnings. In fact, the ambiguities led many to perceive the system as potentially *unsafe*, causing distraction in an otherwise already potentially dangerous situation. In general, the reaction to the concept as described was largely negative.

The problems encountered in conveying the idea were judged to be too difficult to overcome successfully without devoting considerably more time to presenting and discussing the concept. Because the focus group agendas were already quite full, it was decided not to explore intersection assistance further in the subsequent groups.

APPENDIX A
Methodological details of the focus groups

The location and composition of the groups

The focus group research was designed and administered by Charles River Associates, in close consultation with NHTSA and JPO representatives. Michael Kemp of CRA moderated the two groups in the St. Louis suburbs, while Mark Freedman of Westat (who also contributed to the research design) moderated those in Boston, Fort Lauderdale, and Los Angeles.

The first set of groups was conducted in early July in suburban Boston. These groups were designed to explore possible differences in interest levels between "urban" and "suburban / rural" drivers. The first group comprised people driving primarily in and around the city of Boston, while the other group was of people doing a substantial amount of suburban / rural driving and contained some people living outside of the built-up portion of the metropolitan area. In both groups, potential respondents were required to make a minimum number of pertinent trips (urban or suburban / rural) in order to qualify for participation.

The second set of groups was conducted at the end of July in Ft. Lauderdale, Florida. This location was selected specifically to explore the reactions of older drivers, as well as other drivers living in an environment with a large proportion of older drivers.[1] The first Florida group comprised only drivers aged 65 or above. This group was designed to include both people making only local trips in and around southern Florida, as well as people making long distance private vehicle trips to points outside the state. The second group consisted of members of the general population, with participants recruited to reflect the age distribution of the Ft. Lauderdale metropolitan area. The Florida groups also introduced a new format for the concept descriptions. Where the Boston groups had used only a simple printed paragraph, the new format was designed to look like a page from a "Buyers' Guide" for new cars, perhaps taken from a consumer publication such as *Consumer Reports*. This format was used for all three of the concepts tested.

The third set of groups was conducted in the Marina del Rey section of Los Angeles during the first week of August. They were stratified into a group of

[1] The Miami-Ft. Lauderdale metropolitan area has one of the highest concentrations of over-65 population in the United States, as have other Florida metropolitan areas.

"high-end vehicle" owners and a general population group, with the general population group designed to reflect the age distribution of the Los Angeles area. An alternative format for the concept descriptions was introduced for these groups, again designed to look like a reprint from a consumer-oriented publication but this time more like an article from a monthly periodical. Different concepts were presented in one or the other of the two formats.

The final focus groups were conducted in suburban St. Louis in the middle of August. The first of these groups comprised only drivers aged 65 and over, in order to explore the reactions of older drivers in an environment of adverse weather conditions not found in Florida. The other group consisted exclusively of female drivers, but was otherwise similar in composition to the general population groups. Two concept description formats were again used.

Concept descriptions

In each discussion group, only three of the five concepts were tested. The concept descriptions were refined as the groups progressed. Samples of the concept descriptions, as used in the later groups,[2] are shown below.

Crash Avoidance System

Soon to be offered on select new vehicles, CAS uses sophisticated sensors to warn you of impending collisions. Sensors mounted in the front of the vehicle determine if you are in danger of crashing into the rear of a stopped or slow-moving vehicle straight ahead of you. Rear mounted sensors detect objects that you can't see when backing up, and side mounted sensors detect cars in your blind spot when changing lanes or merging. The side mounted sensor will also warn you if you are starting to run off the side of the roadway.

The responsiveness of the system will vary with important driving conditions like the speed of your own vehicle relative to others. The types of sound and/or visual warnings used have been chosen to be effective for the majority of drivers, and they will help you distinguish quickly which type of crash appears imminent.

[2] As discussed in Chapter 2, the "intersection assistance option" was tested only in one of the Boston groups.

Methodological details of the focus groups

Drowsy Driver Detection

These new systems warn you if you are showing early signs of falling asleep at the wheel. There are several ways in which these systems judge whether you are getting drowsy. They can monitor how often and for how long you close your eyes, automatically adapting to different drivers (even those who are wearing glasses). They can also monitor how you are steering, or how well your vehicle is staying in its lane. A warning – one that the majority of drivers find effective and acceptable – is given whenever there are significant signs that you are getting drowsy.

Vision Enhancement Package

This option on new vehicles significantly improves visibility at night, as well as in adverse conditions such as rain or fog. State-of-the-art headlamps provide clearer and more focused light, and make road signs and markings appear much brighter. Infrared sensors enhance your view ahead, to help you see further down the road and to draw attention to people, animals, or objects in the way. Special windshield glass reduces the glare from streetlights or other headlights at night, and also lessens the glare from bright sunshine during the daytime.

Adaptive Cruise Control

This improvement to conventional cruise control automatically adjusts your speed to help maintain a safe distance between vehicles. The system uses radar sensors to track objects ahead of you. If the vehicle ahead of you slows down or another vehicle pulls in front of you, the system will either downshift automatically or ease up on the gas pedal to reduce your speed. Once a safe distance has been reestablished, your vehicle will automatically resume its original speed.

