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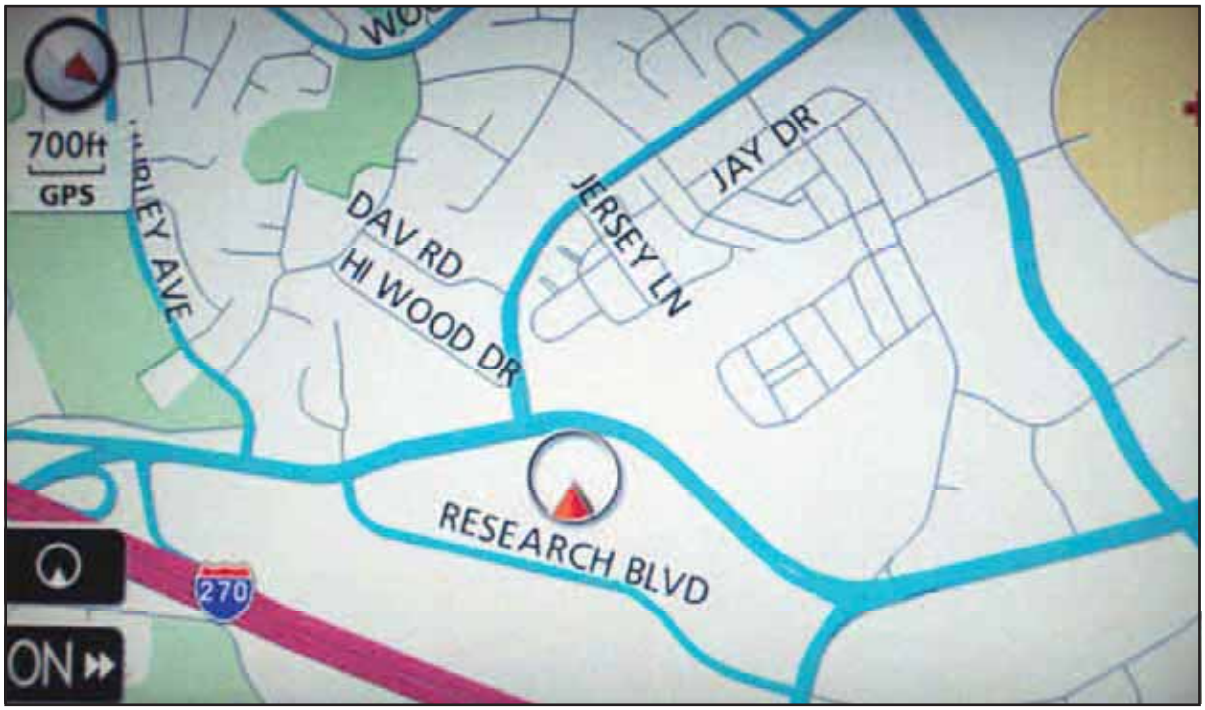
Use of Advanced In-Vehicle Technology By Young and Older Early Adopters

Survey Results on Navigation Systems



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This document describes the results of survey research undertaken by the Automobile Club of Southern California. Questionnaires (10,000) were mailed to insurance customers who own vehicles that may have in-vehicle navigation systems as standard or optional original equipment. Half of the questionnaires were mailed to vehicle owners who were younger than 65, and half of the questionnaires were mailed to owners who were 65 or older. The response rate was approximately 22 percent, including 1,494 respondents who had a navigation system. Follow-up telephone interviews were conducted with 83 navigation system owners. Survey items addressed topics such as learning to use the system, behavioral adaptation, system effectiveness, and perceived safety of the system. Several differences in responses between younger and older respondents were noted. Other response differences were related to vehicle manufacturer and experience with the vehicle (miles driven).</td></tr>
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EXECUTIVE SUMMARY

This report describes the analysis of survey data collected by AAA Foundation for Traffic Safety in cooperation with the Automobile Club of Southern California (ACSC). The survey described here was designed to assess drivers' experiences with built-in vehicle navigation systems (it does not address portable navigation units that are sold as aftermarket devices). This technology is still relatively new to the U.S. passenger vehicle fleet and the purpose of the study was to learn about early adopters' experience using these systems. Some specific areas of interest included drivers' acceptance of the systems, perceived effectiveness and usability of the systems, and behavioral adaptations which may occur with system use. The overarching goal of the study was to learn more about the extent to which navigation systems enhance or detract from safety, particularly with respect to the capabilities and limitations of older drivers. It is possible that new technologies can assist older drivers to drive more safely with less stress, thus extending their safe driving years. It's also possible that, for some drivers, new in-vehicle technologies such as navigation systems are misunderstood and misused in dangerous ways.

Technology-specific questionnaires were mailed to 10,000 potential navigation system owners. Both samples were selected by ACSC from its database of insurance customers. Only owners of particular vehicle makes and models known to have the technology as a standard feature or available option were invited to participate. Half of the questionnaires were mailed to owners who were younger than 65 and the other half were mailed to vehicle owners who were 65 or older. Vehicle owners were asked to mail back the questionnaire to ACSC in a self-addressed postage-paid envelope even if they did not have the technology. Approximately 22 percent of the questionnaires were returned, including questionnaires from 1,494 navigation system owners. ACSC staff also conducted brief telephone interviews with 83 respondents to gather additional information about their experiences with the technology and their suggestions for system improvements.

Desire to have a navigation system and system usage

An overwhelming majority of those who currently have a navigation system (88%) said that if they purchased their same vehicle again, they would want to get the technology again. Among those who do not have an in-vehicle navigation system, the most common reasons given for not purchasing it were related to availability on the specific vehicle that they purchased or that, "I don't need the navigation system to find my way." Cost was also an important reason for not purchasing the system as cited by many (32%) of the respondents who didn't have a navigation system.

Thirty-two percent of respondents said that they use their navigation system less than once a month, and an additional 30 percent said that they use it on e to three times per month. Ten percent of the respondents said that they use their navigation system four or more times per week.

Learning to use the technology

The most common ways that driver's learned to use their navigation systems were by reading the vehicle owner's manuals, and by on-road experience. Nearly half of the respondents said

that they received instructions from the dealership, such as a video, brochure, or demonstration.

Behavioral adaptation

Several items assessed how drivers have incorporated the navigation system into their driving routine. Nearly a third of respondents said that their frequency of using the navigation system has increased since they first started driving the vehicle, whereas only 9 percent said that they use it less now than they did then. Also, vehicle owners with greater levels of experience (miles driven) were more likely than those with less experience to use their system frequently. In fact, nearly 28 percent of respondents with 30,000 or more miles of driving experience with their vehicle said that they use their navigation systems two or more times per week as compared to only 10 percent of those with less than 5,000 miles of vehicle experience.

Drivers were asked how they would change their driving habits if they could no longer use their navigation systems. A majority (66%) said that before leaving on trips they would do more planning than they do. For a minority of respondents, having the navigation system seemed to enable them to drive in unfamiliar places, to drive more often at night, to drive more often in heavy traffic, or to drive alone.

Perceived effectiveness

A large majority of respondents (84%) either agreed or strongly agreed that their risk of getting lost is lower with the navigation system than without it and most respondents (80%) either agreed or strongly agreed that the navigation system does a good job re-routing them after missing a turn. Most respondents (76%) said that listening to voice directions reduces the amount of time they look at the navigation screen.

User interface and usability

Item Q13 asked respondents how they felt about the complexity of their navigation system (based on the number or features/functions). The majority of respondents (65%) thought that the system was about right in terms of complexity and number of features, but 16 percent thought that their system was too simple (not enough features) and 19 percent thought that their system was too complex.

Sixty-four percent of those with navigation systems that accept spoken commands found this feature useful. Regarding driver's preferences for system output, most respondents (61%) preferred to both listen and view directions as opposed to either viewing (13%) or listening to directions (26%) alone.

Some respondents had trouble seeing their navigation screens. Approximately 24 percent agreed or strongly agreed that sun glare often makes it difficult to see maps or directions on the navigation screen, 9 percent disagreed or strongly disagreed that the navigation screen is large enough to see easily, and 8 percent disagreed or strongly disagreed that the navigation screen is in a location where it is easy to see while driving. Other items addressed the perceived demands of interacting with the navigation system in different ways while driving.

Safety

- Forty-five percent of navigation system owners thought that using their systems made them safer drivers and 3 percent thought that it made them less safe. A majority (52%) thought that using the navigation system made them neither more nor less safe.

- Sixty-three percent of respondents said that they were not aware of any manufacturer's warnings or limitations about their navigation system, and 13 percent of navigation system owners said that their systems had created new driving problems or safety concerns for them.
- Seven percent of respondents agreed with the statement, "I find that the navigation system distracts me too much from the task of driving." Eighty percent of respondents disagreed. On other items, 88 percent of respondents agreed that, "Using my in-vehicle navigation system is less distracting than using a paper map or road atlas," and 82 percent of respondents agreed that, "Using my in-vehicle navigation system is less distracting than following printed directions." Only 5 to 8 percent of respondents disagreed with these two statements.
- Thirty-seven percent of respondents found it acceptable to restrict the driver from manually entering a new destination address while the vehicle is moving, and 47 percent found it unacceptable. Those with navigation systems that currently allow this operation were less likely to say that the operation should be restricted.

Need for system improvements

Approximately 54 percent of respondents reported a need for improvements to their navigation systems. The most frequent suggested areas for improvement of navigation systems were related to making the system easier to operate with faster data entry, adding or improving speech recognition capability, and providing a larger, easier-to-read, touch-sensitive screen.

Comparisons by age group

Responses from system owners who were 65 or older were compared to those from system owners who were younger than 65. Among the respondents who had navigation systems, 32 percent were 65 or older. There were many items on which the responses from older and younger respondents differed significantly. Some of these differences are listed below.

- Older respondents were less likely than younger respondents to say that they would want to get a navigation system if they purchased their same model vehicle again.
- Older respondents used their navigation systems less frequently (fewer times per week or month).
- Older respondents were less likely than younger respondents to say that they use their navigation systems now more than when they first purchased their vehicles.
- Older respondents were more likely than younger respondents to have learned how to operate their navigation system from the owner's manual, but among those who said that they learned from reading the owner's manual, older respondents were less likely to say that the manual was easy to use. A higher percentage of older respondents than younger respondents said that have not yet learned how to use their navigation system.
- Older respondents were more likely than younger respondents to say that they would "not change anything" about the way that they drive if they could no longer use their navigation system. Older respondents were also more likely than younger respondents

to say that they would "drive in heavy traffic less often" if they couldn't use their navigation system.

- Older respondents were more likely than younger respondents to prefer listening to spoken directions, while younger respondents were more likely to prefer viewing directions on the navigation screen.
- Older respondents were less likely than younger respondents to strongly agree that the navigation screen is in a location that is easy to see while driving and they were much less likely than younger respondents to strongly agree that the screen is large enough to see easily. Older respondents were more likely than younger respondents to agree that sun glare on the navigation screen often makes it difficult to see maps or directions.
- Older respondents were more likely to say that the navigation system was too complex and wished that it didn't have so many functions.
- A higher percentage of younger respondents than older respondents said that they were aware of manufacturer's warnings or limitations about their navigation system.
- Older respondents were less likely than younger respondents to say that having a navigation system made them safer drivers. However, the percentage of older and younger respondents who thought that the navigation system created new driving problems or safety concerns for them was not significantly different.

Conclusions

The present survey suggests that some drivers may rely more on the navigation system as they gain greater experience with their vehicle, and for some drivers, having the navigation system reduces the psychological stress of being lost and gives them a sense of confidence for driving in certain areas, weather (and lighting) conditions, or traffic conditions where they would otherwise not drive. Using the navigation system may prevent inefficient trips and it may reduce the number of potentially unsafe maneuvers such as U-turns, or sudden or late lane changes near intersections by decreasing the cognitive and visual demands of wayfinding. Nearly 80 percent of respondents agreed that their navigation systems do a good job of rerouting them when they miss a turn. Although the net safety impact of using in-vehicle navigation systems is not known, 45 percent of navigation system owners thought that using their navigation system made them safer drivers and only 3 percent thought that it made them less safe.

Although most drivers find the navigation system to be useful, a substantial number of owners would like system improvements, particularly with regard to ease of operation, especially easier data input (destination programming). Manufacturers should consider ways to simplify operation of the system, while creating better methods to input new address information. For example, many respondents suggested expanding speech recognition capabilities.

Navigations systems were perceived as being too complex by many older respondents and they were less likely than younger respondents to understand the limitations of their system. Effort should be undertaken to improve vehicle owners' manuals, especially for older drivers who are the most likely to read it, and automobile dealers should be encouraged to teach customers about navigation system operations.

Finally, further research, including longitudinal research, should be undertaken to understand how drivers modify their behavior resulting from the long-term use of navigation systems, and how the use of navigation systems may impact drivers' exposure to risk on the highways. For example, do drivers have a tendency to rely too much on their navigation system by following it blindly even when the instructions may be wrong? A second area of needed research is to find ways to improve the efficiency and safety of interaction between driver and navigation system.

PROJECT OVERVIEW: USE OF ADVANCED IN-VEHICLE TECHNOLOGY BY YOUNG AND OLDER EARLY ADOPTERS

This report describes survey research conducted with owners of in-vehicle navigation systems. It is one in a series of reports that describe the work conducted under the overall project on the use of advanced in-vehicle technology by young and older early adopters.

Project Partners

This project was a collaborative effort between the National Highway Traffic Safety Administration and AAA Foundation for Traffic Safety (AAAFTS). AAAFTS joined with the Automobile Club of Southern California (ACSC) to administer mail-out surveys to individuals who were likely to own vehicles equipped with specific advanced in-vehicle technologies. NHTSA engaged Westat, Inc., to work with AAAFTS and ACSC to reduce the data from returned questionnaires, and perform statistical analyses of the results.

Purpose

The purpose of the project was to assess drivers' experiences with recently introduced in-vehicle technologies. Safety issues (either positive or negative) may be discovered or better understood from the experiences of early adopters before the technologies become widely deployed in the U.S. vehicle fleet. Some specific areas of interest included drivers' acceptance of the systems, perceived effectiveness and usability of the systems, and behavioral adaptations which may occur with system use. Another area of particular interest was the use of advanced in-vehicle technologies by older drivers. For the purposes of this study, drivers 65 or older are referred to as "older drivers," and drivers 25 to 64 years old are referred to as "younger drivers."

Specific objectives were to:

- Determine driver acceptance and behavioral adaptation to advanced technology currently available in production automobiles.
- Determine how the use of the technology has affected the driving task from a safety point of view.
- Determine how acceptance and use of technology is influenced by system interface characteristics, operation, and performance.
- Assess drivers' ability to learn how to use the technology and integrate it into the driving task.
- Compare drivers' reactions to and understanding of different interface designs.
- Identify future research needs.

The overarching goal was to learn more about the extent to which advanced in-vehicle technologies enhance or detract from safety, particularly with respect to the capabilities and limitations of older drivers. It is possible that new technologies can assist older drivers to drive more safely with less stress, thus extending their safe driving years. It is also possible that, for some drivers, new in-vehicle technologies are misunderstood and misused in

dangerous ways. A major focus of the data analysis was to compare the responses of older drivers to those of younger drivers.

Project Scope

The project partners selected five in-vehicle technologies for investigation. Some of the factors considered in the choice of technologies were the research priorities of NHTSA and AAAFTS, the relative numbers of vehicle owners in the ACSC insurance database who could be expected to have each technology, and the potential to explore human factors and safety issues associated with each technology through survey methods. Five separate surveys were developed to cover:

- Backing aid systems (sensor-based systems)
- Rear-view video camera systems
- High-intensity discharge (HID) headlamps, and adaptive headlamps
- Navigation systems
- Adaptive cruise control

A total of 40,000 questionnaires were mailed to ACSC-insured members who were invited to participate based on the known manufacturer, model, and model year of their vehicles and the likelihood that the vehicle would have one of the five specific in-vehicle technologies. The number of questionnaires mailed for each technology type is shown below:

Backing Aid Systems	5,000
Rear-View Camera	5,000
Advanced Headlamp Systems	10,000
Navigation Systems	10,000
Adaptive Cruise Control	10,000
Total Questionnaires Mailed	40,000

The results of these five surveys will be released in a series of reports covering the different in-vehicle technologies investigated. This report describes the results from the survey on navigation systems.

NAVIGATION SYSTEMS

An in-vehicle navigation system is a convenience feature designed to provide route guidance. The information given below was taken from an inventory of in-vehicle devices that was conducted as part of the current project and previous projects (Llaneras & Singer, 2002; Llaneras, Neurauter, Singer, & Jenness, 2005).

Functional Characteristics of Navigation Systems

Navigation systems are becoming increasingly more widespread in the United States, with over 144 2005/2006 vehicle model lines offering some form of in-vehicle routing and navigation system, including 35 with speech recognition capability. Although many luxury-class vehicles come with a navigation system as standard equipment, these systems are being offered as options in a wide range of vehicle classes including SUVs and minivans. Routing functions are also being integrated within larger driver information systems (radio, CD player, HVAC, etc.), and the use of voice recognition technology is becoming more common as a means to interact with and control system functions.

The number of available navigation systems is quite large; this section merely highlights basic system features and designs presented and discussed in an earlier NHTSA report (Llaneras and Singer, 2002). Systems with speech recognition and those with new or unique designs are highlighted as well.

Navigation system displays & location

All of the available factory installed systems include some form of visual display which drivers use to program destinations, view maps, receive systems status information, access visual-based routing and guidance information, and perform other navigation related tasks. Most navigation systems rely on three primary guidance display screens to communicate navigation information to drivers: (1) maps, (2) maneuver lists with sequenced turn directions, and (3) turn-by-turn guidance displays which generally “pop up” in advance of a turn. The vast majority of systems tend to locate visual displays in the center stack area of the instrument panel where conventional radio and HVAC controls are typically found. Retractable displays (visible only when the system is in operation) are also common; these configurations tend to locate the display closer to the driver’s line of sight, yet limit distraction when the system is not in operation. Most systems allow the display (and the navigation system itself) to be easily viewed and operated by a front seat passenger. The Chrysler Pacifica is one exception, and is the only system currently available to embed the visual display within the instrument cluster itself as the primary display. Figure 1 shows the 4.2-inch color visual display for the Pacifica which is integrated under the speedometer. This unique design is intended to allow the driver to easily glance to the display (as well as limit glare); it unfortunately also makes the system difficult for passengers to use since the view of the display is limited (as is access to the controls that are located to the right just under the cluster brow).

Pacific Navigation Display & Controls

Figure 1. 2005 Chrysler Pacifica in-dash navigation system

The driver of an Audi A8 also has the option of viewing the navigation screen in its instrument cluster, but this is in addition to the center screen which is still easily viewable by a passenger. The driver information system can be used to view standard vehicle information, trip computer, navigation screen, and even supplementary ACC information if so equipped. The driver can rotate between these views by pressing the reset button located on the windshield wiper stalk on the right side of the steering column.

Another vehicle with an unorthodox location for the navigation display is the Nissan Quest. The Quest places the display in between the driver and passenger, but it is located in a pod on top of the dashboard angled toward the driver. The controls to the system are accessible by a passenger, but the angled position towards the driver may make it difficult for a passenger to view.

One new feature for the 2005 model year is Acura's navigation system featuring real-time traffic information, offered on the RL (Figure 2). This system uses XM Satellite radio in conjunction with the navigation system to present traffic, accident, construction, and weather updates that are related to the selected route. For now, this feature is limited to selected metropolitan areas.

Figure 2: Acura RL Real-Time Navigation System

System operation and satisfaction

Navigation systems incorporate a relatively large number of features and options for configuring displayed information and executing tasks. A variety of methods exist for programming a destination into a navigation system, and most systems tend to support at least five different methods, with street address, point of interest, and address book entry methods among the most prevalent. Some systems allow destinations to be programmed using a phone number, and even speech commands using voice recognition software. The vocabulary (or number of commands) recognized by the system varies by system. The 2005 Acura RL system can recognize 550 voice commands, while other systems have a much more limited vocabulary. In many cases, the voice command system is activated by a button press and can be used to interact with systems other than navigation including, the radio, CD player, and telephone.

Many, but not all, navigation systems restrict or lock out complex tasks (i.e., destination entry) when the vehicle is moving. All systems warn the driver against attempting to interact with the device while driving. Nevertheless, many systems do incorporate features that may minimize glance times to displays (and eyes-off-road time) and manage information flow such as limiting the number of available menu options or rows of items on a display, and use of auditory outputs for routing information and system feedback.

DEVELOPMENT OF SURVEY INSTRUMENTS

Content areas

Questionnaires were developed through an iterative process that included several stages of review by project partners. Initial drafts of the questionnaires were based on NHTSA's exploratory study of early adopters of in-vehicle technologies (Llaneras, 2006). Many new items were written to address the specific objectives of the current project such as determining driver acceptance and adaptation to the technologies and determining how use of the technology has affected safety of the driving task. Items were developed to address several key content areas, including:

- Background information about the vehicle owner – age, gender, experience with the vehicle, etc.;
- Acceptance of the technology – use and desire to obtain the technology;
- Learning how to use the technology – sources of information, difficulty with learning;
- Behavioral adaptation to the technology – changes in driving behavior with the technology, how drivers rely on the technology;
- Perceived effectiveness of the technology – how well owners believe that the technology works under several specific scenarios and weather conditions;
- User interface and usability – sounds, visual displays;
- Safety – overall opinion of the safety of the system, driving incidents related to the technology; and
- Need for improvements – owners' suggestions for needed improvements regarding the technology and regarding the design of vehicles for older people.

All the questionnaire items are listed in Table 1. Items are grouped by their key topic area. Note that some items may apply to more than one topic area, but they are listed here only under their primary topic area.

Table 1. Navigation system questionnaire: Content areas and associated items

Background	1. Age 2. Gender 3. Do you have physical conditions which make driving more difficult? 4. A navigation system shows maps on a screen and/or provides step by step driving directions to help the driver get to a chosen destination. Does your vehicle have a navigation system installed by the manufacturer? 4A. If no, then why not? 4B. If you purchased this same model again would you want a factory installed navigation system? (for those who do not currently have a navigation system) 6. Approximately how many miles have you personally driven this vehicle?
Acceptance	5. If you purchased this model again would you want a factory installed navigation system? (for those who currently have a navigation system) 7. How often do you use your vehicle's navigation system?
Learning	8. How did you learn to use your vehicle's navigation system? 10. Were there things that were especially difficult to learn about your vehicle's navigation system? 10A. If yes, please explain.
Behavioral Adaptation to	14. Imagine that your navigation system broke down. How would you change the way you drive if you could not use your navigation system anymore?

System	16. How has your usage of the navigation system changed since you first started driving this vehicle? 21. For what types of trips do you use your navigation system? 22. How frequently do you use your navigation system in the following ways? 22A. Manually entering a new street address while parked. 22B. Manually entering a new street address while driving. 22C. Verbally entering destination information while parked. 22D. Verbally entering destination information while driving. 22E. Looking at an area map on the navigation screen while driving 22F. Reading turn-by-turn directions displayed on the navigation screen while driving. 22G. Listening to turn-by-turn directions while driving. 22H. Asking your passenger to control or get information from the navigation system while you are driving. 22I. Choosing the route that will take the shortest time. 22J. Choosing the route that is the shortest distance. 22K.Choosing a route to avoid major roadways. 22L.Choosing a route that will avoid traffic problems and congestion.
Perceived Effectiveness	12B. Does listening to voice directions reduce the amount of time that you look at the navigation screen? 15F. My risk of getting lost is lower with the navigation system than without it (strongly disagree, disagree, neutral, agree, strongly agree, not applicable). 15H. The navigation system does a good job rerouting me when I miss a turn (strongly disagree, disagree, neutral, agree, strongly agree, not applicable).
User Interface and Usability	11. Does your navigation system respond to spoken commands? 11A. Do you find this feature useful? 11B. How well does the system understand what you say? 12. While driving, do you prefer to listen to spoken turn-by-turn directions from the navigation system, or do you prefer to view directions on the screen? 12A. Why don't you prefer to listen to voice directions? 13. Thinking about the number of features/functions and complexity of your navigation system, would you say that your system is: (Too simple, I wish I could do more things with it, About right in terms if complexity and number of features/functions, Too complex, I wish that it didn't have so many different functions) 15A.The navigation system is in a location where it is easy to see when I am driving (strongly disagree, disagree, neutral, agree, strongly agree, not applicable). 15B. The navigation screen is large enough to see easily (strongly disagree, disagree, neutral, agree, strongly agree, not applicable). 15E. Sun glare or reflections on the navigation screen often make it difficult to see maps or directions (strongly disagree, disagree, neutral, agree, strongly agree, not applicable). 23. How demanding are each of these navigation system activities while you are driving? 23A. Manually entering a new street address while driving. 23B. Verbally entering destination information while driving. 23C. Looking at an area map on the navigation screen while driving. 23D. Reading turn-by-turn directions displayed on the navigation screen while driving. 23E. Listening to turn-by-turn directions while driving. 23F. Choosing an alternative route while driving.
Safety	9. Are you aware of any warnings or limitations about your vehicle's navigation system? 9A. If yes, please explain. 15C. Using my in-vehicle navigation system is less distracting than using a paper map or road atlas (strongly disagree, disagree, neutral, agree, strongly agree, not applicable). 15D. Using my in-vehicle navigation system is less distracting than following printed directions (strongly disagree, disagree, neutral, agree, strongly agree, not applicable). 15G. I find that the navigation system distracts me too much from the task of driving (strongly disagree, disagree, neutral, agree, strongly agree, not applicable). 17. Does your current navigation system allow you to manually enter a new destination while you are driving?

	18. Some navigation systems do not allow the driver to manually enter a new destination address while the vehicle is moving. Is this restriction acceptable to you? 19. Does using the navigation system create any new driving problems or safety concerns for you? 19A. If yes, please explain. 20. Overall, does having the navigation system make you a safer driver?
Need for Improvements	24. Is there anything about the navigation system that you think should be improved or changed? 24A. If yes, please explain. 25. In general, do you believe that car manufacturers are doing enough to design vehicles to accommodate an aging population? 25A. If you answered "no" then what more do you believe could be done?

The questionnaire (see Appendix B) was designed so that all survey items and a cover letter could be printed double-sided on no more than five sheets of paper. Pilot tests were conducted to ensure comprehension of the questions and to ensure that the typical completion time for the questionnaire was less than 15 minutes. A second stage of pilot tests was conducted by mailing out 100 questionnaires to drivers insured through the Automobile Club of Southern California. This mail-out was used to get an indication of the expected response rate for the survey and to review the types of answers that respondents provided to ensure that each item was understandable.

Final questionnaires for the navigation survey were mailed out during November, 2006. A cover letter from ACSC was included that explained the purpose of the survey and invited the vehicle owner to participate (see Appendix B). All vehicle owners who received questionnaires were asked to return the questionnaire even if they did not have the indicated technology on their vehicle. On the back of the cover letter, respondents were asked whether they would be willing to participate with ACSC in a brief phone interview about their vehicle. Those who were willing to do this were asked to write in their contact information.

Telephone Interviews

A subset of survey respondents who gave their consent to be called was selected for telephone interviews. ACSC staff only called system owners who indicated on the written questionnaire that they thought that their navigation system should be improved, as a goal of the telephone interviews was to uncover any potential problems with the systems that were not addressed by items on the questionnaire. ACSC staff made up to three attempts to contact each member selected for a phone interview. The telephone interviewers used a script to guide the conversation (see Appendix D). Eighty-three owners of navigation systems were interviewed. The interviewees' comments are given in Appendix E. Selected comments from the telephone interviews also are included *(in italics)* in the Results section.

Sampling

The sampling plan and data collection protocol for this study were designed to meet the mutual needs of all project partners. Practical considerations, such as project budgets, variables available in the ACSC insurance database, and estimated questionnaire return rate contributed to the sampling plan. ACSC queried their database to identify a subset of customers who owned particular vehicle models (and model years) that have a navigation system as standard equipment or might have it as optional equipment. Note that the

investigators could not determine in advance whether owners in the insurance database that owned vehicles with optional ACC had purchased these options, thus, some people who received the survey did not own a vehicle that actually had a navigation system.

Navigation system questionnaires (n = 10,000) were mailed to a random sample of these candidate system owners subject to the following constraints. To the extent feasible, 75 percent of the questionnaires for each survey were mailed to vehicle owners whose vehicle included the technology as a factory-installed standard feature and 25 percent of the questionnaires were mailed to owners of vehicles on which the technology was a factory-installed optional feature. An additional sampling requirement was that, to the extent possible, one-half of the questionnaires for each technology survey were mailed to vehicle owners 65 or older, and the other half were mailed to vehicle owners who were 25 to 64 years old. Respondents were not offered any monetary or other incentives for their voluntary participation.

RESULTS

Tabulated response frequencies for all survey items are show in Appendix B. In this section, the results from the survey are described in more detail, along with selected quotations from follow-up telephone interviews. The complete set of quotations from the telephone interviews is given in Appendix D.

Nearly all respondents with navigation systems had vehicles from 20 different vehicle manufacturers in the 2001 to 2006 model years (with one from 2000 and one from 2007). All system owners' data was used for the majority of the analyses reported here. However, due to the small sample size obtained for some vehicle manufacturers, we restricted comparisons between manufacturers to those with adequate data in our sample. Some comparisons involved seven manufacturers including BMW, Cadillac, Chrysler, Infiniti, Jaguar, Lexus, and Mercedes-Benz, while other comparisons involved only the five manufacturers with the largest number of navigation system owners in the sample (BMW, Cadillac, Chrysler, Lexus, and Mercedes-Benz). Unless noted, all comparisons between age groups involved respondents who were younger than 65 (younger group) being compared to respondents who were 65 or older (older group).

1. General Characteristics of Survey Respondents

Response rate

Vehicle owners selected for the navigation system survey were instructed to return the questionnaire even if they did not have a navigation system on their vehicle. Approximately 22.4 percent (n = 2,236) of the 10,000 questionnaires mailed were returned, and 66.8 percent (n = 1,494) of those who returned the questionnaire reported having a navigation system.

Age and gender

Approximately 32 percent of the respondents with a navigation system were 65 or older. Figure 3 shows the number of respondents in each of six age categories who have navigation systems. The dark bar represents the number of men and the lighter bar represents the number of women. Overall, 32 percent of the respondents who reported owning a navigation system were women; however, the ratio of male to female navigation system owners was significantly related to age group, $\chi^2(5) = 83.6$, $p < .001$. There were more female respondents (55%) than male respondents (45%) with navigation systems in the youngest age group, but the ratio of women to men decreased with increasing age. In the oldest two age groups only 20 and 15 percent of respondents with a navigation system were women.

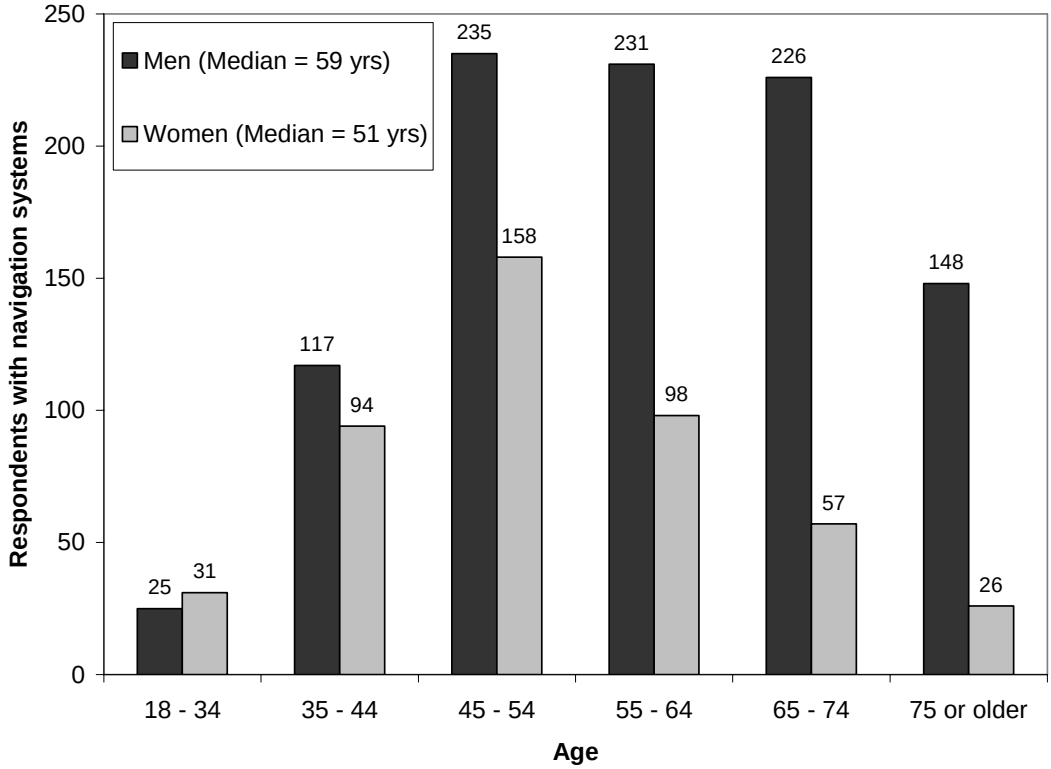

Figure 3. Age and gender of respondents with navigation systems

Among the sample of navigation system owners, vehicle manufacturer was significantly related to both the respondent's age group, $\chi^2(6) = 42.6$, $p < .001$, and respondent's gender, $\chi^2(6) = 13.8$, $p < .001$. Table 2 shows the number of older and younger navigation system owners for each of seven vehicle manufacturers. Table 3 shows the number of male and female system owners by vehicle manufacturer. Chrysler had the highest percentage of older respondents (58%) and Jaguar had the lowest percentage of older respondents (18%). Jaguar had the highest percentage of male respondents (79%) and Lexus had the lowest (61%).

Table 2. Navigation system owners' age group by vehicle manufacturer

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Infiniti	Jaguar	Lexus	Mercedes-Benz	Total
Younger than 65	163 (79.90)	74 (69.16)	27 (41.54)	23 (65.71)	28 (82.35)	153 (62.70)	469 (70.53)	937 (69.20)
65 or older	41 (20.10)	33 (30.84)	38 (58.46)	12 (34.29)	6 (17.65)	91 (37.30)	196 (29.47)	417 (30.80)
Total Row Pct.	204 15.07	107 7.90	65 4.80	35 2.58	34 2.51	244 18.02	665 49.11	1,354 100.00

Table 3. Navigation system owners' gender by vehicle manufacturers

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Infiniti	Jaguar	Lexus	Mercedes-Benz	Total
Female	51 (25.50)	39 (37.50)	18 (28.57)	11 (32.35)	7 (20.59)	95 (39.42)	206 (31.60)	427 (32.15)
Male	149 (74.50)	65 (62.50)	45 (71.43)	23 (67.65)	27 (79.41)	146 (60.58)	446 (68.40)	901 (67.85)
Total	200	104	63	34	34	241	652	1,328
Row Pct.	15.06	7.83	4.74	2.56	2.56	18.15	49.10	100.00

Physical conditions that make driving more difficult

Respondents were asked, (Q3): "Do you have any physical conditions which make driving more difficult?" The most commonly reported physical conditions were vision problems (6.2%), hearing problems (2.6%), and difficulty turning my head/neck (2.8%). Eighty-nine percent of all respondents reported that they have no physical conditions which make driving more difficult. The overall response frequencies are given in Appendix B.

Among those with navigation systems, 93 percent of younger respondents and 87 percent of older respondents reported having none of the physical conditions listed. This difference was statistically significant, $\chi^2(1) = 11.4$, $p < .001$. Older system owners were more likely than younger system owners to report having hearing problems [$\chi^2(1) = 25.8$, $p < .001$; 5% versus 0.6%], dexterity problems [$\chi^2(1) = 13.4$, $p < .001$; 2.8% versus 0.4%] and difficulty turning the head or neck [$\chi^2(1) = 7.7$, $p < .01$; 4% versus 1.5%]. Older and younger navigation system owners did not differ significantly with respect to vision problems $\chi^2(1) = 0.3$, $p = .57$, or other conditions $\chi^2(1) = 0.5$, $p = .50$.

Driving experience with currently owned vehicle

Navigation system owners were asked to write in the number of miles they had personally driven their vehicle. Not surprisingly, navigation system owners who had older vehicles (by model year) tended to have driven their vehicles more miles than system owners with newer vehicles, $r = -.26$, $p < .0001$. The number of miles driven (Q6) was used as a surrogate measure of experience with the vehicle and its associated in-vehicle technologies. The responses were grouped into seven mileage categories and are shown in Appendix B. For analysis purposes, the number of mileage categories (experience levels) was reduced to five: less than 5,000 miles; 5,000 to 9,999 miles; 10,000 to 19,999 miles; 20,000 to 29,999 miles; 30,000 miles or more. Among navigation system owners, experience level was not significantly related to gender, $\chi^2(4) = 0.5$, $p = .97$, nor was it significantly related to age group, $\chi^2(4) = 5.6$, $p = .23$.

As described in the sections below, responses to several questionnaire items (Q7, Q8, Q12B, Q14E, Q14F, Q15F, Q16, Q17, Q18, Q21B, Q21C, Q21D, Q22A, Q22B, Q22C, Q22D, Q22H, Q22I, Q23B, Q24) were significantly related to level of vehicle experience.

2. Navigation System Acceptance

> *"I would never buy a car without a navigation system now [. . .] It's like air conditioning, once you use one you never get another car without it." – (Male, 61)*
>
> *"The navigation system is too complicated and it gives you the wrong directions. It is useless." – (Male, 69)*
>
> *"I did not want it at all. The dealer looked around but couldn't find [my vehicle model] without it. I didn't like the technology, but now I thoroughly enjoy using it. Now, I won't buy a car without it. – (Female, 58)*

Desire to have a navigation system

Two identical questions on the navigation system survey were targeted to respondents who currently have (Q5) or do not have (Q4B) the system: "If you purchased this same vehicle again would you want a navigation system?" The response frequencies for these items were combined and are shown in Table 4. (Only those who indicated definitively on item Q4 that they either have or do not have a navigation system were included in this analysis.) The pattern of responses depended significantly on whether or not the respondents currently have a navigation system, $\chi^2(2) = 722$, $p < .001$. Nearly 88 percent of those who currently have a navigation system said that they would want to purchase it again, while only 37 percent of those without the system said they would want it.

Table 4. Respondents who would want a navigation system if they purchased their same vehicle again

Frequency Row Pct.	Yes	No	Don't Know	Total
Respondents who have a navigation system now	1,264 87.96	88 6.12	85 5.92	1,437 100.00
Respondents who do not have a navigation system	255 36.90	260 37.63	176 25.47	691 100.00

Table 5 shows the response frequencies for younger and older navigation systems owners to item Q5. The responses depended significantly on age group, $\chi^2(2) = 20.9$, $p < .001$. Younger respondents were more likely than older respondents to say that they would want to get a navigation system if they purchased their same model vehicles again.

Table 5. Navigation system owners who would want to get a factory installed navigation system if they purchased their same model vehicles again. (Q5) by age group

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Yes	907 (90.34)	357 (82.45)	1,264 (87.96)
No	44 (4.38)	44 (10.16)	88 (6.12)
Don't Know	53 (5.28)	32 (7.39)	85 (5.92)
Total Row Pct.	1,004 69.87	433 30.13	1,437 100.00

Responses to item Q5 also depended significantly on the respondent's vehicle manufacturer, $\chi^2(8) = 20.8$, $p < .01$, as shown in Table 6. Approximately 87 to 91 percent of BMW, Cadillac, Lexus, and Mercedes-Benz owners would want to get a navigation system again, but fewer Chrysler owners (75%) indicated that would want to get a navigation system if they purchased their same vehicle model again. The responses to item Q5 did not depend significantly on the respondent's level of experience with the vehicle, $\chi^2(8) = 9.4$, $p = .31$.

Table 6. Navigation system owners who would want to get a factory installed navigation system if they purchased their same model vehicle again. (Q5) by vehicle manufacturer

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Yes	171 (87.24)	94 (91.26)	48 (75.00)	211 (89.03)	560 (88.19)	1,084 (87.77)
No	9 (4.59)	7 (6.80)	7 (10.94)	8 (3.38)	43 (6.77)	74 (5.99)
Don't Know	16 (8.16)	2 (1.94)	9 (14.06)	18 (7.59)	32 (5.04)	77 (6.23)
Total Row Pct.	196 15.87	103 8.34	64 5.18	237 19.19	635 51.42	1,235 100.00

Respondents who do not currently have a navigation system were asked why they didn't have it (item Q4A). The four most common reasons cited for not having a navigation system were related to availability of the system, not having a need for the system, cost of the system, and lack of knowledge about the system:

- (42%) - "It was not an option on my vehicle."
- (35%) - "I don't need the navigation system to find my way."
- (32%) - "The navigation system was not worth the extra cost."
- (31%) - "It never occurred to me to look for one when I was buying the vehicle,"

Twelve percent of respondents thought that the navigation system would be a nuisance or distraction. Relatively few respondents (7%) cited bundling with other unwanted options as a reason for not having a navigation system, and despite the growing availability of aftermarket systems including nomadic navigation systems, only 3 percent of respondents indicated that they intended to use an aftermarket navigation system. The complete list of response frequencies for these items is shown in Appendix B.

Navigation system use

> *"[My navigation system] is always on – to look for a quicker exit, or a restaurant. My system is used daily as part of my normal driving routine." – (Male, 35)*

Item Q7 asked respondents how often that they use their vehicles' navigation system. Thirty-two percent of respondents use their navigation system less than once a month. Thirty percent use it one to three times per month, 16 percent use it once a week, 12 percent use it two to three times per week, and 10 percent use it four or more times per week. These responses depended significantly on age group, $\chi^2(4) = 53.8$, $p < .001$, as shown in Table 7. As compared to younger respondents, older respondents use their navigation system less frequently.