Like conventional cruise control, you can turn this feature on and off, and use it only when you judge the conditions are suitable. The benefits of ACC include a lowered risk of crashes and the ability to use cruise control in a wider range of traffic conditions.

Intersection Assistance Option

This option is specifically designed to help you negotiate road intersections, by warning you whenever the locations or speeds of other traffic at the intersection present the risk of a crash. This includes traffic on cross streets that you may not be able to see well, either because of poor sight lines or because there are many directions to watch. The warning is based on signals transmitted to your vehicle by a computer that uses traffic detection equipment on all the roads leading to the intersection.

Concept description formats

Exhibits 3 and 4 show the two different formats that were tested.

Exhibit 3. Sample concept description in the *Buyers' Guide* format

Methodological details of the focus groups

Exhibit 4. Sample concept description in the *magazine reprint* format

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AUTOMOTIVE SAFETY

SAFETY GOES HIGH-TECH FOR THE 21st CENTURY

Your next new car may be able to protect you in ways you never thought possible through a dazzling array of new safety features that push the very limits of modern technology.

By William H. Frost

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CRASH AVOIDANCE SYSTEMS

Soon to be offered on select new vehicles, CAS uses sophisticated sensors to warn you of impending collisions. Sensors mounted in the front of the vehicle determine if you are in danger of crashing into the rear of a stopped or slow-moving vehicle straight ahead of you. Rear mounted sensors detect objects that you can't see when backing up, and side mounted sensors detect cars in your blind spot when changing lanes or merging. The side mounted sensor will also warn you if you are starting to run off the side of the roadway.

The responsiveness of the system will vary with important driving conditions like the speed of your own vehicle relative to others. The types of sound and/or visual warnings used have been chosen to be effective for the majority of drivers, and they will help you distinguish quickly which type of crash appears imminent.

Continued on page 71

APPENDIX B
Participant responses following the discussions

At the end of each group discussion, the participants were asked to give a written response to the following question, printed on a sheet of paper:[1]

> *Assume that the following options would be available on the next new vehicle you purchase. For each of them, indicate how likely you would be to order the option on your next new vehicle by checking one of the four boxes . . .*[2]

The counts below show the numbers of respondents expressing "*likely*" and "*unlikely*" answers to the listed features. Participants were asked about the three new crash avoidance concepts that they had discussed in their group, along with seven other optional features that are currently available. Of these other features, only the data for antilock brakes are shown here.

	Total responses	***"Likely" responses***	***"Unlikely" responses***
"Crash avoidance system"			
All respondents	**55**	**43**	**12**
males	24	18	6
females	31	25	6
with children at home	14	9	5
without children at home	41	34	7
aged up to 64	28	19	9
aged 65 or older	25	23	2
HH income less than $80k	35	30	5
HH income $80k or more	17	11	6
new vehicle bought below $30k	33	25	8
new vehicle price $30k+	22	18	4
less than 15,000 miles per year	44	37	7
15,000 miles or more per year	11	6	5
Drowsy driver detection			
All respondents	**55**	**37**	**18**
males	24	16	8
females	31	21	10
with children at home	14	10	4
without children at home	41	27	14
aged up to 64	28	19	9
aged 65 or older	25	17	8

[1] The question used in the two initial (Boston) groups was different. It asked the respondents to *rank* their preference for ten optional vehicle features, including the new concepts just discussed. The Boston responses are not reflected in the counts provided in this appendix.

[2] The boxes identified these responses: *Highly unlikely*, *Not very likely*, *Somewhat likely*, and *Very likely*.

Participant responses following the discussions

	Total responses	*"Likely" responses*	*"Unlikely" responses*
Drowsy driver detection			
All respondents	**55**	**37**	**18**
HH income less than $80k	35	24	11
HH income $80k or more	17	12	5
new vehicle bought below $30k	33	22	11
new vehicle price $30k+	22	15	7
less than 15,000 miles per year	44	29	15
15,000 miles or more per year	11	8	3
Adaptive cruise control			
All respondents	**35**	**15**	**20**
males	14	8	6
females	21	7	14
with children at home	13	5	8
without children at home	22	10	12
aged up to 64	28	10	18
aged 65 or older	5	3	2
HH income less than $80k	18	6	12
HH income $80k or more	16	8	8
new vehicle bought below $30k	18	7	11
new vehicle price $30k+	17	8	9
less than 15,000 miles per year	24	11	13
15,000 miles or more per year	11	4	7
Vision enhancement package			
All respondents aged 65 or older	**20**	**18**	**2**
males	10	9	1
females	10	9	1
HH income less than $80k	17	15	2
HH income $80k or more	1	1	0
new vehicle bought below $30k	15	14	1
new vehicle price $30k+	5	4	1
Antilock brake system			
All respondents	**55**	**46**	**9**
males	24	20	4
females	31	26	5
with children at home	14	12	2
without children at home	41	34	7
aged up to 64	28	23	5
aged 65 or older	25	22	3
HH income less than $80k	35	31	4
HH income $80k or more	17	12	5
new vehicle bought below $30k	33	27	6
new vehicle price $30k+	22	19	3
less than 15,000 miles per year	44	39	5
15,000 miles or more per year	11	7	4