Table 7. Navigation system use by age group

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Less than once a month	266 (26.68)	188 (44.34)	454 (31.95)
Approximately 1-3 times per month	298 (29.89)	126 (29.72)	424 (29.84)
Approximately once per week	182 (18.25)	50 (11.79)	232 (16.33)
Approximately 2-3 times per week	130 (13.04)	35 (8.25)	165 (11.61)
4 or more times per week	121 (12.14)	25 (5.90)	146 (10.27)
Total Row Pct.	997 70.16	424 29.84	1,421 100.00

It is also possible to look at responses to Q7 by manufacturer for differences in navigation system use. Table 8 shows the reported frequency of navigation system usage by vehicle manufacturer, $\chi^2(16) = 42.6$, $p < .001$. Approximately 30 percent of Lexus owners use their navigation system two or more times per week, and 51 percent of the Lexus owners use their system at least once a week. In contrast, only 13 percent of Chrysler owners use their navigation system two or more times per week and only 21 percent of Chrysler owners use their system at least once per week.

Table 8. Navigation system use by vehicle manufacturer

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Less than once a month	55 (28.21)	30 (29.70)	26 (42.62)	59 (24.89)	233 (37.16)	403 (32.48)
Approximately 1-3 times per month	66 (33.85)	24 (23.76)	22 (36.07)	57 (24.05)	189 (30.14)	358 (29.60)
Approximately once per week	28 (14.36)	22 (21.78)	5 (8.20)	50 (21.10)	89 (14.19)	194 (16.08)
Approximately 2-3 times per week	25 (12.82)	14 (13.86)	6 (9.84)	37 (15.61)	64 (10.21)	146 (11.81)
4 or more times per week	21 (10.77)	11 (10.89)	2 (3.28)	34 (14.35)	52 (8.29)	120 (10.02)
Total Row Pct.	195 15.97	101 8.27	61 5.00	237 19.41	627 51.35	1,221 100.00

Responses to Q7 were also analyzed based on prior driving experience with the vehicle. The reported frequency of use of the navigation system depended significantly on experience level, $\chi^2(16) = 42.7$, $p < .001$. Within each of five different levels of vehicle experience, Figure 4 shows the percentage of respondents who use their navigation system frequently (two or more times per week) and the percentage of respondents who use their navigation system infrequently (less than once per month). Note that the percentages of respondents who use their navigation system moderately frequently (between one and four times per month) are not represented in this figure. As shown in Figure 4, drivers with higher levels of vehicle experience were more likely than drivers with less experience to use their navigation system frequently. Also, drivers with less vehicle experience were more likely than drivers with more vehicle experience to be infrequent users. This data suggest that drivers may increase their use of the navigation system as they gain experience with their vehicles; however, an alternative explanation is that vehicle owners who do the most driving tend to use their navigation systems more frequently than vehicle owners who do less driving.

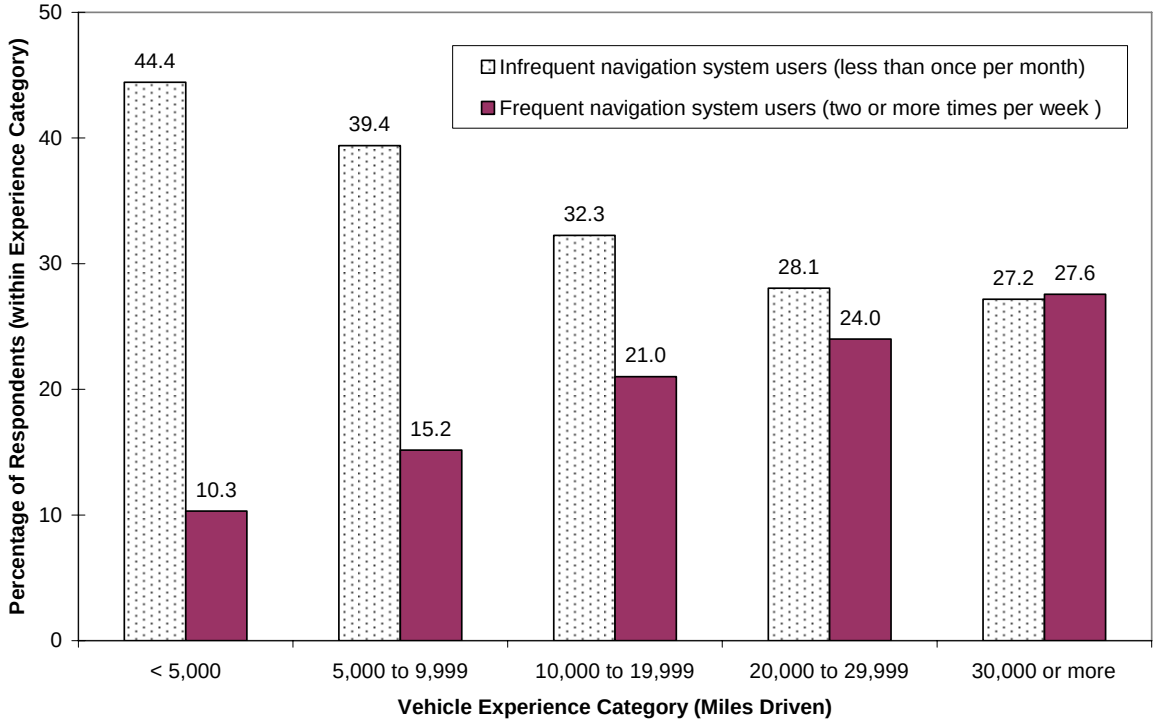

Figure 4. Percentage of frequent and infrequent navigation system users by level of vehicle experience

3. Learning to Use the Navigation System

> *"Direct training in Germany when we bought the car helped a lot." – (Male, 77)*
>
> *"I received no help from the dealer in figuring out how to operate the navigation system." – (Male, 55)*

Item Q8 asked respondents with a navigation system how they had learned to use the system. The three most common responses were: (a) Vehicle owner's manual (65%), (b) On-road experience and practice (trial and error) (55%), and (c) Instructions from the dealership, such as video, brochure, or demonstration (47%). A small percentage of people received help from a friend (13%). The remaining response options totaled less than 7 percent.

<u>Differences in learning to use the navigation system based on vehicle manufacturer</u>

Respondents' learning methods were compared between the five most common vehicle manufacturers in the sample. Two of the learning methods showed response differences based on vehicle manufacturer. The percentage of respondents who learned to use their navigation system from dealership instructions differed significantly by manufacturer, $\chi^2(4) = 17.3$, $p < .01$. Chrysler owners chose this response 34 percent of the time (the least frequent) and Cadillac owners chose this response 59 percent of the time (the most frequent). Mercedes-Benz (46%), BMW (47%), and Lexus (56%) fell in between. There was also a significant difference across manufacturers in the percentage of respondents who indicated

that they learned to use their navigation system from on-road experience and practice, $\chi^2(4) = 11.4$, $p < .05$. Sixty-two percent of BMW owners and 60 percent of Lexus owners chose this response. Only 51 percent of Mercedes-Benz owners chose this response, which was the lowest among the five manufacturers compared.

Age differences in learning to use the navigation system

Responses from younger and older navigation system owners were compared for each of the learning methods listed in item Q8. There were significant differences between the percentage of older respondents (75%) and younger respondents (60%) who used the vehicle owner's manual, $\chi^2(1) = 28.3$, $p < .001$. Although older respondents were more likely than younger respondents to use the vehicle owner's manual for learning the navigation system, younger respondents who used the manual were more likely than older respondents who used the manual to say that it was easy to use, $\chi^2(1) = 4.9$, $p < .05$.

A higher percentage of younger respondents (61%) than older respondents (43%) said that they learned to use the navigation system with on-road experience and practice, $\chi^2(1) = 41.4$, $p < .001$. A higher percentage of older respondents (9.5%) than younger respondents (2.9%) said that they have not yet learned how to use their navigation system, $\chi^2(1) = 29.1$, $p < .001$.

Differences in learning to use the navigation system based on level of vehicle experience

Responses to items Q8A, Q8D, and Q8F, (but not Q8B, Q8C, or Q8E) depended significantly on the respondent's level of vehicle experience. These results are shown in Table 9, and summarized here:

- The percentage of respondents who learned to use their vehicle's navigation system based on instructions from the dealership (Q8A) depended significantly on level of vehicle experience, $\chi^2(4) = 9.8$, $p < .05$. The percentage of respondents who reported using this learning method was highest for the group with 5,000 to 9,999 miles of experience and did not differ systematically with increasing experience.
- The percentage of respondents who learned to use their vehicle's navigation system based on help from by a friend or relative (Q8D) depended significantly on level of vehicle experience, $\chi^2(4) = 17.8$, $p < .01$. The percentage of respondents who reported using this learning method decreased systematically with higher levels of vehicle experience.
- The percentage of respondents who learned to use their vehicle's navigation system by on-road experience and practice (Q8F) depended significantly on level of vehicle experience, $\chi^2(4) = 36.2$, $p < .001$. The percentage of respondents who reported using this learning method increased systematically with higher levels of vehicle experience.

Table 9. Learning methods that differ by level of vehicle experience

Percentage of respondents who reported using the learning method	Level of Vehicle Experience				
	Less than 5,000 Miles	5,000 to 9,999 Miles	10,000 to 19,999 Miles	20,000 to 29,999 Miles	30,000 or More Miles
Instructions from dealership (Q8A)	49.22	56.89	44.02	51.59	45.75
Help from friend or relative (Q8D)	20.31	17.37	12.54	9.92	9.11
On-road experience and practice (Q8F)	36.72	45.51	56.85	57.54	62.75

Difficulty in learning to use the navigation system

Item Q10 asked respondents, "Were there things that were especially difficult to learn about your vehicle's navigation system?" Approximately 25 percent of respondents said yes to this question. Among those who responded affirmatively, 42 percent mentioned difficulties with learning to program the desired destination. A significantly higher percentage of older respondents (32%) than younger respondents (22%) said that there were things that were especially difficult to learn, $\chi^2(1) = 14.9$, $p < .001$. Responses did not depend significantly on the respondent's vehicle manufacturer, $\chi^2(4) = 3.5$, $p = .48$.

4. Behavioral Adaptation

> *"It makes driving easier – you do not look for street signs [when using the navigation system]." – (Male, 73)*
>
> *"[Since getting the navigation system] I am more comfortable driving in the evening [. . .] I am much more comfortable using the freeways now." - (Female, 68)*
>
> *"I have begun to rely on it after six to eight months. But, it is difficult to use. I only use it when I have the time to use it." – (Male, 47)*
>
> *"[The navigation system] has given me an independence I did not have before. I have gone to Yosemite, Sequoia, Navato, San Diego, and La Jolla. I've even used it for a jury summons to get me to the courthouse. It's given me a sense of independence I would not have living alone." – (Female, 72)*

Usage patterns

Navigation systems are designed to be used in several different ways, and it is of interest to determine how often system owners choose to interact with their systems in these different ways.

> *"[My system] is very helpful if you think that you may be close to your destination, but can't see the street number for the road you are on. You hit the map button, and it says you are at 2700 X Street, then 2600 X Street, etc. This tells you that you are going in the right direction." - (Male, 71)*

> *"I listen to the on-board navigation system, but also use a map online. I have an after-market navigation system that I attach to the windshield. It has more information than [the vehicle] system." - (Male, 32)*

Item Q22 asked survey participants, "How frequently do you use your navigation system in the following ways?" The participants were then given 12 situations where they may have used the navigation system, and a response scale which included "Never," "Rarely," "Occasionally," "Frequently," and "Not applicable." The complete set of response frequencies for these items is given in Appendix B. Responses to each situation were analyzed by age group, level of experience with the vehicle, and vehicle manufacturer. The results of these analyses are summarized below:

- Q22A. Manually entering a new street address while parked. The majority of respondents use their navigation system in this way. Eighty-seven percent of respondents reported doing this activity either "frequently" or "occasionally." There were significant differences between younger and older system owners' responses to this item, $\chi^2(4) = 38.4$, $p < .001$. Seven percent of older respondents and 3 percent of younger respondents said that they never manually entered a new street address while parked. Forty-eight percent of older respondents and 63 percent of younger respondents say that they did this activity frequently. Responses to item Q22A also depended significantly on experience level, $\chi^2(16) = 42.8$, $p < .001$. Those drivers with 30,000 or more miles were more likely than drivers with less vehicle experience to say that they did this activity frequently. Differences in responses based on the respondent's vehicle manufacturer were not statistically significant, $\chi^2(16) = 14.3$, $p = .58$.
- Q22B. Manually entering a new street address while driving. Overall, 47 percent of respondents said that they "never" do this activity and an additional 14 percent said that the item was "not applicable." Presumably this indicates that 61 percent of the respondents do not manually enter new street addresses while driving. There were significant differences between younger and older respondents on this item, $\chi^2(4) = 72.6$, $p < .001$. Older respondents were less likely than younger respondents to say they rarely (16 versus 22%), occasionally (6 versus 16%), and frequently (2 versus 6%) entered a new street address while driving. In contrast, older respondents (63%) were more likely than younger respondents (40%) to say they never entered a new street address while driving. Responses to item Q22B depended significantly on

experience level, $\chi^2(16) = 41.8$, $p < .001$. Those drivers with 30,000 or more miles were more likely to say they did this activity frequently or occasionally. Responses to item Q22B also depended significantly on vehicle manufacturer, $\chi^2(16) = 233.1$, $p < .001$. Some navigation systems restrict or lockout complex tasks such as manual entry of new street addresses the vehicle is moving. Accordingly, the "not applicable" responses to item Q22B differed widely by manufacturer. Thirty-eight percent of Cadillac owners, 29 percent of Chrysler owners, and 25 percent of Lexus owners chose this response. Only 7 percent of BMW owners and 6 percent of Mercedes-Benz owners chose this response.

- Q22C. Verbally entering destination information while parked. Relatively few respondents have or choose to use this feature. Eighty-seven percent of respondents said the item was either "not applicable" or that they "never" do this activity. There were significant differences between younger and older respondents on this item, $\chi^2(4) = 20.1$, $p = .001$. Older respondents were more likely than younger respondents to say they occasionally (9 versus 4%) or frequently (4 versus 2%) entered a new street address while parked, and less likely to say that they rarely did this activity (3 versus 6%). The responses to item Q22C also depended significantly on experience level, $\chi^2(16) = 30.5$, $p < .05$. Navigation system owners with less than 5,000 miles of experience were more likely to say they did this activity frequently or occasionally as compared to system owners with greater experience (15% versus 6 - 10%). Drivers with 20,000 or more miles of experience were more likely than drivers in less experienced groups to say that they never did this (29% versus 22 - 23%).
- Q22D. Verbally entering destination information while driving. As was the case for item Q22C, relatively few respondents have or use this feature. Approximately 90 percent of respondents said the item was either "not applicable" or that they "never" do this activity. There were significant differences between younger and older respondents on this item, $\chi^2(4) = 12.9$, $p < .05$. Older respondents were more likely than younger respondents to say they never verbally entered a new street address while driving (32% versus 26%). The responses to item Q22D also depended significantly on experience level, $\chi^2(16) = 30.0$, $p < .05$. Respondents with 10,000 to 19,999 miles of experience were the least likely to report doing this activity. Only 6 percent of respondents with this level of experience said that they verbally entered a new street address while driving frequently, occasionally, or rarely as compared to 18 percent of drivers with less than 5,000 miles of experience.
- Q22E. Looking at an area map on the navigation screen while driving. Sixty-five percent of respondents reported doing this activity "frequently" or "occasionally." There was a significant difference between younger and older respondents on this item, $\chi^2(4) = 56.97$, $p < .001$. Older respondents were more likely than younger respondents to say they never looked at an area map on a navigation screen while driving (22% versus 9%) and older respondents were less likely than younger respondents to say they do this activity frequently (17% versus 31%). Differences in responses based on the respondent's experience level were not statistically significant, $\chi^2(16) = 18.6$, $p = .29$, however responses were significantly related to vehicle manufacturer, $\chi^2(16) = 35.9$, $p < .01$. Comparing owners of vehicles from five

manufacturers, Mercedes-Benz owners and Chrysler owners were the least likely to report looking at a map on the navigation screen, "frequently" or "occasionally," and they were the most likely to report doing this "never" or "rarely."

- Q22F. Reading turn-by-turn directions displayed on the navigation screen while driving. Forty-seven percent of respondents reported doing this activity "frequently" or "occasionally." There was a difference between younger and older respondents on this item, $\chi^2(4) = 19.23$, $p < .001$. Older respondents were more likely than younger respondents to say that they never read turn-by-turn directions displayed on a navigation screen while driving (28 versus 19%), and older respondents were less likely than younger respondents to say they do this activity frequently (14 versus 21%). Differences in responses based on the vehicle manufacturer were not statistically significant, $\chi^2(16) = 20.3$, $p = .21$. Also, differences in responses based on the level of experience were not statistically significant, $\chi^2(16) = 24.3$, $p = .08$.
- Q22G. Listening to turn-by-turn directions while driving. Eighty-three percent of respondents reported doing this activity "frequently" or "occasionally." This method of getting information from the navigation system was used more frequently than looking at a map on the display or reading turn-by-turn directions. Responses were not significantly related to the respondent's age group, $\chi^2(4) = 7.8$, $p = .10$. However, responses differed significantly by vehicle manufacturer, $\chi^2(16) = 33.9$, $p < .01$, as shown in Table 10. Chrysler owners were more likely than owners of other vehicle makes to report doing this activity frequently.

Table 10. Frequency of listening to turn-by-turn directions by manufacturer.

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Never	15 (7.89)	4 (4.04)	5 (8.20)	16 (6.78)	26 (4.26)	66 (5.51)
Rarely	20 (10.53)	7 (7.07)	0 (0.00)	17 (7.20)	25 (4.09)	69 (5.76)
Occasionally	30 (15.79)	15 (15.15)	5 (8.20)	46 (19.49)	90 (14.73)	186 (15.54)
Frequently	121 (63.68)	69 (69.70)	47 (77.05)	148 (62.71)	434 (71.03)	819 (68.42)
Not Applicable	4 (2.11)	4 (4.04)	4 (6.56)	9 (3.81)	36 (5.89)	57 (4.76)
Total	190	99	61	236	611	1,197
Row pct.	15.87	8.27	5.10	19.72	51.04	100.00

- Q22H. Asking your passenger to control or get information from the navigation system while you are driving. Fifty-nine percent of respondents said that they do this frequently or occasionally. Twenty percent of older respondents and 15 percent of younger respondents said that they never did this, while 25 percent of older respondents and 30 percent of younger respondents said that they did this frequently.

However, the observed differences in responses from older and younger participants failed to reach statistical significance, $\chi^2(4) = 8.4$, $p = .08$. There were significant differences in responses between respondents who owned cars by different manufacturers, $\chi^2(16) = 44.0$, $p < .001$. Mercedes-Benz owners and Cadillac owners were the most likely to say that they did this frequently (31% and 32%) and Lexus owners were the least likely to say that they did this frequently (19%). Lexus owners were the most likely to say that they never did this (20%). The responses to item Q22H depended significantly on the respondent's level of experience with their vehicle, $\chi^2(16) = 45.3$, $p < .001$, however, the differences between the five experience levels were not systematic. The largest differences between experience levels were for the "never" response. Only 9 percent of respondents with 5,000 to 9,999 miles of experience said "never" while 21 percent of respondents with 20,000 to 29,999 miles of experience said "never."

- Q22I. Choosing the route that will take the shortest time. Eighty-one percent of respondents said that they do this frequently or occasionally. Observed differences in responses from older and younger participants failed to reach statistical significance, $\chi^2(4) = 8.6$, $p = .07$. There were significant differences in responses between respondents who owned cars by different manufacturers, $\chi^2(16) = 38.2$, $p < .01$. A higher percentage of BMW, Cadillac, Lexus, and Mercedes-Benz owners (50 to 58%) said that they do this frequently as compared to Chrysler owners (38%). Chrysler owners were more likely to say that they never choose the route that will take the shortest time (15% versus 4 to 8% for BMW, Cadillac, Lexus, and Mercedes-Benz). The responses to item Q22I also depended significantly on experience level, $\chi^2(16) = 30.6$, $p < .05$. System owners with the most experience (30,000 miles or more) were the most likely to say they did this frequently (60%) and they were the least likely to say that they either rarely or never did this (13%).

- Q22J. Choosing the route that is the shortest distance. Seventy-four percent of respondents said that they do this frequently or occasionally. Responses from older and younger participants did not differ significantly, $\chi^2(4) = 4.1$, $p = .39$. There were significant differences between respondents who owned cars by different manufacturers, $\chi^2(16) = 46.3$, $p < .001$. In particular, Chrysler owners were the most likely to say that the question was "not applicable" (13%) as compared to 7 percent of Mercedes-Benz owners and 4 percent for owners of each of the other three manufacturers. Chrysler owners were also the most likely to say "never" (12%) as compared to 3 to 9 percent for the others. Cadillac owners (46%) and Mercedes-Benz owners (42%) were the most likely to say that they did this frequently. The responses to item Q22J did not depend significantly on experience level, $\chi^2(16) = 19.6$, $p = .24$.

- Q22K. Choosing a route to avoid major roadways. Only 33 percent of respondents said that they do this frequently or occasionally. Twenty-eight percent of respondents said that they never do this and an additional 9 percent of respondents said the question was not applicable. There was a significant difference between younger and older respondents on this item, $\chi^2(4) = 9.9$, $p < .05$. Older respondents were more likely than younger respondents to say that they never chose a route to avoid major roadways (33 versus 26%) and older respondents were slightly less likely than

younger respondents to say they did this activity frequently (8 versus 10%). The responses to item Q22K did not depended significantly on experience level, $\chi^2(16) = 21.0$, $p = .18$. There were significant differences between respondents who owned cars by different manufacturers, $\chi^2(16) = 27.4$, $p < .05$, as shown in Table 11. BMW and Mercedes-Benz owners were the most likely to say that they did this frequently (11% each) and both Chrysler and Lexus owners were less likely than the others to say that they did this frequently (5% and 6%, respectively). Chrysler owners were more likely than the others to say that they never chose a route to avoid major roadways (40% versus 24 – 30%).

Table 11. Frequency of choosing a route to avoid major roadways by vehicle manufacturer.

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Never	57 (30.16)	29 (29.90)	24 (40.00)	62 (26.50)	149 (24.35)	321 (26.93)
Rarely	53 (28.04)	30 (30.93)	11 (18.33)	79 (33.76)	196 (32.03)	369 (30.96)
Occasionally	48 (25.40)	19 (19.59)	13 (21.67)	62 (26.50)	134 (21.90)	276 (23.15)
Frequently	21 (11.11)	9 (9.28)	3 (5.00)	14 (5.98)	68 (11.11)	115 (9.65)
Not Applicable	10 (5.29)	10 (10.31)	9 (15.00)	17 (7.26)	65 (10.62)	111 (9.31)
Total Row Pct.	189 15.86	97 8.14	60 5.03	234 19.63	613 51.34	1,192 100.00

- Q22L. Choosing a route that will avoid traffic problems and congestion. Approximately 45 percent of respondents do this frequently or occasionally. Twenty-two percent of respondents said that this item was not applicable and 15 percent of respondents said that they never do this. The responses depended significantly on the respondent's age group, $\chi^2(4) = 13.8$, $p < .01$, with the largest difference being for the "not applicable" response. Twenty-four percent of younger respondents and 16 percent of older respondents chose this response. Thirty percent of the group with least experience (less than 5,000 miles) said they did this frequently, whereas only 19 percent of respondents in the group with 20,000 – 29,999 miles of experience and 19 percent of respondents in the group with 30,000 miles or more of experience said that they did this frequently. However, the observed differences in responses based on experience level failed to reach statistical significance, $\chi^2(16) = 25.3$, $p = .06$. Responses to item Q22L were significantly related to vehicle manufacturer, $\chi^2(16) = 30.6$, $p < .05$. In particular, responses from Chrysler owners stood out because 33 percent of them said, "never" to this item whereas only 11 to 16 percent of the owners of other vehicle makes said, "never."

Changes in usage of the navigation system over time

Item Q16 asked drivers about the changes in frequency of navigation system use since they first started driving their vehicle. Overall, approximately 31 percent of respondents said that the use the system more now than when they first started driving their vehicles and 9 percent said that they us it less now. There was a significant difference between younger and older respondents on this item, $\chi^2(2) = 21.72$, $p < .001$, as shown in Table 12. Younger respondents were more likely than older respondents to say that they use the system more now than they did at first and younger respondents were less likely than older respondents to say that their usage had stayed the same.

Table 12. Navigation system usage changes by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
I use it more now than I did in the beginning	342 (34.30)	93 (21.99)	435 (30.63)
I use it less now than I did in the beginning	81 (8.12)	46 (10.87)	127 (8.94)
My usage has stayed about the same	574 (57.57)	284 (67.14)	858 (60.42)
Total	997 70.21	423 29.79	1,420 100.00

The responses to item Q16 also depended significantly on the respondent's experience level, $\chi^2(8) = 23.9$, $p < .01$. These results are shown in Table 13. Those drivers with less than 10,000 miles of experience driving their vehicles were less likely to say that their usage of the navigation system is more now than when they first started driving their vehicle. Drivers with 30,000 miles or more were slightly more likely to say that their navigation system use is less now than when they first started driving the vehicle. Differences based on vehicle manufacturer were not statistically significant, $\chi^2(8) = 11.5$, $p = .17$.

Table 13. Navigation system usage changes by experience level.

Frequency (Col. Pct.)	Less than 5,000 miles	5,000 to 9,999 miles	10,000 to 19,999 miles	20,000 to 29,999 miles	30,000 miles or more	Total
I use it more now than I did in the beginning	25 (20.49)	41 (25.31)	112 (33.53)	85 (34.98)	155 (32.22)	418 (31.15)
I use it less now than I did in the beginning	10 (8.20)	13 (8.02)	18 (5.39)	18 (7.41)	57 (11.85)	116 (8.64)
My usage has stayed about the same	87 (71.31)	108 (66.67)	204 (61.08)	140 (57.61)	269 (55.93)	808 (60.21)
Total Row Pct.	122 9.09	162 12.07	334 24.89	243 18.11	481 35.84	1,342 100.00

Changes in driving behavior with the navigation system

Item Q14 asked respondents, "Imagine that your navigation system broke down. How would you change the way you drive if you could not use your navigation system anymore?" The complete set of response frequencies for item Q14 are given in Appendix B. The most frequent response, made by 66 percent of respondents was, "Before leaving on a trip I would do more route planning than I do now." This may suggest that many navigation system users typically rely on the system to do route planning after they start out on their trip. The second most frequent response (37%) was, "I would not change anything about the way I drive." The frequency of this response differed significantly by age group, $\chi^2(1) = 46.4$, $p < .001$. Fifty percent of older respondents and 31 percent of younger respondents chose this response.

For a minority of respondents, having the navigation system seemed to enable them to drive in unfamiliar places, to drive more often at night, to drive more often in heavy traffic, or to drive alone, because without it they say that they would do these activities less often. The percentage of older and younger system owners who said that they would do these activities less often if they didn't have their navigation system did not differ significantly by age group except for the item about driving in heavy traffic, $\chi^2(1) = 4.3$, $p < .05$. Three percent of older respondents and only 1.4 percent of younger respondents said that they would drive in heavy traffic less often than they do now if they couldn't use their navigation system.

5. Perceived Effectiveness

> *"Recently it took me to the wrong place, 10 blocks away, ending up in a cemetery. I'm a little distrustful of it." – (Male, 81)*
>
> *"Most of the time [the navigations system] is quite helpful." – (Male, 72)*
>
> *"I trust the navigation system to get me there. It is real helpful at night, or for rainy weather driving, especially for poorly lit streets or freeways. It is helpful to tell you where a curve in the road is ahead of you when you can't see it yet." – (Male, 62)*

Perceived effectiveness of navigation systems was assessed by items Q12B, Q15F, and Q15H. Other items related to perceived system effectiveness are discussed in the sections on "User interface and usability" and "Safety."

Item Q12B asked drivers if listening to voice directions reduces the amount of time they look at the navigation screen. Most respondents to this item (76%) said "Yes." There was a significant difference between younger and older respondents on this item, $\chi^2(2) = 11.3$, $p < .01$, as shown in Table 14. Younger respondents were more likely than older respondents to say that listening to voice directions did not reduce the amount of time that they look at the navigation screen. Older respondents were more likely than younger respondents to say that they didn't know.

Table 14. Perception of whether voice directions reduce the amount of time looking at navigation screen by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Yes	727 (75.18)	329 (78.33)	1,056 (76.14)
No	176 (18.20)	50 (11.90)	226 (16.29)
Don't Know	64 (6.62)	41 (9.76)	105 (7.57)
Total	967 69.72	420 30.28	1,387 100.00

The responses to item Q12B depended significantly on experience level, $\chi^2(8) = 19.2$, $p < .05$. The major difference was that the percentage of don't know responses decreased systematically with experience from 14 percent for those with less than 5,000 miles driving experience in their vehicle to 5 percent for those with 30,000 miles or more. Responses also depended significantly on vehicle manufacturer, $\chi^2(8) = 18.0$, $p < .05$. The percentage of respondents who said yes ranged from 70 percent of Lexus owners to 84 percent of Chrysler owners.

Item Q15F asked drivers how strongly they agreed or disagreed with the statement that their risk of getting lost is lower with the navigation system than without it. A large majority of

respondents (84%) either agreed or strongly agreed with the statement. There was a significant difference between younger and older respondents on this item, $\chi^2(5) = 30.5$, $p < .001$, as shown in Figure 5. Younger respondents were more likely than older respondents to strongly agree. Responses to item Q15F also depended significantly on experience level, $\chi^2(20) = 40.4$, $p < .01$, but no systematic trends based on increasing experience were evident.

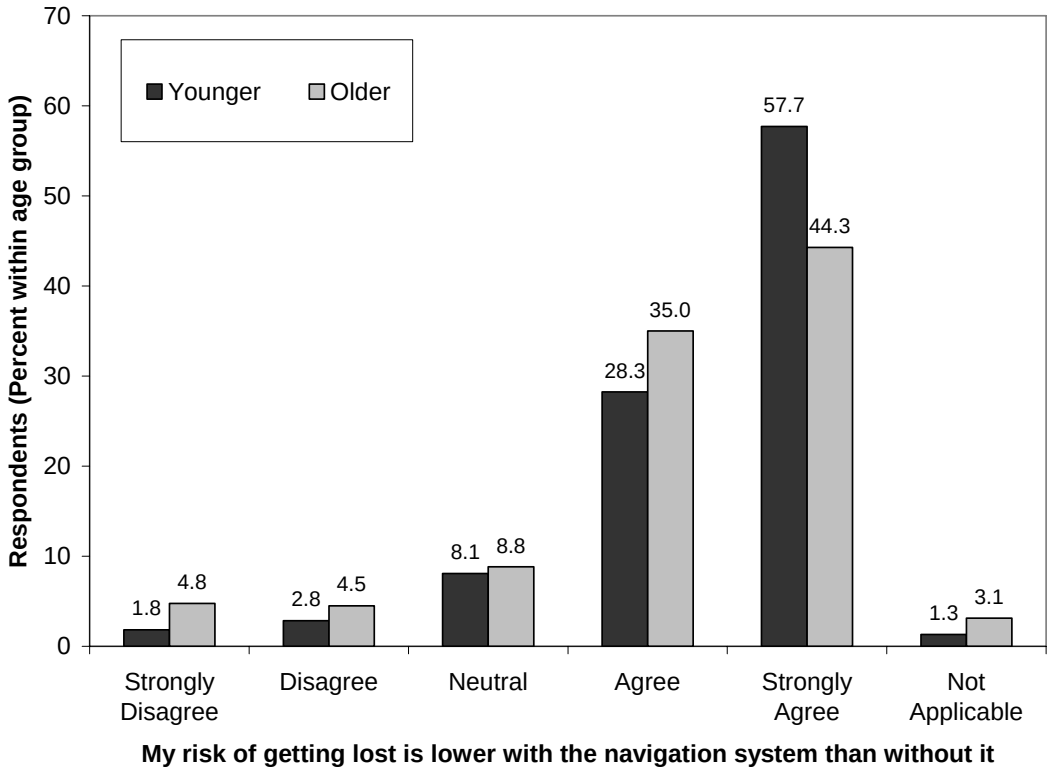

Figure 5. Younger and older respondents' perception of risk of getting lost.

Item Q15H asked drivers how strongly they agreed or disagreed with the statement that the navigation system does a good job re-routing them after missing a turn. Most respondents (80%) either agreed or strongly agreed with the statement. Similar to the responses for item Q15F shown above, there was a significant difference between younger and older respondents on item Q15H, $\chi^2(5) = 28.7$, $p < .001$, as shown in Figure 6. Younger respondents were more likely than older respondents to strongly agree with the statement. Differences based on the respondent's experience level were not statistically significant, $\chi^2(20) = 27.1$, $p = .13$.

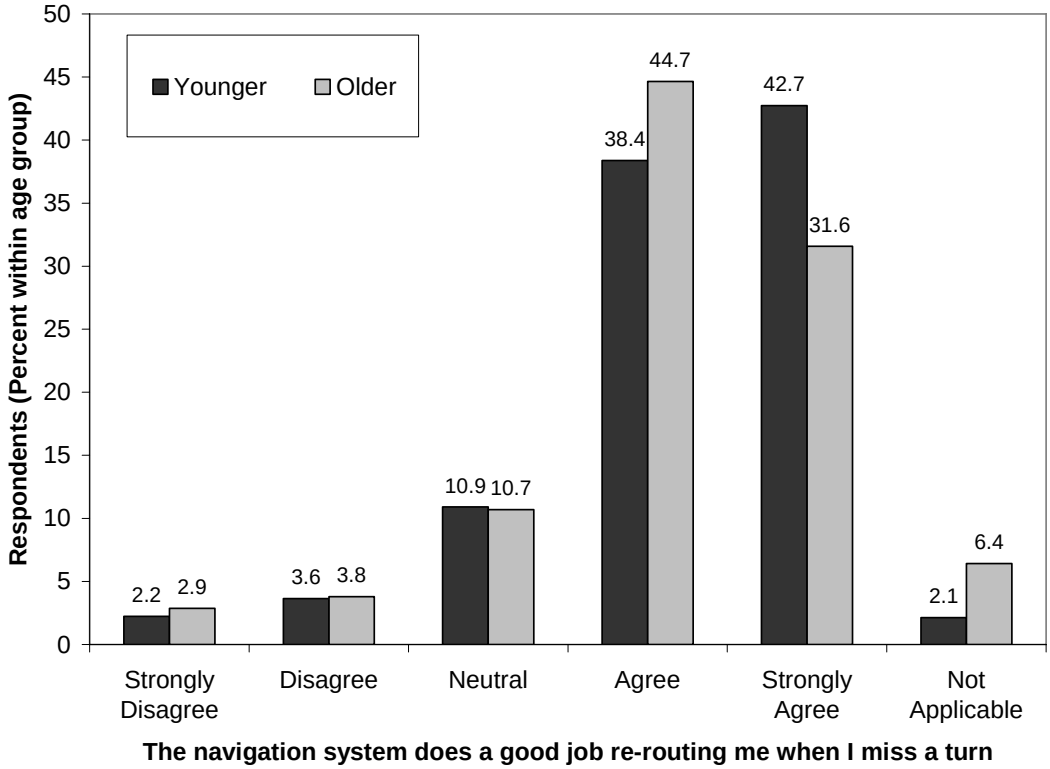

Figure 6. Younger and older respondents' perception of re-routing.

6. User Interface and Usability

> *"It's a pain to have to enter only one letter at a time. It's very slow and cumbersome." – (Male, 35)*

Spoken commands

> *"[My navigation system] is always helpful but it uses an obsolete data entry technique, Voice activation is needed." – (Male, 60)*

Item Q11 asked respondents whether their navigation system responds to spoken commands. There were significant differences between respondents who owned cars by different manufacturers, $\chi^2(8) = 59.4$, $p < .001$, as shown in Table 15. Chrysler owners were much less likely to say that their system responds to spoken commands. Of the five manufacturers listed in the table, BMW owners were most likely to have navigation systems with spoken commands.

Table 15. Frequency of navigation systems responding to spoken command by manufacturer.

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Yes	72 (39.34)	12 (12.50)	2 (3.51)	63 (27.04)	113 (18.02)	262 (21.28)
No	96 (52.46)	70 (72.92)	48 (84.21)	148 (63.52)	452 (72.09)	814 (68.83)
Don't Know	15 (8.20)	14 (14.58)	7 (12.28)	22 (9.44)	62 (9.89)	120 (9.89)
Total	183	96	57	233	627	1,196
Row Pct.	15.30	8.02	4.77	19.48	52.42	100.00

Item Q11a followed up on the previous question and asked if respondents found spoken command capability to be a useful feature. Most of the respondents (64%) who reported having this feature found it useful. The responses depended significantly on the respondent's vehicle manufacturer, $\chi^2(4) = 11.3$, $p < .05$, as shown in Table 16. Note that the number of respondents with Chrysler and Cadillac vehicles is very small. Among Mercedes-Benz, Lexus, and BMW owners, the highest proportion of respondents who found the feature useful were those with Mercedes-Benz vehicles.

Table 16. Is responding to spoken commands a useful feature? By vehicle manufacturer

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Yes	45 (62.50)	8 (47.06)	5 (83.33)	35 (51.47)	103 (71.53)	196 (63.84)
No	27 (37.50)	9 (52.94)	1 (16.67)	33 (48.53)	41 (28.47)	111 (36.16)
Total	72	17	6	68	144	307
Row Pct.	23.45	5.54	1.95	22.15	46.91	100.00

Spoken directions

> *"[There is] not enough time to react for making turns. [This] can be dangerous. The navigation system should tell you a minute or two before you get to an intersection." – (Female, 48)*

Item Q12 asked drivers whether they preferred to listen to spoken directions, preferred to view directions on the screen, or preferred both together. Most respondents (61%) preferred both together, whereas 26 percent preferred listening to directions and only 13 percent preferred viewing directions on the screen. There was a significant difference between younger and older respondents on this item, $\chi^2(2) = 39.6$, $p < .001$, as shown in Table 17. Younger respondents were more likely than older participants to prefer viewing directions and slightly more likely to say both together. Older respondents were more likely than younger respondents to say that they prefer listening to directions. The responses to item Q12 did not

depend significantly on the respondent's level of experience with the vehicle, $\chi^2(8) = 13.1$, $p = .11$.

Table 17. Frequency of preferences for spoken or viewed directions by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
View directions	148 (15.37)	31 (7.64)	179 (13.08)
Listen to directions	210 (21.81)	149 (36.70)	359 (26.22)
Both together	605 (62.82)	226 (55.67)	831 (60.70)
Total Row Pct.	963 70.34	406 29.66	1,369 100.00

Visibility of the navigation system screen

> *"Sun from the back or side can come in and wash out the [navigation system] screen." – (Male, 74).*
>
> *"I have the [navigation system screen] brightness set on max and it is still hard to read. The screen brightness is adjustable but not the contrast. The navigation screen has an anti-glare cover and I'm careful to clean it, but the least amount of sunlight that strikes it washes it out completely." – (Male, 51)*

Items Q15A, Q15B, and Q15E asked respondents about the visibility of their navigation system screens. There were no statistically significant differences in responses to any of these three items based on the respondent's level of experience with the vehicle.

Item Q15A asked respondents whether they agreed or disagreed that the navigation screen is in a location where it is easy to see when driving. Approximately 82 percent of respondents either agreed or strongly agreed and eight percent disagreed or strongly disagreed. There was a significant difference between younger and older respondents on this item, $\chi^2(5) = 71.0$, $p < .001$, as shown in Table 18. Younger respondents were more likely than older respondents to strongly agree with the statement. In contrast, older respondents were slightly more likely than younger respondents to only agree, to be neutral, or to disagree.

Table 18. Navigation screen is in location where it is easy to see while driving by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Strongly Disagree	31 (3.13)	17 (4.00)	48 (3.39)
Disagree	35 (3.54)	31 (7.29)	66 (4.67)
Neutral	72 (7.28)	51 (12.00)	123 (8.70)
Agree	391 (39.53)	207 (48.71)	598 (42.29)
Strongly Agree	457 (46.21)	108 (25.41)	565 (39.96)
Not Applicable	3 (0.30)	11 (2.59)	14 (0.99)
Total Row Pct.	989 69.94	425 30.06	1,414 100.00

Item Q15B asked respondents whether they agreed that the navigation screen is large enough to see easily. Nearly 81 percent either agreed or strongly agreed with the statement, while nine percent either disagreed or strongly disagreed. Responses from younger and older respondents differed significantly on this item, $\chi^2(2) = 58.6$, $p < .001$, as shown in Table 19. Younger respondents were much more likely to strongly agree that the navigation screen is large enough to see easily. In contrast, older respondents were slightly more likely to disagree or only agree with the statement.

Table 19. Navigation screen is large enough to see easily by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Strongly Disagree	28 (2.83)	8 (1.88)	36 (2.54)
Disagree	59 (5.95)	37 (8.71)	96 (6.78)
Neutral	85 (8.58)	49 (11.53)	134 (9.46)
Agree	395 (39.86)	227 (53.41)	622 (43.93)
Strongly Agree	421 (42.48)	97 (22.82)	518 (36.58)
Not Applicable	3 (0.30)	7 (1.65)	10 (0.71)
Total Row Pct.	991 69.99	425 30.01	1,416 100.00

Item Q15E asked respondents whether they agreed that sun glare or reflections on the navigation screen often make it difficult to see maps or directions. There was a significant difference between younger and older respondents on this item, $\chi^2(2) = 44.2$, $p < .001$, as shown in Table 20. Younger respondents were more likely than older respondents to disagree or strongly disagree with this statement. In contrast, older respondents were more likely than younger respondents to agree.

Table 20. Sun glare often makes it difficult to see maps or directions by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Strongly Disagree	216 (21.80)	43 (10.21)	259 (18.34)
Disagree	359 (36.23)	132 (31.35)	491 (34.77)
Neutral	175 (17.66)	91 (21.62)	266 (18.84)
Agree	148 (14.93)	95 (22.57)	243 (17.21)
Strongly Agree	53 (5.35)	40 (9.50)	93 (6.59)
Not Applicable	40 (4.04)	20 (4.75)	60 (4.25)
Total Row Pct.	991 70.18	421 29.82	1,412 100.00

The responses to item Q15E depended significantly on the respondent's vehicle manufacturer, $\chi^2(20) = 93.6$, $p < .001$, as shown in Table 21. Lexus owners stood out as being much more likely to agree or strongly agree with the statement than owners of other makes of vehicles.

Table 21. Sun glare often makes it difficult to see maps or directions by vehicle manufacturer.

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Strongly Disagree	55 (28.35)	22 (21.78)	13 (20.63)	28 (11.72)	98 (15.88)	216 (18.05)
Disagree	74 (38.14)	42 (41.58)	20 (31.75)	58 (24.27)	231 (37.44)	425 (34.61)
Neutral	26 (13.40)	15 (14.85)	14 (22.22)	47 (19.67)	130 (21.07)	232 (19.06)
Agree	24 (12.37)	7 (6.93)	6 (9.52)	78 (32.64)	97 (15.72)	212 (17.50)
Strongly Agree	10 (5.15)	8 (7.92)	4 (6.35)	22 (9.21)	36 (5.83)	80 (6.72)
Not Applicable	5 (2.58)	7 (6.93)	6 (9.52)	6 (2.51)	25 (4.05)	49 (4.06)
Total	194 15.98	101 8.32	63 5.19	239 19.69	617 50.82	1,214 100.00

Features and complexity of the navigation system

> *"Keep things simple. A computer with MapQuest is a lot easier to use." – (Female, 51)*
>
> *"A touch screen would be a big improvement." – (Male, 72)*
>
> *"Women like simple and to-the-point things while guys like gadgets, and lots of details." – (Female, 61)*

Item Q13 asked respondents how they felt about the complexity of their navigation systems (based on the number or features/functions). The majority of respondents (65%) thought that the system was about right in terms of complexity and number of features, but 16 percent thought that their system was too simple (not enough features) and 19 percent thought that their system was too complex. There was a significant difference between younger and older respondents on this item, $\chi^2(2) = 38.2$, $p < .001$, as shown in Table 22. Younger respondents were much more likely than older respondents to say their system was too simple and wished more things could be done with it. In contrast, older respondents were more likely than younger respondents to say that the system was too complex, and wished that it didn't have so many different functions.

Table 22. Perceived complexity of navigation system by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Too simple, I wish I could do more things with it	190 (19.19)	38 (8.90)	228 (16.09)
About right in terms of complexity and number of features/functions	647 (65.35)	277 (64.87)	924 (65.21)
Too complex, I wish that it didn't have so many different functions	153 (15.45)	112 (26.23)	265 (18.70)
Total Row Pct.	990 69.87	427 30.13	1,417 100.00

There was a significant difference between respondents who owned cars by different manufacturers, $\chi^2(8) = 25.6$, $p < .01$, as shown in Table 23. BMW, Cadillac, and Mercedes-Benz owners were more likely to feel their system was too complex. Chrysler owners were more likely to say their system was about right with respect to system complexity.

Table 23. Perceived complexity of navigation system by vehicle manufacturer.

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Too simple, I wish I could do more things with it	38 (19.79)	13 (12.75)	5 (8.77)	23 (9.70)	115 (18.31)	194 (15.93)
About right in terms of complexity and number of features/functions	106 (55.21)	67 (65.69)	45 (78.95)	174 (73.42)	392 (62.42)	784 (64.79)
Too complex, I wish that it didn't have so many different functions	48 (25.00)	22 (21.57)	7 (12.28)	40 (16.88)	121 (19.27)	238 (19.28)
Total Row Pct.	192 15.79	102 8.39	57 4.69	237 19.49	628 51.65	1,216 100.00

Perceived demands of various navigation system activities

Item Q23 asked participants "How demanding are each of these navigation system activities while you are driving?" They were then given a list of six activities where they may have used the navigation system while driving, and a response scale that included "Not at all "Demanding," "Slightly Demanding," "Somewhat Demanding," "Very Demanding," "Extremely Demanding," and "Not Applicable." The complete set of response frequencies is given in Appendix B, and the responses are summarized below. For each activity, the perceived demand was compared between older and younger respondents. For several of the items, older respondents were more likely than younger respondents to say that the activity described was not applicable to them, and as compared to younger respondents, older respondents tended to say that the activities were more demanding. Level of experience with the vehicle was not significantly related to responses to any of these items, except for Q23B.

- Q23A. Manually entering a new street address while driving. A third of the respondents (34%) said that this item was not applicable. Thirty-one percent found the activity to be very demanding or extremely demanding. Twenty percent found it to be not all demanding or only slightly demanding. There was a significant difference between younger and older respondents on this item, $\chi^2(5) = 33.9$, $p < .001$, as shown in Table 24. Younger respondents were more likely to say this activity was somewhat or slightly demanding. In contrast, older respondents were more likely to say this activity was extremely demanding. Furthermore, older respondents were more likely to respond, "Not applicable." This result may indicate that older respondents have been reluctant to even attempt this activity, or that their vehicle does not permit this action while in motion.

- Q23B. Verbally entering destination information while driving. A large majority (75%) of respondents said that this item was not applicable. Approximately 14 percent said that this activity was not at all demanding or only slightly demanding. Differences between the responses of older and younger respondents were not statistically significant, $\chi^2(5) = 1.9$, $p = .86$. Responses to item Q23B were significantly related to the respondent's level of experience with the vehicle, $\chi^2(20) = 56.2$, $p < .001$. The percentage of those who said that the activity was not at all demanding decreased from 19 percent for those with the least experience (less than 5,000 miles) to 6 to 8 percent for those groups with more than 10,000 miles of experience. At the same time, those who said that the item was not applicable varied from 57 percent (for those with less than 5,000 miles) to 71 to 80 percent for those groups with more than 10,000 miles of experience.

- Q23C. Looking at an area map on the navigation screen while driving. A majority of respondents (59%) found this activity to be either not at all demanding or only slightly demanding. However, nearly 13 percent of respondents found it to be either very demanding or extremely demanding. There was a significant difference between younger and older respondents on this item, $\chi^2(5) = 25.8$, $p < .001$, as shown in Table 25. Younger respondents were more likely to say that this activity was not at all demanding. Also, older respondents were more likely than younger respondents to respond "Not applicable," possibly indicating that they do not use the system in this way.

- Q23D. Reading turn-by-turn directions displayed on the navigation screen while driving. About half (51%) of the participants said that this activity was not at all demanding or only slightly demanding, whereas 15 percent of respondents found it to be either very demanding or extremely demanding. There was a significant difference between younger and older respondents on this item, $\chi^2(5) = 41.5$, $p < .001$, as shown in Table 26. Younger respondents were more likely to say this activity was not at all or slightly demanding. Older respondents were more likely to feel this task is very demanding or extremely demanding. Also, older respondents were more likely to respond "Not applicable."
- Q23E. Listening to turn-by-turn directions while driving. Sixty-three percent of respondents found this activity to be not at all demanding and an additional 11 percent said that it was only slightly demanding. Approximately 10 percent found it to be either very demanding or extremely demanding. There was a significant difference between older and younger respondents, $\chi^2(5) = 12.3$, $p < .05$, as shown in Table 27. Younger respondents were more likely than older respondents to say that this activity was somewhat demanding, very demanding, or extremely demanding.
- Q23F. Choosing an alternative route while driving. A sizable percentage (22%) of the respondents said that this item was not applicable. Approximately 38 percent of respondents said that it was not at all demanding or only slightly demanding, while 19 percent said that it was very demanding or extremely demanding. Younger and older respondents differed significantly in their responses to this item, $\chi^2(5) = 32.3$, $p < .001$, as shown in Table 28. Younger respondents were more likely to say this activity was somewhat demanding, but older respondents were more likely to say that this activity was very demanding. Also, older respondents were much more likely to respond that the item was not applicable for them.

Table 24. Perceived demand of manually entering a new street address while driving (Q23A) by age group

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Not at all Demanding	98 (9.95)	40 (9.83)	138 (9.91)
Slightly Demanding	115 (11.68)	25 (6.14)	140 (10.06)
Somewhat Demanding	172 (17.46)	42 (10.32)	214 (15.37)
Very Demanding	160 (16.24)	56 (13.76)	216 (15.52)
Extremely Demanding	133 (13.50)	81 (19.90)	214 (15.37)
Not Applicable	307 (31.17)	163 (40.05)	470 (33.76)
Total Row Pct.	985 70.76	407 29.24	1,392 100.00

Table 25. Perceived demand of looking at an area map on the navigation screen while driving (Q23C) by age group

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Not at all Demanding	328 (33.54)	108 (26.47)	436 (31.46)
Slightly Demanding	279 (28.53)	107 (26.23)	386 (27.85)
Somewhat Demanding	217 (22.19)	87 (21.32)	304 (21.93)
Very Demanding	65 (6.65)	41 (10.05)	106 (7.65)
Extremely Demanding	45 (4.60)	23 (5.64)	68 (4.91)
Not Applicable	44 (4.50)	42 (10.29)	86 (6.20)
Total Row Pct.	978 70.56	408 29.44	1,386 100.00

Table 26. Perceived demand of reading turn-by-turn directions displayed on the navigation screen while driving (Q23D) by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Not at all Demanding	271 (27.68)	82 (20.40)	353 (25.56)
Slightly Demanding	272 (27.78)	85 (21.14)	357 (25.85)
Somewhat Demanding	202 (20.63)	70 (17.41)	272 (19.70)
Very Demanding	79 (8.07)	53 (13.18)	132 (9.56)
Extremely Demanding	39 (3.98)	30 (7.46)	69 (5.00)
Not Applicable	116 (11.85)	82 (20.40)	198 (14.34)
Total Row Pct.	979 70.89	402 29.11	1,381 100.00

Table 27. Perceived demand of listening to turn-by-turn directions while driving (Q23E) by age group

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Not at all Demanding	619 (62.91)	256 (62.90)	875 (62.90)
Slightly Demanding	99 (10.06)	54 (13.27)	153 (11.00)
Somewhat Demanding	67 (6.81)	18 (4.42)	85 (6.11)
Very Demanding	59 (6.00)	13 (3.19)	72 (5.18)
Extremely Demanding	51 (5.18)	18 (4.42)	69 (4.96)
Not Applicable	89 (9.04)	48 (11.79)	137 (9.85)
Total Row Pct.	984 70.74	407 29.26	1,391 100.00

Table 28. Perceived demand of choosing an alternative route while driving (Q23F) by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Not at all Demanding	179 (18.40)	73 (18.11)	252 (18.31)
Slightly Demanding	203 (20.86)	73 (18.11)	276 (20.06)
Somewhat Demanding	228 (23.43)	54 (13.40)	282 (20.49)
Very Demanding	95 (9.76)	51 (12.66)	146 (10.61)
Extremely Demanding	81 (8.32)	31 (7.69)	112 (8.14)
Not Applicable	187 (19.22)	121 (30.02)	308 (22.38)
Total Row Pct.	973 70.71	403 29.29	1,376 100.00

7. Safety

Perceived safety of navigation systems

Navigation system owners were asked (Q20), “Overall, does having a navigation system make you a safer driver?” The responses are shown in Figure 7. The majority of respondents (52%) thought that having a navigation system made them neither more nor less safe.

Approximately 45 percent of respondents thought that they were safer drivers by having a navigation system, and only 3 percent felt that the navigation system made them less safe. These responses did not depend significantly on the participant's level of experience with the vehicle, $\chi^2(8) = 7.9$, $p = .44$, nor did they depend significantly on vehicle manufacturer, $\chi^2(8) = 8.1$, $p = .43$. The responses did differ significantly by age group, $\chi^2(2) = 12.8$, $p < .01$, as shown in Table 29. Older respondents were less likely than younger respondents to say that having a navigation system made them safer.

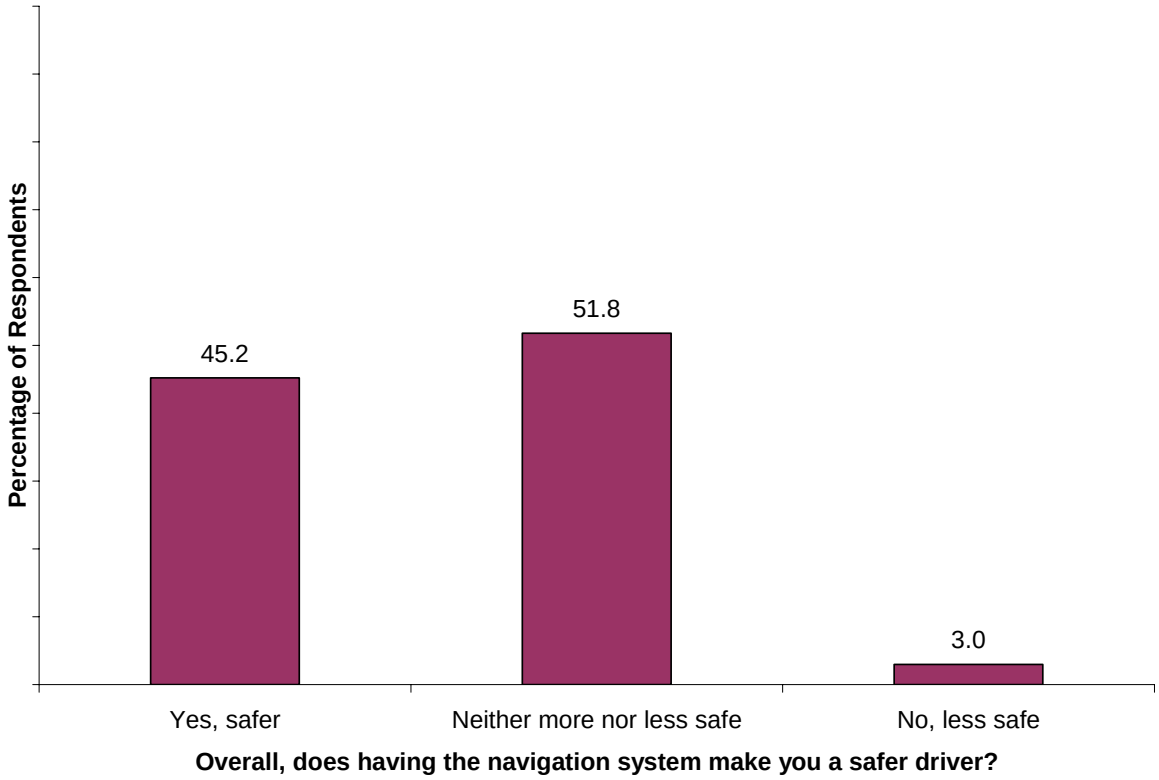

Figure 7. Overall perceived safety benefit of the navigation system

Table 29. Does having the navigation system make you a safer driver? (Q20) by age group

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Safer	484 (48.26)	168 (38.89)	652 (45.44)
Neither more nor less safe	496 (49.45)	246 (56.94)	742 (51.71)
Less safe	23 (2.29)	18 (4.17)	41 (2.86)
Total Row Pct.	1003 69.90	432 30.10	1,435 100.00

Another closely related item asked (Q19), "Does using the navigation system create any new driving problems or safety concerns for you?" The responses to this item are shown in Figure 8. While the majority of respondents (87%) did not have any concerns, approximately 13 percent of navigation system owners indicated that they did have some safety concerns. A follow up item asked respondents to explain their safety concerns. The resulting text strings were read by data coding staff and categorized according to meaning. The three most commonly mentioned concerns were, "distracts attention from driving," "entering information while driving is dangerous," and "system may provide wrong directions or unnecessary detours."

One respondent who answered, "Don't know" for item Q19 was not included in the analyses by age group and by experience. The respondent's age group was not significantly related to the responses for item Q19, $\chi^2(1) = 0.1$, $p = .80$. The responses did not depend significantly on either the respondent's experience level, $\chi^2(4) = 2.5$, $p = .65$, or vehicle manufacturer, $\chi^2(8) = 8.1$, $p = .43$.

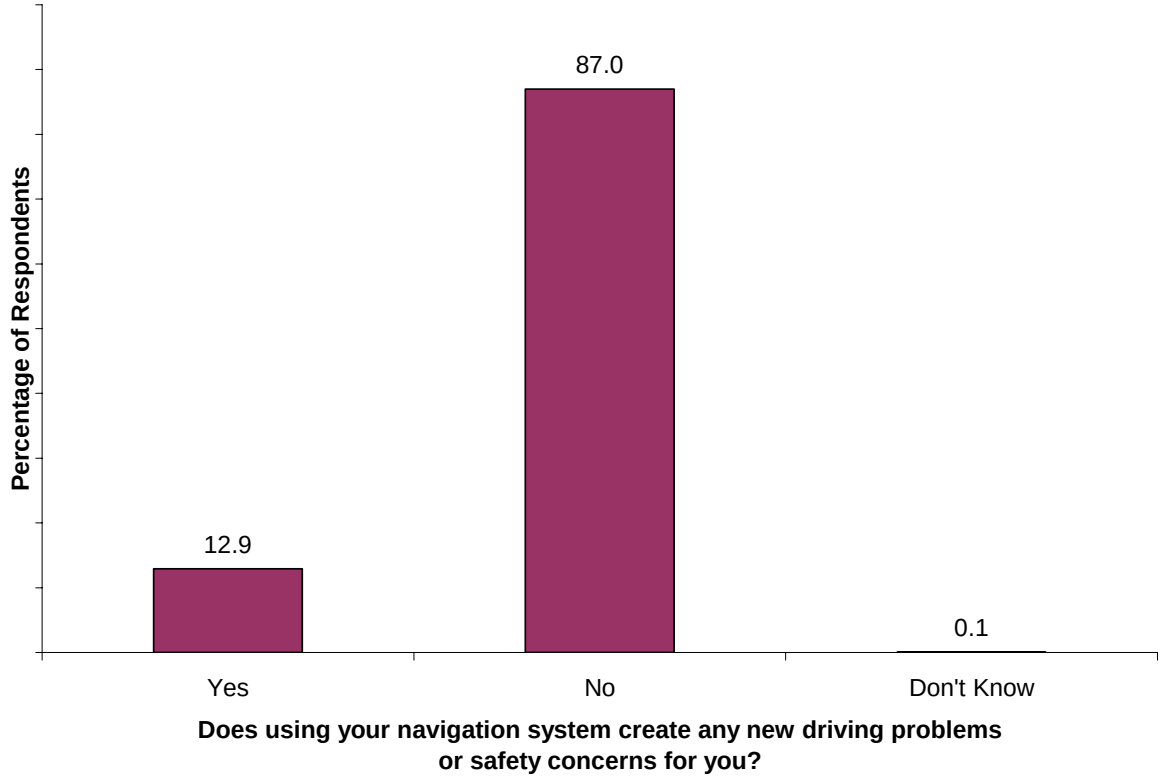

Figure 8. Any safety concerns about your navigation system?

Driver distraction and the navigation system

> *"I used to have the navigation system sound on, but found it too distracting." – (Male, 81)*

Items Q15C, Q15D, and Q15G asked respondents about their perception of distraction caused by the navigation system. The pattern of results for these three items was similar.

Item Q15C asked respondents if they agreed with the statement that using an in-vehicle navigation system is less distracting than using a paper map or road atlas. Overall, nearly 88 percent of respondents either agreed or strongly agreed with the statement. There was a significant difference between younger and older respondents on this item, $\chi^2(5) = 41.9$, $p < .001$, as shown in Table 30. Younger respondents were more likely than older respondents to strongly agree with the statement.

Table 30. Perception that the navigation system is less distracting than a paper map by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Strongly Disagree	23 (2.32)	14 (3.30)	37 (2.61)
Disagree	21 (2.12)	18 (4.25)	39 (2.75)
Neutral	51 (5.14)	24 (5.66)	75 (5.30)
Agree	239 (24.09)	153 (36.08)	392 (27.68)
Strongly Agree	647 (65.22)	203 (47.88)	850 (60.03)
Not Applicable	11 (1.11)	12 (2.83)	23 (1.62)
Total Row Pct.	992 70.06	424 29.94	1,416 100.00

Item Q15D asked respondents whether they agreed with the statement that using an in-vehicle navigation system is less distracting than following printed directions. Approximately 82 percent of respondents agreed or strongly agreed with the statement. There was a significant difference between younger and older respondents on this item, $\chi^2(5) = 38.3$, $p < .001$, as shown in Table 31. Younger respondents were more likely than older respondents to strongly agree with the statement.

Table 31. Perception that the navigation system is less distracting than following printed directions by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Strongly Disagree	27 (2.73)	12 (2.85)	39 (2.76)
Disagree	43 (4.34)	31 (7.36)	74 (5.24)
Neutral	85 (8.59)	44 (10.45)	129 (9.14)
Agree	256 (25.86)	148 (35.15)	404 (28.63)
Strongly Agree	572 (57.78)	175 (41.57)	747 (52.94)
Not Applicable	7 (0.71)	11 (2.61)	18 (1.28)
Total Row Pct.	990 70.16	421 29.84	1,411 100.00

Item Q15G asked respondents whether they agreed with the statement that using a navigation system distracts them too much from the task of driving. The majority of respondents (80%) either disagreed or strongly disagreed with this statement. There was a significant difference between younger and older respondents on this item, $\chi^2(5) = 18.9$, $p < .01$, as shown in Table 32. Younger respondents were more likely than older respondents to strongly disagree with the statement.

Table 32. Perception that the navigation system distracts too much from the task of driving by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Strongly Disagree	391 (39.53)	128 (30.33)	519 (36.78)
Disagree	423 (42.77)	182 (43.13)	605 (42.88)
Neutral	97 (9.81)	57 (13.51)	154 (10.91)
Agree	33 (3.34)	23 (5.45)	56 (3.97)
Strongly Agree	28 (2.83)	19 (4.50)	47 (3.33)
Not Applicable	17 (1.72)	13 (3.08)	30 (2.13)
Total Row Pct.	989 70.09	422 29.91	1,411 100.00

Manually entering a new address while driving

> *"I never try to enter a destination while I'm driving. My wife does that so I can drive." – (Male, 80)*

Item Q17 asked respondents if their current navigation system allows them to manually enter a new destination address while driving. Forty-five percent of respondents said "Yes," 33 percent of respondents said, "No," and 22 percent of respondents said that they didn't know. There were significant differences in the responses to this item based on vehicle manufacturer, $\chi^2(8) = 412.1$, $p < .001$. As shown in Table 33, Mercedes-Benz and BMW owners were much more likely than Cadillac, Chrysler, and Lexus owners to answer "Yes." Chrysler and Mercedes-Benz owners were the most likely to respond that they don't know.

Table 33. Does your current navigation system allow you to manually enter an address while driving? (Q17) by vehicle manufacturer.

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Yes	131 (67.18)	14 (13.46)	8 (12.50)	31 (12.81)	386 (60.60)	569 (43.94)
No	25 (12.82)	72 (69.23)	37 (57.81)	169 (69.83)	89 (13.97)	392 (34.25)
Don't Know	39 (20.00)	18 (17.31)	19 (29.69)	42 (17.36)	162 (25.43)	280 (21.82)
Total Row Pct.	195 15.71	104 8.38	64 5.16	242 19.50	637 51.33	1,241 100.00

There was also significant difference between younger and older respondents on this item, $\chi^2(2) = 93.6$, $p < .001$, as shown in Table 34. Younger respondents were more likely than older respondents to answer yes, and older respondents were more likely than younger respondents to say they did not know if this was possible with their current system.

Table 34. Does your current navigation system allow you to manually enter an address while driving? (Q17) by age group.

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Yes	506 (50.10)	144 (32.95)	650 (44.92)
No	354 (35.05)	130 (29.75)	484 (33.45)
Don't Know	150 (14.85)	163 (37.30)	313 (21.63)
Total Row Pct.	1010 69.80	437 30.20	1,447 100.00

Item Q18 asked respondents, "Some navigation systems do not allow the driver to manually enter a new destination address while the vehicle is moving. Is this restriction acceptable to

you?" Overall, 37 percent of the respondents found this restriction acceptable, 47 percent found it unacceptable and 16 percent of respondents said that they didn't know. There was a significant difference between respondents who owned cars by different manufacturers across frequency categories, $\chi^2(8) = 61.0$, $p < .001$, as shown in Table 35. Mercedes-Benz and BMW owners were less likely to respond yes. Mercedes-Benz and BMW owners were also more likely to say that they don't know. It seems that the respondents who have systems that allow this operation are reluctant to see the operation be restricted, whereas respondents whose system doesn't allow this operation are more likely to find such a restriction acceptable. To test this interpretation of the results, responses to items Q17 and Q18 were recoded as "Yes" = 1, "Don't Know" = 0, and "No" = -1. The Pearson correlation coefficient between recoded responses for respondents (n = 1,217) represented in Table 33 and Table 35 who answered both questions Q17 and Q18 is r = -.32, $p < .001$. The significant negative correlation supports the interpretation of the results given above. Note that when the same procedure is applied to navigation system owners' data for all vehicle manufacturers (n = 1417), the resulting correlation coefficient has approximately the same value, r = -.33, $p < .001$.

Table 35. Is it acceptable to restrict manual entry of a new destination address while the vehicle is moving? (by vehicle manufacturer)

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Yes	49 (25.93)	45 (43.69)	33 (51.56)	124 (51.88)	183 (29.28)	434 (36.93)
No	111 (58.73)	47 (45.63)	22 (34.38)	87 (36.40)	319 (51.04)	586 (47.09)
Don't Know	29 (15.34)	11 (10.68)	9 (14.06)	28 (11.72)	123 (19.68)	200 (15.98)
Total	189	103	64	239	625	1,220
Row Pct.	15.49	8.44	5.25	19.59	51.23	100.00

As was the case for item Q17, there was a significant difference between responses from younger and older respondents on item Q18, $\chi^2(2) = 78.9$, $p < .001$. As shown in Table 36, older respondents were more likely than younger respondents to say that the restriction is acceptable, and younger respondents were much more likely than older respondents to find the restriction unacceptable.

Table 36. Is it acceptable to restrict manual entry of a new destination address while the vehicle is moving? (by age group)

Frequency (Col. Pct.)	Younger than 65	65 or older	Total
Yes	335 (33.74)	195 (45.67)	530 (37.32)
No	538 (54.18)	127 (29.74)	665 (46.83)
Don't Know	120 (12.08)	105 (24.59)	225 (15.85)
Total Row Pct.	993 (69.93)	427 (30.07)	1,420 100.00

Responses to item Q18 were also significantly related to experience level, $\chi^2(8) = 26.1$, $p < .01$. Drivers with the least experience were most likely to say that the restriction was acceptable (42%) and drivers with 30,000 or more miles were least likely to say that this restriction was acceptable (33%). The percentage of drivers who said that they didn't know decreased with experience from 23 percent to 13 percent.

Awareness of warnings and limitations about navigation systems

Item Q9 asked respondents if they were aware of any manufacturer's warnings or limitations about the respondent's navigation system. Vehicle owner's manuals typically list warnings and limitations regarding navigation systems. For example, the manual for the navigation system on the 2004 Honda Pilot states, "Warning – Using the navigation system while driving can take your attention away from the road, causing a crash in which you could be seriously injured or killed." Despite warnings in the owner's manual, 63 percent of navigation system owners in the present survey said that they were not aware of any manufacturer's warnings or limitations about their system. There was a significant difference between respondents who owned cars by different manufacturers, $\chi^2(4) = 18.8$, $p < .001$, as shown in Table 37. Lexus owners were the most likely to answer "Yes," while Cadillac and Chrysler owners were the most likely to answer "No."

Table 37. Are you aware of any manufacturer's warnings or limitations about your navigation system? (Q9) by vehicle manufacturer

Frequency (Col. Pct.)	BMW	Cadillac	Chrysler	Lexus	Mercedes-Benz	Total
Yes	71 (36.04)	31 (29.52)	17 (26.98)	109 (46.58)	207 (32.45)	435 (36.38)
No	126 (63.96)	74 (70.48)	46 (73.02)	125 (53.42)	431 (67.55)	802 (63.62)
Total Row Pct.	197 15.93	105 8.49	63 5.09	234 18.92	638 51.58	1,237 100.00

Among those who were aware of warnings, the most commonly mentioned were to operate the navigation system only when stopped and to always pay attention to the road. The complete set of response frequencies for this item is given in Appendix B. Awareness of

warnings or limitations about the navigation system did not depend significantly on the respondent's level of experience, $\chi^2(4) = 5.6$, $p = .22$, but it did depend significantly on the respondent's age group, $\chi^2(1) = 8.8$, $p < .01$. A higher percentage of younger respondents (40%) than older respondents (31%) said that they were aware of warnings or limitations about their system.

8. Need for Improvements to Navigation Systems

> *"Outside of California [the navigation system] is great. Things are too dynamic [in California] – things are changing too rapidly here. It's best to rely on an AAA map." – (Male, 71)*
>
> *"[My system] does not have any information for traffic problems." – (Female, 65)*
>
> *"With all the hands-free stuff, it would be nice to have voice-activation." – (Male, 73)*

Respondents were asked whether there is anything about their navigation system that should be improved or changed (Q24). Approximately 54 percent of respondents reported a need for improvements, and 45 percent did not see a need for improvements. Fourteen respondents (1%) who said that they didn't know were not included in subsequent analyses. Differences between younger and older respondents did not reach statistical significance, $\chi^2(1) = 3.2$, $p = .07$. However, the responses were significantly related to experience level, $\chi^2(4) = 30.0$, $p < .001$. The percentage of respondents who said yes to this item increased systematically with vehicle experience from 34 percent (for those with less than 5,000 miles) to 63 percent (for those with 30,000 miles or more). Navigation system owners may tend to see more need for improvements as they become more familiar with their system. Alternatively, drivers with more experience may tend to have older model year vehicles with earlier generations of navigation systems that lacked some of the functionality of more recent technology.

The most frequently cited topic areas suggested for improvement are shown in Appendix B. These include making the system easier to operate, including a voice recognition system, and provide a larger, clearer screen, that is easier to operate by touch.

During the follow-up telephone interviews with 83 navigation system owners, many respondents commented that they would like their system to have faster data entry capabilities, including voice commands. The complete set of telephone interview responses is given in Appendix D.

9. Meeting the Needs of Older Drivers

> *"It is difficult to read not only the navigation screen, but all the dash instruments at a certain time of day. As an older person, the problem is dimness and lack of contrast of the letters, characters, and dials on the dash." – (Male, 72)*
>
> *"Safety is paramount for older people. But manufacturers are more concerned with building their cars so they can go faster than the competition, and safety is more of an afterthought, or just an additional expense for something that should be installed on vehicles without a price tag." – (Male, 68)*
>
> *"Why [have] tachometers? Why not [have] all digital displays such as oil pressure, outside temperature, even something like battery life expectancy remaining? It would be great to know this before a trip." – (Female, 72)*
>
> *"[My vehicle] has lots of chrome. [I] painted the center console and shift gate black – they had beautiful chrome but the glare was intense." – (Male, 79)*

Respondents were asked whether they, "believe that car manufacturers are doing enough to design vehicles to accommodate an aging population" (Q25). Most of those responding said "Yes" to this question (74%), and the percentage was very similar for those with navigation systems and for those without navigation systems. For those with navigation systems, the responses to item Q25 did not depend significantly on age group, $\chi^2(2) = 3.3$, $p = .19$, nor did they depend significantly on vehicle manufacturer, $\chi^2(8) = 7.0$, $p = .53$.

Those who answered "No" to item Q25 were asked what more they believe could be done. The most common responses were to improve the driver's interface with vehicle systems, to improve visibility around the vehicle, and to improve or add vehicle safety features (such as backing aids). The complete set of response frequencies is shown in Appendix B.

SUMMARY AND DISCUSSION

Summary of Findings

Questionnaires were mailed to owners of particular vehicles known to offer navigation systems as standard features or as available options in an effort to understand how these types of systems are influencing driver behavior (modifying behavior in potentially positive or negative ways) and to assess the extent to which early adopters of these systems understand the systems' performance capabilities and limitations. Forty-five percent of navigation system owners think that their systems make them safer drivers and a large majority said that they would want to get the system if they purchased the same vehicle again.

Survey sample

Navigation system questionnaires mailed to 10,000 ACSC insurance customers who were identified as owning vehicle models known to offer a navigation system as a standard feature or as an available option. Half of the questionnaires were mailed to vehicle owners who were younger than 65 and half of the questionnaires were mailed to owners who were 65 or older. Approximately 22 percent of the questionnaires were returned. Of the questionnaires returned, 1,494 (67%) were from navigation system owners. Approximately 32 percent of the respondents with navigation systems were 65 or older. Thirty-two percent of respondents with navigation systems were women.

Desire to have a navigation system

A majority (88%) of those who currently have a navigation system said that if they purchased their same vehicle again, they would want to get the technology again. Among those who do not currently have the technology, only 37 percent said that they would want to get a navigation system if they purchased their same vehicle again. The most common reasons cited for not purchasing a navigation system were related to availability on the specific vehicle that they purchased (42%) or that "I don't need the navigation system to find my way" (35%). Cost was cited as a reason by 32 percent of those who did not purchase a navigation system.

Learning to use the navigation system

The most frequently cited methods for learning how to use the navigation system were the vehicle owner's manual (65%) and "On-road experience . . ." (55%). Nearly half of the respondents (47%) said that they received instructions from the dealership, such as video, brochure, or demonstration.

Behavioral adaptation

Several items assessed how drivers have incorporated the navigation system into their driving routine. Nearly a third of respondents said that their frequency of using the navigation system has increased since they first started driving the vehicle, whereas only 9 percent said that they use it less now than they did then. Also, vehicle owners with greater levels of experience driving the equipped vehicle (miles driven) were more likely than those with less experience to use their system frequently. In fact, nearly 28 percent of respondents with 30,000 or more miles of driving experience with their vehicle said that they use their navigation system two or more times per week as compared to only 10 percent of those with less than 5,000 miles of vehicle experience.

Drivers were also asked how frequently they use their navigation system in 12 specific ways. For some of these items, such as "Manually entering a new street address while driving," and "Verbally entering destination information . . .," a large number of respondents chose to answer "Not applicable" or "Never." The destination entry scenario that was used most frequently was "Manually entering a new street address while parked." Listening to turn-by-turn directions was reported more frequently than was reading turn-by-turn directions.

Responses to the items above that are related to choosing a route did not depend on the participant's age group, but older and younger respondents did differ on items related to entering new destination information. Older respondents were less likely than younger respondents to enter information while driving. Responses to several of the items depended on the respondent's level of experience with the vehicle, but in many cases these differences were not systematic.

Drivers were asked how they would change their driving habits if they could no longer use their navigation system. A majority (66%) said that before leaving on trips they would do more planning than they do. For a minority of respondents, having the navigation system seemed to enable them to drive in unfamiliar places, to drive more often at night, to drive more often in heavy traffic, or to drive alone, as suggested by their reporting that they would engage in these activities less frequently if they could no longer use their navigation system.

Perceived effectiveness

A large majority of respondents (84%) either agreed or strongly agreed that their risk of getting lost is lower with the navigation system than without it and most respondents (80%) either agreed or strongly agreed that the navigation system does a good job re-routing them after missing a turn. Most respondents (76%) said that listening to voice directions reduces the amount of time they look at the navigation screen. Other items related to perceived effectiveness are discussed in sections on "User interface and usability" and "Safety."

User interface and usability

Item Q13 asked respondents how they felt about the complexity of their navigation system (based on the number or features/functions). The majority of respondents (65%) thought that the system was about right in terms of complexity and number of features, but 16 percent though that their system was too simple (not enough features) and 19 percent thought that their system was too complex.

Sixty-four percent of those with navigation systems that accept spoken commands found this feature useful. Regarding driver's preferences for system output, most respondents (61%) preferred to both listen and view directions as opposed to either viewing (13%) or listening to directions (26%) alone.

Some respondents had trouble seeing their navigation screens. Approximately 24 percent agreed or strongly agreed that sun glare often makes it difficult to see maps or directions on the navigation screen, nine percent disagreed or strongly disagreed that the navigation screen is large enough to see easily, and eight percent disagreed or strongly disagreed that the navigation screen is in a location where it is easy to see while driving. Other items addressed the perceived demands of interacting with the navigation system in different ways while driving.

Safety

- Sixty-three percent of respondents said that they were not aware of any manufacturer's warnings or limitations about their navigation system. The most common warnings cited in vehicle owner's manuals relate to the potential for driver distraction, and the need for the driver to not rely only on the voice guidance from the system but to make sure that all maneuvers are made legally and safely.
- Forty-five percent of navigation system owners thought that using their system made them a safer driver and three percent thought that it made them less safe. A majority (52%) thought that using the navigation system made them neither more nor less safe.
- Thirteen percent of navigation system owners said that their system had created new driving problems or safety concerns for them.
- Seven percent of respondents agreed or strongly agreed with the statement, "I find that the navigation system distracts me too much from the task of driving." Eighty percent of respondents disagreed or strongly disagreed.
- Eighty-eight percent of respondents agreed or strongly agreed with the statement, "Using my in-vehicle navigation system is less distracting than using a paper map or road atlas." Five percent of respondents disagreed or strongly disagreed.
- Eighty-two percent of respondents agreed or strongly agreed with the statement, "Using my in-vehicle navigation system is less distracting than following printed directions." Eight percent of respondents disagreed or strongly disagreed.
- Thirty-seven percent of respondents found it acceptable to restrict the driver from manually entering a new destination address while the vehicle is moving, and 47 percent found it unacceptable. Respondents with systems that currently allow manual destination entry while the vehicle is in motion were more likely to rate restricting this operation as unacceptable. Nearly 19 percent of respondents said that they manually enter new street addresses (frequently or occasionally) while driving.

Need for improvements

Respondents were asked whether there is anything about the way that their navigation system works that should be improved or changed. Approximately 54 percent of respondents reported a need for improvements.

- The most frequent suggested areas for improvement of navigation systems were related to making the system easier to operate with faster data entry, adding or improving speech recognition capability, and providing a larger, easier-to-read, touch-sensitive screen.
- In general, 74 percent of survey respondents thought that vehicle manufacturers are doing enough to design vehicles to accommodate an aging population.

Summary of comparisons by age group

Responses from system owners who were 65 or older were compared to those from system owners who were younger than 65. Among the respondents who had navigation systems, 32

percent were 65 or older. There were many items on which the responses from older and younger respondents differed significantly. These differences are listed below.

- Older respondents were more likely than younger respondents to report having physical conditions which make driving more difficult, including hearing problems, dexterity problems, and difficulty turning the head and neck.
- Older respondents were less likely than younger respondents to say that they would want to get a navigation system if they purchased their same model vehicle again.
- Older respondents used their navigation system less frequently (fewer times per week or month). Also, older respondents entered a new street address while parked less frequently than younger respondents. Older respondents were more likely to say that they never look at an area map on the navigation screen while driving. Older respondents were more likely than younger respondents to say that they occasionally or frequently verbally entered new destination information while parked, but they were also more likely to say that they never verbally entered destination information while driving. Older respondents were less likely than younger respondents to read-turn-by-turn directions on the navigation screen while driving, and were less likely to choose a route specifically to avoid major roadways.
- Older respondents were less likely than younger respondents to say that they use their navigation system now more than when they first purchased their vehicle.
- Older respondents were more likely than younger respondents to have learned how to operate their navigation system from the owner's manual, but among those who said that they learned from reading the owner's manual, older respondents were less likely to say that the manual was easy to use. A higher percentage of older respondents than younger respondents said that have not yet learned how to use their navigation system.
- Older respondents were more likely than younger respondents to say that they would "not change anything" about the way that they drive if they could no longer use their navigation system. Older respondents were more likely than younger respondents to say that they would "drive in heavy traffic less often" if they couldn't use their navigation system.
- Older respondents were slightly more likely than younger respondents to say that listening to voice directions reduces the amount of time that they look at the navigation screen, and older respondents were more likely than younger respondents to say that they didn't know.
- Older respondents were less likely than younger respondents to strongly agree with the statements, "My risk of getting lost is lower with the navigation system than without it," and "The navigation system does a good job re-routing me when I miss a turn."
- Older respondents were more likely than younger respondents to prefer listening to spoken directions, while younger respondents were more likely to prefer viewing directions on the navigation screen.
- Older respondents were less likely than younger respondents to strongly agree that the navigation screen is in a location that is easy to see while driving and they were much

less likely than younger respondents to strongly agree that the screen is large enough to see easily. Older respondents were more likely than younger respondents to agree that sun glare on the navigation screen often makes it difficult to see maps or directions.

- Older respondents were more likely to say that the navigation system was too complex and wished that it didn't have so many functions.
- When asked how demanding it is to perform each of several different navigation system activities while driving, older respondents were more likely than younger respondents to say that the activities were either more demanding or not applicable to them. Older respondents were more likely than younger respondents to say that manually entering a new street address while driving was extremely demanding. Younger respondents were more likely than older respondents to rate looking at an area map on the navigation screen while driving, and reading turn-by-turn directions on the navigation screen while driving as "Not at all demanding." Older respondents were more likely than younger respondents to say that choosing an alternative route while driving was very demanding or extremely demanding.
- Older respondents were less likely than younger respondents to say that having a navigation system made them safer drivers. However, the percentage of older and younger respondents who thought that the navigation system created new driving problems or safety concerns for them was not significantly different.
- Younger respondents were more likely than older respondents to strongly disagree that their navigation system distracts them too much from the task of driving. Younger respondents were more likely than older respondents to strongly agree that using an in-vehicle navigation system is less distracting than using a paper map or road atlas. Younger respondents were also more likely than older respondents to strongly agree that using their navigation system is less distracting than following printed directions.
- A higher percentage of younger respondents than older respondents said that they were aware of manufacturer's warnings or limitations about their navigation system.

Study Limitations

The survey methodology used in this study was an effective way to assess a large number of drivers' perceptions about in-vehicle navigation systems. It provided insights into drivers' understanding of the functional capabilities of the systems and it was also effective at providing information about how the systems may be impacting driver behavior. Given the various limitations of the method explained below, however, the results provided by this work should be confirmed by observational studies and experimental methods.

- Self-reports were obtained from mail-out questionnaires sent to a random sample of ACSC members who were possibly navigation system owners (based on model of vehicle owned). There are some inherent weaknesses associated with this type of data. Self-reports can be unreliable, especially where respondents need to rely on memories of past events or where respondents may have certain expectancies about giving answers that they believe the researchers "want" to see, for example. Although each questionnaire was mailed to a specific vehicle owner to be answered about a specific

vehicle, it is possible that other household members completed some questionnaires or that a respondent answered the questionnaire based on experience with a vehicle other than the one specified.

- In this study, no attempt was made to obtain a nationally representative sample. It is likely that ACSC members included in the survey differ in some ways from other vehicle owners who are not members of an automobile club, or from those who live in different areas of the country with different weather and traffic conditions. For example, items that addressed the perceived effectiveness of the technologies in snow or rain may get very different responses from vehicle owners living in colder climates. The limitations and characteristics of the sample obtained should be considered carefully if the results are generalized.

- The response rate for the navigation system survey was 22.4 percent. This sample may not be representative of ACSC members because those who responded may have had different experiences with the technology as compared to those who did not respond. Future studies of this type should attempt to increase the response rate by converting non-responders to responders through methods such as a second or third mailing, through a telephone call, or by offering an incentive to participate.

- Based on the data from the navigation system survey, certain changes over time in system usage, behavioral adaptations, system knowledge, and owners' opinions may be inferred if they were significantly related to the level of experience with the system. However, level of experience was measured indirectly by asking respondents how many miles they had driven the vehicle, rather than asking them how much they had used the system. It is possible that there are large differences in cumulative system usage between drivers who have similar levels of experience with the vehicle. Also, this study used a cross-sectional approach as opposed to tracking individual drivers over time. That is, the survey yielded a range of driver experience levels allowing comparisons between these groups and providing a basis for interpreting how behavior and knowledge with these systems changed across time as cumulative usage of the system increased. A weakness of the cross sectional approach is that it is difficult to make firm conclusions about the effects of experience over time for individuals. It is possible that drivers who tend to keep their vehicles longer (and therefore have more experience with a particular vehicle) are different in important ways from drivers who purchase vehicles more frequently. Another issue is that drivers with the higher levels of experience tend to have older vehicles which may have had earlier versions of the navigation system technology. Future work should follow specific individuals over time to examine how system usage changes and behavioral adaptations develop.

- This study assessed vehicle owners' perceptions of the impact of navigation systems on their driving safety, and investigated the other impacts of navigation systems that might plausibly impact safety; however, the actual impact of navigation systems on driving safety and crash risk are not known and were not addressed in this study.

Implications

- Further research, including longitudinal research should be undertaken to understand how drivers modify their behavior resulting from the long term use of navigation systems, and how the use of navigation systems may impact drivers' exposure to risk on the highways. The present survey suggests that some drivers may rely more on the navigation system as they gain greater experience, and it would be useful to investigate whether drivers have a tendency to blindly follow navigation system commands, even when the system map is wrong or when the instructions conflict with local traffic rules. For some drivers, having the navigation system may increase the number and length of their trips by giving them a sense of confidence for driving in certain areas, weather (and lighting) conditions or traffic conditions where they would otherwise not drive. On the other hand, using the navigation system may prevent many inefficient trips (and potentially unsafe maneuvers such as U-turns, or sudden or late lane changes near intersections) as well as the psychological stress of being lost.

- Navigations systems were perceived as being too complex by many older respondents and they were less likely than younger respondents to understand the limitations of their system. Efforts should be undertaken to improve vehicle owners' manual, especially for older drivers who are the most likely to read it, and automobile dealers should be encourage to teach customers about navigation system operations.

- The results indicate that older drivers as compared to younger drivers have more trouble with the visual displays. Improving the displays to make them larger and better shielded from glare may be one way to deal with this problem. Alternatively, manufacturers and drivers could be encouraged to make greater use of auditory displays.

- Younger and older drivers differed with regard to how distracting they felt the navigation displays were. Further research is needed to determine if this result may be related to younger drivers' overconfidence in their abilities as opposed to older drivers being more distracted.

- Although most drivers find the navigation system to be a useful feature, a substantial number of owners would like system improvements, particularly with regard to ease of operation, especially easier data input (destination programming). Manufacturers should consider ways to simplify operation of the system, while creating better methods to input new address information. Some possibilities suggested by respondents are to allow more extensive use of speech input for address information, and to allow users to download address information from other sources such as electronic address books, cell phones, the driver's home computer, PDA, or portable navigation system, and to provide a button to store the vehicle's current location as a future destination.

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APPENDIX A: MAIL-OUT SURVEY INSTRUMENT AND RECRUITMENT LETTER

1577 So. Valley Vista Drive
Diamond Bar, CA 91765

«First_Name» «Last_Name»
«Address»
«City», «State» «Zip»

Dear Member:

The Automobile Club of Southern California (AAA) is working on a major research project to reduce traffic crashes and injuries on our roadways. We need your help in this important study.

The goal of our study is to make recommendations to the automotive industry and government about the kinds of innovative equipment that should be put on vehicles to protect drivers and make our roads safer. The Club selected your name *at random* from the rolls of all Club members who are owners of recent model vehicles.

The car you own is likely to be equipped with the technology we are investigating. As an "early adopter" of this technology, your responses will be very valuable. Please take a few minutes to fill out the attached survey and mail it back in its pre-paid envelope. This survey covers factory-installed:

- **Navigation Systems** that show maps on a screen and/or provide step by step driving directions to help the driver get to a destination. This survey only covers navigation systems that were purchased as **original equipment** on your vehicle.

Please let us know, by filling out the attached questionnaire, whether your «Model_Yr» «Manufacturer», with Vehicle Identification Number «VIN» has a navigation system and if so, what your experience has been with it.

Even if your vehicle does not have a factory installed navigation system, you can still provide us with valuable input because you drive a recent model vehicle. Please fill out the first four questions and the last question as these will aid us in understanding drivers' purchasing decisions in regards to navigation systems.

All information you provide is voluntary, strictly *confidential* and will be used *solely* for scientific purposes. (It will not affect your insurance rates or membership and will not be used for marketing purposes.)

Thank you in advance for your help with this project and for participating in its exciting opportunity to influence our next generation of motor vehicles.

Please complete the enclosed survey and return it in the postage paid envelope.

Thank you for your cooperation,

Steven D. Mazor
Manager, Automotive Research Center
(909) 612-2560

(over)

OPTIONAL:
We are planning to follow up on this written questionnaire with more in-depth telephone interviews of some of the survey respondents. These interviews are expected to take up to 15 minutes. If you would be willing to participate in a follow up interview, please fill in the personal (optional) information below. We will only be contacting a limited number of respondents for follow ups. They will be selected randomly from those who volunteer. Not all volunteers will be contacted.

Would you like to participate in a telephone interview? *(circle one)* Yes No

If yes, please tell us:

Your name (optional)_____

Telephone number_____

Best time(s) of day to reach you at this number? *(circle all that apply)*

Morning Afternoon Evening

Thank you for completing the survey!
Please mail it back in the business reply envelope provided.

Automobile Club of Southern California
1577 So. Valley Vista Drive
Diamond Bar, CA 91765

Please tell us about yourself:

1. **Age: ____** (*you must be at least 18 years of age to participate*)

2. **Gender** *(circle one)* Male Female

3. **Do you have any physical conditions which make driving more difficult?**
(check boxes for <u>all</u> that apply)

Vision problems ..... ☐
Hearing problems ..... ☐
Dexterity problems (e.g. arthritis) ..... ☐
Difficulty turning my head/neck ..... ☐
Other *(explain):* _____ ☐
None ..... ☐

4. **A <u>navigation system</u> shows maps on a screen and/or provides step by step driving directions to help the driver get to a chosen destination. Does your vehicle have a <u>navigation system installed by the manufacturer</u>? (If you only have a navigation system that was <u>not</u> original equipment on your vehicle then answer "No" here.)**

(circle one) Yes → Go to question 5 on next page

No → Answer questions 4a and 4b, then skip to question 25.

4a. If <u>no</u>, then why not? *(check boxes for <u>all</u> that apply)*

A navigation system was not an option on my vehicle ..... ☐
It never occurred to me to look for one when I bought the vehicle ..... ☐
I thought the navigation system would be a nuisance or distraction..... ☐
I didn't trust the navigation system ..... ☐
I didn't need a navigation system to find my way ..... ☐
The navigation system was not worth the extra cost..... ☐
The navigation system was only available with other options I didn't want ..... ☐
I intended to use an aftermarket navigation system in this vehicle ..... ☐
I was not the person who decided to get this vehicle ..... ☐
None of the above ..... ☐

4b. If you purchased this same model vehicle again would you want a factory installed navigation system?
(circle one) Yes No Don't Know

Please go to question 25.

(over)

5. If you purchased this same model vehicle again would you want a factory installed navigation system?

(circle one) Yes No Don't Know

6. Approximately how many miles have you personally driven this vehicle?

_____miles

7. How often do you use your vehicle's navigation system?

(circle one)

Less than once a month 1

Approximately 1 – 3 times per month 2

Approximately once per week 3

Approximately 2 – 3 times per week 4

Four or more times per week 5

8. How did you learn to use your vehicle's navigation system?

(check boxes for <u>all</u> that apply)

Instructions from the dealership, such as a video, brochure, or demonstration ..... ☐

Vehicle owner's manual ..... ☐

Was the owner's manual easy to use? Yes ☐ No ☐

Help from friend or relative ..... ☐

Information on the Internet ..... ☐

On-road experience and practice (trial and error) ..... ☐

I have not yet learned how to use the navigation system ..... ☐

I don't want to learn how to use the navigation system ..... ☐

9. Are you aware of any manufacturer's warnings or limitations about your navigation system?

(circle one) Yes No

(If <u>yes</u>, please explain): _____

_____

_____

10. Were there things that were especially difficult to learn about your navigation system? *(circle one)* Yes No

(If <u>yes</u>, please explain): _____

11. Does your navigation system respond to spoken commands?

(circle one) Yes → Please answer questions 11a & 11b.

No → Skip to question 12.

Don't know → Skip to question 12.

11a. Do you find this feature useful? *(circle one)* Yes No

11b. How well does the system understand what you say?

(circle one)

Not well 1

Fairly well 2

Very well 3

I don't know because I don't use spoken commands 4

12. While driving, do you prefer to listen to spoken turn-by-turn directions from the navigation system, or do you prefer to view directions on the screen?

(circle one then please continue with either 12a or 12b)

View directions ..... 1 → go to question 12a.

Listen to directions ..... 2 → go to question 12b.

Both together ..... 3 → go to question 12b.

12a. Why don't you prefer to listen to voice directions?

(check boxes for <u>all</u> that apply)

It is too difficult to understand the words spoken by the system ..... ☐

The system voice annoys me ..... ☐

The system voice doesn't relate to what I am seeing on the road ..... ☐

The system voice gives the wrong directions ..... ☐

It does not give me voice directions in my native tongue ..... ☐

Other reason ..... ☐

12b. Does listening to voice directions reduce the amount of time that you look at the navigation screen?

(circle one) Yes No Don't Know

13. Thinking about the number of features/functions and complexity of your navigation system, would you say that your system is: *(circle one)*

Too simple, I wish I could do more things with it 1

About right in terms of complexity and number of features/functions 2

Too complex, I wish that it didn't have so many different functions 3

14. Imagine that your navigation system broke down. How would you change the way you drive if you could not use your navigation system anymore?

(check boxes for <u>all</u> that apply)

I would go to fewer unfamiliar places than I do now ..... ☐

I would drive at night less often than I do now..... ☐

I would drive in heavy traffic less often than I do now ..... ☐

I would drive alone less often than I do now ..... ☐

Before leaving on a trip I would do more route planning than I do now. ☐

I would not change anything about the way I drive..... ☐

Other (*specify*):_____ ☐

15. Please indicate how much you agree or disagree with the following statements.

(circle one response for each row)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable
A. The navigation screen is in a location where it is easy to see when I am driving.	1	2	3	4	5	NA
B. The navigation screen is large enough to see easily.	1	2	3	4	5	NA
C. Using my in-vehicle navigation system is <u>less</u> distracting than using a paper map or road atlas.	1	2	3	4	5	NA
D. Using my in-vehicle navigation system is <u>less</u> distracting than following printed directions.	1	2	3	4	5	NA
E. Sun glare or reflections on the navigation screen often make it difficult to see maps or directions.	1	2	3	4	5	NA
F. My risk of getting lost is lower with the navigation system than without it.	1	2	3	4	5	NA
G. I find that the navigation system distracts me too much from the task of driving.	1	2	3	4	5	NA
H. The navigation system does a good job re-routing me when I miss a turn.	1	2	3	4	5	NA

16. How has your usage of the navigation system changed since you first started driving this vehicle? *(circle one)*

I use it more now than I did in the beginning 1

i. Why? _____

I use it less now than I did in the beginning..... 2

ii. Why? _____

My usage has stayed about the same 3

17. Does your current navigation system allow you to manually enter a new destination address while you are driving?

(circle one) Yes No Don't Know

18. Some navigation systems do not allow the driver to manually enter a new destination address while the vehicle is moving. Is this restriction acceptable to you?

(circle one) Yes No Don't Know

19. Does using the navigation system create any new driving problems or safety concerns for you?

(circle one) Yes No

(If yes, please explain): _____

_____

20. Overall, does having the navigation system make you a safer driver? *(circle one)*

Safer 1

Neither more nor less safe..... 2

Less safe..... 3

21. For what types of trips do you use your navigation system? *(check boxes for all that apply)*

Long distance trips to unfamiliar destinations ..... ☐

Long distance trips to familiar destinations ..... ☐

Local trips to unfamiliar destinations..... ☐

Local trips to familiar destinations..... ☐

22. How frequently do you use your navigation system in the following ways? *(Please circle one response for each row. Circle "NA" if the function listed is not possible with your navigation system.)*

	Never	Rarely	Occasionally	Frequently	Not Applicable
A. Manually entering a new street address while parked.	1	2	3	4	NA
B. Manually entering a new street address while driving.	1	2	3	4	NA
C. Verbally entering destination information while parked.	1	2	3	4	NA
D. Verbally entering destination information while driving.	1	2	3	4	NA
E. Looking at an area map on the navigation screen while driving.	1	2	3	4	NA
F. Reading turn-by-turn directions displayed on the navigation screen while driving.	1	2	3	4	NA
G. Listening to turn-by-turn directions while driving.	1	2	3	4	NA
H. Asking your passenger to control or get information from the navigation system while you are driving.	1	2	3	4	NA
I. Choosing the route that will take the shortest time.	1	2	3	4	NA
J. Choosing the route that is the shortest distance.	1	2	3	4	NA
K. Choosing a route to avoid major roadways.	1	2	3	4	NA
L. Choosing a route that will avoid traffic problems and congestion.	1	2	3	4	NA

23. How demanding are each of these navigation system activities <u>while you are driving</u>? *(Please circle one response for each row.)*

	Not at all Demanding	Slightly Demanding	Somewhat Demanding	Very Demanding	Extremely Demanding	Not Applicable
A. Manually entering a new street address <u>while driving</u>.	1	2	3	4	5	NA
B. Verbally entering destination information <u>while driving</u>.	1	2	3	4	5	NA
C. Looking at an area map on the navigation screen <u>while driving</u>.	1	2	3	4	5	NA
D. Reading turn-by-turn directions displayed on the navigation screen <u>while driving</u>.	1	2	3	4	5	NA
E. Listening to turn-by-turn directions <u>while driving</u>.	1	2	3	4	5	NA
F. Choosing an alternative route <u>while driving</u>.	1	2	3	4	5	NA

24. Is there anything about the navigation system that you think should be improved or changed? *(circle one)* Yes No

(If <u>yes</u>, explain): _____

_____

25. In general, do you believe that car manufacturers are doing enough to design their vehicles to accommodate an aging population?

(circle one) Yes No

If you answered "<u>no</u>" then what more do you believe could be done?

(Explain): _____

_____

_____

Thank you for completing the survey!

Please mail it back in the business reply envelope provided.

Automobile Club of Southern California

1577 So. Valley Vista Drive

Diamond Bar, CA 91765

APPENDIX B: TABULATED SURVEY RESULTS FOR NAVIGATION SYSTEMS

The following list shows the response frequencies for each item on the navigation survey. Counts shown are the number of respondents who selected a particular response. Note that some items on the questionnaire required the respondent to choose a single best response, while other items required the respondent to indicate all responses that apply. The responses to open-ended questions (write-in responses) have been coded into categories. Of the 10,000 navigation questionnaires mailed out, 2,236 questionnaires were returned within three months and were included in the analyses. For each item, the response percentages shown are calculated based on a total count of responses, a sub-total count of valid responses, or the total number of respondents depending on which measure researchers believe is most appropriate for understanding the pattern of results. For items on which the participant was able to make multiple responses, percentages are based on the total number of respondents who selected at least one response to that question. For items where open-ended responses were solicited, the responses were read by data coding staff and classified into a small number of post-hoc categories. These categories are shown in *italics* in the response descriptions below.

Model year of vehicle

Description	Count	Percentage	Count With Navigation	Percentage With Navigation
2000	1	0.04	1	0.07
2001	333	14.89	263	17.60
2002	425	19.01	312	20.88
2003	431	19.28	268	17.94
2004	588	26.30	384	25.70
2005	406	18.16	225	15.06
2006	51	2.28	40	2.68
2007	1	0.04	1	0.07
Total	2,236	100.00	1,494	100.00

Vehicle manufacturer

Description	Count	Percentage	Count With Navigation	Percentage With Navigation
Acura	35	1.57	16	1.07
Audi	35	1.57	28	1.87
Bentley	1	0.04	1	0.07
BMW	237	10.60	204	13.65
Buick	7	0.31	0	0.00
Cadillac	183	8.18	107	7.17
Chevrolet	14	0.63	0	0.00
Chrysler	82	3.67	65	4.35
Dodge	7	0.31	3	0.20
Ford	2	0.09	0	0.00
GMC	2	0.09	0	0.00
Honda	35	1.57	7	0.47
Infiniti	67	3.00	35	2.34
Jaguar	61	2.73	34	2.28
Jeep	6	0.27	2	0.13
Land Rover	29	1.30	27	1.81
Lexus	322	14.40	244	16.33
Lincoln	28	1.25	10	0.67
Mazda	1	0.04	0	0.00
Mercedes-Benz	771	34.48	665	44.51
Mini	2	0.09	1	0.07
Nissan	28	1.25	4	0.27
Pontiac	2	0.09	0	0.00
Porsche	21	0.94	18	1.20
Toyota	238	10.64	21	1.41
Volkswagen	1	0.04	0	0.00
Volvo	19	0.85	2	0.13
Total	2,236	100.00	1,494	100.00

Q1. Age (self-reported)

Description	Count	Percentage	Count With Navigation	Percentage With Navigation
18 - 34 years	81	3.11	56	3.83
35 - 44 years	251	12.08	212	14.49
45 - 54 years	463	21.18	395	27.00
55 - 64 years	403	18.43	336	22.97
65 - 74 years	551	25.21	289	19.75
75 years or older	437	19.99	175	11.96
Subtotal Valid Responses	2,186	100.00	1,463	100.00
Not Ascertained	50		31	
Total	2,236		1,494	

Q2. Gender

Category	Description	Count	Percentage	Count With Navigation	Percentage With Navigation
1	Male	1417	65.00	991	67.69
2	Female	763	35.00	473	32.31
	Subtotal Valid Responses	2180	100.00	1464	100.00
9	Not Ascertained	56		30	
	Total	2,236		1,494	

Q3. Do you have any physical conditions which make driving more difficult?

Category	Description	Count	Percentage	Count With Navigation	Percentage With Navigation
1	Vision problems	113	6.15	58	4.79
2	Hearing problems	48	2.61	25	2.06
3	Dexterity problems (e.g. arthritis)	29	1.58	14	1.16
4	Difficulty turning my head/neck	52	2.83	28	2.31
5	Other conditions	16	0.87	9	0.74
6	None	1,635	89.00	1,106	91.33
	Subtotal Valid Responses	1,893		1,240	
	Total Respondents	1,837	100.00	1,211	100.00
9	Not Ascertained	399		283	

Q3. Other physical condition (explain).

Category	Description	Count	Percentage	Count With Navigation	Percentage With Navigation
1	*Physically handicapped*	1	6.25	1	11.11
2	*Physical size*	2	12.50	1	11.11
3	*Joint problems*	0	0.00	0	0.00
94	*Other*	4	25.00	2	22.22
	Subtotal Valid Responses	7		4	
	Total respondents who responded “other” in Q3.	16	100.00	9	100.00
95	Response did not pertain to the question	1	6.25	0	0.00
96	Text response not reported	8	50.00	5	55.55

Q4. A navigation system shows maps on a screen and/or provides step by step driving directions to help the driver get to a chosen destination. Does your vehicle have a navigation system installed by the manufacturer? Answer "no" if navigation system was not original equipment on vehicle

Category	Description	Count	Percentage
1	Yes	1494	67.03
2	No	735	32.97
	Subtotal Valid Responses	2,229	100.00
9	Not Ascertained	7	
	Total	2,236	

Q4a. If no, then why not?

Category	Description	Count	Percentage
1	A navigation system was not an option on my vehicle	282	41.59
2	It never occurred to me to look for one when I bought the vehicle	211	31.12
3	I thought the navigation system would be a nuisance or distraction	84	12.39
4	I didn't trust the navigation system	17	2.51
5	I didn't need the navigation system to find my way	238	35.10
6	The navigation system was not worth the extra cost	219	32.30
7	The navigation system was only available with other options I didn't want	47	6.93
8	I intended to use an aftermarket navigation system in the vehicle	20	2.95
9	I was not the person who decided to get this vehicle	37	5.46
	None	51	7.52
	Subtotal Valid Responses	1,206	
	Total Respondents	678	100.00
9	Not Ascertained		

Q4b. If you purchased this same model vehicle again would you want a factory installed navigation system?
(For vehicle owners who do not have a navigation system)

Category	Description	Count	Percentage
1	Yes	256	36.99
2	No	260	37.57
8	Don't Know	176	25.43
	Subtotal Valid Responses	692	100.00
9	Not Ascertained	1,544	
	Total	2,236	

Q5. If you purchased this same model vehicle again would you want a factory installed navigation system?
(For vehicle owners who currently have a navigation system)

Category	Description	Count	Percentage
1	Yes	1,282	87.27
2	No	96	6.54
8	Don't Know	91	6.19
	Subtotal Valid Responses	1,469	100.00
9	Not Ascertained	767	
	Total	2,236	

Q6. Approximately how many miles have you personally driven this vehicle?

Category	Description	Count	Percentage
1	*(< 5,000 miles)*	130	9.19
2	*(5,000 to 9,999)*	169	11.95
3	*(10,000 to 10,999)*	352	24.89
4	*(20,000 to 29,999)*	255	18.03
5	*(30,000 to 39,999)*	206	14.57
6	*(40,000 to 49,999)*	122	8.63
7	*(50,000 +)*	180	12.73
	Subtotal Valid Responses	1,414	100.00
	Not Ascertained	822	
	Total	2,236	

Q7. How often do you use your vehicle's navigation system?

Category	Description	Count	Percentage
1	Less than once a month	455	31.86
2	Approximately 1-3 times per month	425	29.76
3	Approximately once per week	233	16.32
4	Approximately 2-3 times per week	167	11.69
5	4 or more times per week	148	10.36
	Subtotal Valid Responses	1,428	
	Total Respondents	2,236	100.00
9	Not Ascertained	808	

Q8. How did you learn to use your vehicle's navigation system?

Category	Description	Count	Percentage
1	Instructions from the dealership, such as video, brochure, or demonstration	690	47.39
2	Vehicle owner's manual	940	64.56
3	Help from a friend or relative	185	12.71
4	Information on the Internet	13	0.89
5	On-road experience and practice (trial and error)	807	55.43
6	I have not yet learned how to use the navigation system	71	4.88
7	I don't want to learn to use the navigation system	25	1.72
	Subtotal Valid Responses	2,731	
	Total Respondents	1,456	100.00

Q9. Are you aware of any manufacturer's warnings or limitations about your vehicle's navigation system?

Category	Description	Count	Percentage
1	Yes	533	36.89
2	No	912	63.11
	Subtotal Valid Responses	1,445	100.00
9	Not Ascertained	791	
	Total	2,236	

Q9. If yes, please explain.

Category	Description	Count	Percentage
1	*System may not be accurate/up to date*	36	6.75
2	*Only use system when stopped*	248	46.53
3	*Always pay attention to road*	63	11.82
4	*Does not allow for input when vehicle is in motion*	23	4.32
94	*Other*	66	12.38
	Subtotal Valid Responses	436	
	Total respondents who answered "yes" to Q9	533	100.00
95	Response did not pertain to the question	11	2.06
96	Text response not reported	114	21.31

Q10. Were there things that were especially difficult to learn about your vehicle's navigation system?

Category	Description	Count	Percentage
1	Yes	352	24.84
2	No	1,063	75.02
	Subtotal Valid Responses	1,415	100.00
8	Don't Know (written on form)	2	0.14
9	Not Ascertained	819	
	Total	2,236	

Q10. If yes, please explain.

Category	Description	Count	Percentage
1	*Creation of address book*	14	3.98
2	*Programming desired destination*	149	42.33
3	*Initial system setup*	27	7.67
4	*Correcting a street address*	16	4.55
5	*How to locate information by name*	21	5.97
6	*Trouble reading map*	3	0.85
7	*Trouble with verbal directions*	4	1.14
94	*Other*	83	23.58
	Subtotal valid responses	317	
	Total respondents who answered “yes” to Q10	352	100.00
95	Response did not pertain to the question	8	2.27
96	Text response not reported	51	14.49

Q11. Does your navigation system respond to spoken commands?

Category	Description	Count	Percentage
1	Yes	298	21.26
2	No	964	68.76
8	Don’t know (written on form)	140	9.99
	Subtotal Valid Responses	1,402	100.00
9	Not Ascertained	834	
	Total	2,236	

Q11a. Do you find the feature useful?

Category	Description	Count	Percentage
1	Yes	222	63.98
2	No	124	35.73
8	Don’t know (written on form)	1	0.29
	Subtotal Valid Responses	347	100.00
9	Not Ascertained	1,889	
	Total	2,236	

Q11b.How well does the system understand what you say?

Category	Description	Count	Percentage
1	Not well	49	14.54
2	Fairly well	113	33.53
3	Very well	88	26.11
4	I don't know because I don't use spoken commands	87	25.82
	Subtotal Valid Responses	337	100.00
9	Not Ascertained	1,899	
	Total	2,236	

Q12. While driving, do you prefer to listen to spoken turn-by-turn directions from the navigation system, or do you prefer to view directions on the screen?

Category	Description	Count	Percentage
1	View directions	181	13.13
2	Listen to directions	360	26.12
3	Both together	837	60.74
	Subtotal Valid Responses	1,378	100.00
9	Not Ascertained	858	
	Total	2,236	

Q12a. Why don't you prefer to listen to voice directions?

Category	Description	Count	Percentage
1	It is too difficult to understand the words spoken by the system	10	5.52
2	The system voice annoys me	150	82.87
3	The system voice doesn't relate to what I am seeing on the road	38	20.99
4	The system voice gives wrong directions	24	13.26
5	It does not give me voice directions in my native tongue	2	1.10
	Other	64	35.36
	Subtotal Valid Responses	288	
	Total respondents who prefer to view directions	181	100.00
95	Response did not pertain to the question	0	0.00

Q12b.Does listening to voice directions reduce the amount of time that you look at the navigation screen?

Category	Description	Count	Percentage
1	Yes	1,060	75.99
2	No	229	16.42
8	Don't know	106	7.60
	Subtotal Valid Responses	1,395	100.00
9	Not Ascertained	841	
	Total	2,236	

Q13. Thinking about the number of features/functions and complexity of your navigation system, would you say your system is

Category	Description	Count	Percentage
1	Too simple, I wish I could do more things with it	228	16.00
2	About right in terms of complexity and number of features/functions	931	65.33
3	Too complex, I wish that it didn't have so many different functions	266	18.67
	Subtotal Valid Responses	1,425	100.00
9	Not Ascertained	811	
	Total	2,236	

Q14. Imagine that your navigation system broke down. How would you change the way you drive if you could not use your navigation system anymore?

Category	Description	Count	Percentage
1	I would go to fewer unfamiliar places than I do now	113	7.97
2	I would drive at night less often than I do now	58	4.09
3	I would drive in heavy traffic less often than I do now	27	1.90
4	I would drive alone less often than I do now	31	2.19
5	Before leaving on a trip I would do more route planning than I do now	933	65.80
6	I would not change anything about the way I drive	521	36.74
7	Other	78	5.50
	Subtotal Valid Responses	1,761	
	Total Respondents who answered "yes" to Q14	1,418	100.00

Q14. Other (specify)

Category	Description	Count	Percentage
1	*Map (road atlas/Thomas/McNally)*	50	64.10
2	*Internet (Mapquest, Google, Yahoo)*	17	18.09
3	*Cell phone/GPS/handheld devices*	5	5.32
94	*Other*	20	21.28
	Subtotal Valid Responses	92	
	Total Respondents who answered "other" to Q14.	78	100.00
95	Response did not pertain to question	3	3.19

Q15. For each of the following statements on the left, please indicate how much you agree or disagree.

Q15a. The navigation screen is in a location where it is easy to see when I am driving.

Category	Description	Count	Percentage
1	Strongly Disagree	49	3.45
2	Disagree	66	4.64
3	Neutral	123	8.65
4	Agree	604	42.48
5	Strongly Agree	566	39.80
6	Not Applicable	14	0.98
	Subtotal Valid Responses	1,422	100.00
9	Not Ascertained	814	
	Total	2,236	

Q15b. The navigation screen is large enough to see easily.

Category	Description	Count	Percentage
1	Strongly Disagree	36	2.53
2	Disagree	96	6.75
3	Neutral	135	9.49
4	Agree	627	44.06
5	Strongly Agree	519	36.47
6	Not Applicable	10	0.70
	Subtotal Valid Responses	1,423	100.00
9	Not Ascertained	813	
	Total	2,236	

Q15c. Using my in-vehicle navigation system is less distracting than using a paper map or road atlas.

Category	Description	Count	Percentage
1	Strongly Disagree	38	2.67
2	Disagree	39	2.74
3	Neutral	75	5.27
4	Agree	397	27.88
5	Strongly Agree	852	59.83
6	Not Applicable	23	1.62
	Subtotal Valid Responses	1,424	100.00
9	Not Ascertained	812	
	Total	2,236	

Q15d. Using my in-vehicle navigation system is less distracting than following printed directions.

Category	Description	Count	Percentage
1	Strongly Disagree	40	2.82
2	Disagree	74	5.21
3	Neutral	129	9.09
4	Agree	409	28.82
5	Strongly Agree	749	52.78
6	Not Applicable	18	1.27
	Subtotal Valid Responses	1,419	100.00
9	Not Ascertained	817	
	Total	2,236	

Q15e. Sun glare or reflections on the navigation screen often make it difficult to see maps or directions.

Category	Description	Count	Percentage
1	Strongly Disagree	260	18.31
2	Disagree	492	34.65
3	Neutral	269	18.94
4	Agree	245	17.25
5	Strongly Agree	94	6.62
6	Not Applicable	60	4.23
	Subtotal Valid Responses	1,420	100.00
9	Not Ascertained	816	
	Total	2,236	

Q15f. My risk of getting lost is lower with the navigation system than without it.

Category	Description	Count	Percentage
1	Strongly Disagree	39	2.75
2	Disagree	45	3.17
3	Neutral	118	8.32
4	Agree	433	30.51
5	Strongly Agree	758	53.42
6	Not Applicable	26	1.83
	Subtotal Valid Responses	1,419	100.00
9	Not Ascertained	817	
	Total	2,236	

Q15g. I find that the navigation system distracts me too much from the task of driving.

Category	Description	Count	Percentage
1	Strongly Disagree	520	36.65
2	Disagree	608	42.85
3	Neutral	155	10.92
4	Agree	59	4.16
5	Strongly Agree	47	3.31
6	Not Applicable	30	2.11
	Subtotal Valid Responses	1,419	100.00
9	Not Ascertained	817	
	Total	2,236	

Q15h. The navigation system does a good job rerouting me when I miss a turn.

Category	Description	Count	Percentage
1	Strongly Disagree	34	2.40
2	Disagree	53	3.74
3	Neutral	154	10.85
4	Agree	573	40.38
5	Strongly Agree	557	39.25
6	Not Applicable	48	3.38
	Subtotal Valid Responses	1,419	100.00
9	Not Ascertained	817	
	Total	2,236	

Q16. How has your usage of the navigation system changed since you first started driving the vehicle?

Category	Description	Count	Percentage
1	I use it more now than I did in the beginning.	436	30.58
2	I use it less now than I did in the beginning.	128	8.98
3	My usage has stayed about the same.	862	60.45
	Subtotal Valid Responses	1,426	100.00
9	Not Ascertained	810	
	Total	2,236	

Q16. I use it more now than I did in the beginning, why?

Category	Description	Count	Percentage
1	*Familiarity, Comfort, Knowledge, Trust of Navigation System*	212	48.62
2	*Not using maps, Internet, Cell phone, GPS, Handheld devices*	3	0.69
3	*Convenience*	51	11.70
94	*Other*	7	1.61
	Subtotal Valid Responses	273	
	Total respondents who responded “more” to Q16.	436	100.00
95	Response did not pertain to the question	3	0.69
96	Text response not reported	163	37.39

Q16. I use it less now than I did in the beginning, why?

Category	Description	Count	Percentage
1	*No longer learning/Novelty Wore off*	8	6.25
2	*Too time consuming or complicated to utilize/difficult to use*	31	24.22
3	*Too expensive to obtain updates/no longer accurate*	6	4.69
4	*Distracting*	3	2.34
94	*Other*	40	31.25
	Subtotal Valid Responses	88	
	Total respondents who reported “less” to Q16.	128	100.00
95	Response did not pertain to the question	1	0.78
96	Text response not reported	40	31.25

Q17. Does your current navigation system allow you to manually enter a new destination address while you are driving?

Category	Description	Count	Percentage
1	Yes	652	44.84
2	No	487	33.49
8	Don't Know	315	21.66
	Subtotal Valid Responses	1,454	100.00
9	Not Ascertained	782	
	Total	2,236	

Q18. Some navigation systems do not allow the driver to manually enter a new destination address while the vehicle is moving. Is this restriction acceptable to you?

Category	Description	Count	Percentage
1	Yes	534	37.42
2	No	667	46.74
8	Don't Know (written on form)	226	15.84
	Subtotal Valid Responses	1,427	100.00
9	Not Ascertained	809	
	Total	2,236	

Q19. Does using the navigation system create any new driving problems or safety concerns for you?

Category	Description	Count	Percentage
1	Yes	186	12.93
2	No	1,251	87.00
	Don't know (written on form)	1	0.07
	Subtotal Valid Responses	1,438	100.00
9	Not Ascertained	798	
	Total	2,236	

Q19. If yes, please explain.

Category	Description	Count	Percentage
1	*System may provide wrong directions or unnecessary detours*	28	15.05
2	*Distracts attention from driving/glare*	91	48.92
3	*Entering information while driving is dangerous*	29	15.59
94	*Other*	28	15.05
	Subtotal Valid Responses	176	
	Total respondents who responded "yes" to Q19	186	100.00
95	Response did not pertain to the question	3	1.60
96	Text response not reported	16	8.51

Q20. Overall, does having the navigation system make you a safer driver?

Category	Description	Count	Percentage
1	Yes, safer	653	45.22
2	Neither more nor less safe	748	51.80
3	No, less safe	43	2.98
	Subtotal Valid Responses	1,444	100.00
9	Not Ascertained	792	
	Total	2,236	

Q21. For what types of trips do you use your navigation system?

Category	Description	Count	Percentage
1	Long distance trips to unfamiliar destinations	1,192	85.76
2	Long distance trips to familiar destinations	382	27.48
3	Local trips to unfamiliar destinations	1,228	88.35
4	Local trips to familiar destinations	180	12.95
	Subtotal Valid Responses	2,982	
9	Not Ascertained		
	Total who responded "yes" to Q21	1,390	100.00

Q22. How frequently do you use your navigation system in the following ways?

Q22a. Manually entering a new street address when parked.

Category	Description	Count	Percentage
1	Never	58	4.15
2	Rarely	96	6.87
3	Occasionally	387	27.68
4	Frequently	821	58.73
5	Not applicable	36	2.58
	Subtotal Valid Responses	1,398	100.00
9	Not Ascertained	838	
	Total	2,236	

Q22b. Manually entering a new street address while driving.

Category	Description	Count	Percentage
1	Never	647	46.71
2	Rarely	282	20.36
3	Occasionally	190	13.72
4	Frequently	68	4.91
5	Not applicable	198	14.30
	Subtotal Valid Responses	1,385	100.00
9	Not Ascertained	851	
	Total	2,236	

Q22c. Verbally entering destination information while parked.

Category	Description	Count	Percentage
1	Never	349	25.49
2	Rarely	67	4.89
3	Occasionally	80	5.84
4	Frequently	35	2.56
5	Not applicable	838	61.21
	Subtotal Valid Responses	1,369	100.00
9	Not Ascertained	867	
	Total	2,236	

Q22d.Verbally entering destination information while driving.

Category	Description	Count	Percentage
1	Never	384	27.89
2	Rarely	65	4.72
3	Occasionally	52	3.78
4	Frequently	25	1.82
5	Not applicable	851	61.80
	Subtotal Valid Responses	1,377	100.00
9	Not Ascertained	859	
	Total	2,236	

Q22e. Looking at an area map on the navigation screen while driving.

Category	Description	Count	Percentage
1	Never	181	12.97
2	Rarely	261	18.70
3	Occasionally	540	38.68
4	Frequently	374	26.79
5	Not applicable	40	2.87
	Subtotal Valid Responses	1,396	100.00
9	Not Ascertained	840	
	Total	2,236	

Q22f. Reading turn-by-turn directions displayed on the navigation screen while driving.

Category	Description	Count	Percentage
1	Never	300	21.47
2	Rarely	365	26.13
3	Occasionally	390	27.92
4	Frequently	260	18.61
5	Not applicable	82	5.87
	Subtotal Valid Responses	1,397	100.00
9	Not Ascertained	839	
	Total	2,236	

Q22g. Listening to turn-by-turn directions while driving.

Category	Description	Count	Percentage
1	Never	83	5.93
2	Rarely	83	5.93
3	Occasionally	226	16.15
4	Frequently	938	67.05
5	Not applicable	69	4.93
	Subtotal Valid Responses	1,399	100.00
9	Not Ascertained	837	
	Total	2,236	

Q22h. Asking your passenger to control or get information from the navigation system while you are driving.

Category	Description	Count	Percentage
1	Never	232	16.57
2	Rarely	254	18.14
3	Occasionally	433	30.93
4	Frequently	398	28.43
5	Not applicable	83	5.93
	Subtotal Valid Responses	1,400	100.00
9	Not Ascertained	836	
	Total	2,236	

Q22i. Choosing the route that will take the shortest time.

Category	Description	Count	Percentage
1	Never	81	5.83
2	Rarely	107	7.70
3	Occasionally	366	26.33
4	Frequently	755	54.32
5	Not applicable	81	5.83
	Subtotal Valid Responses	1,390	100.00
9	Not Ascertained	846	
	Total	2,236	

Q22j. Choosing the route that is the shortest distance

Category	Description	Count	Percentage
1	Never	93	6.71
2	Rarely	187	13.49
3	Occasionally	491	35.43
4	Frequently	538	38.82
5	Not applicable	77	5.56
	Subtotal Valid Responses	1,386	100.00
9	Not Ascertained	850	
	Total	2,236	

Q22k. Choosing a route to avoid major roadways.

Category	Description	Count	Percentage
1	Never	394	28.28
2	Rarely	418	30.01
3	Occasionally	319	22.90
4	Frequently	135	9.69
5	Not applicable	127	9.12
	Subtotal Valid Responses	1,393	100.00
9	Not Ascertained	843	
	Total	2,236	

Q22l. Choosing a route that will avoid traffic problems and congestion.

Category	Description	Count	Percentage
1	Never	208	14.95
2	Rarely	247	17.76
3	Occasionally	338	24.30
4	Frequently	294	21.14
5	Not applicable	304	21.85
	Subtotal Valid Responses	1,391	100.00
9	Not Ascertained	845	
	Total	2,236	

Q23. How demanding are each of these navigation system activities while you are driving?

Q23a. Manually entering a new street address while driving.

Category	Description	Count	Percentage
1	Not at all demanding	141	10.08
2	Slightly demanding	142	10.15
3	Somewhat demanding	214	15.30
4	Very demanding	216	15.44
5	Extremely demanding	215	15.37
6	Not applicable	471	33.67
	Subtotal Valid Responses	1,399	100.00
9	Not Ascertained	837	
	Total	2,236	

Q23b. Verbally entering destination information while driving.

Category	Description	Count	Percentage
1	Not at all demanding	117	8.48
2	Slightly demanding	75	5.44
3	Somewhat demanding	72	5.22
4	Very demanding	46	3.34
5	Extremely demanding	36	2.61
6	Not applicable	1,033	74.91
	Subtotal Valid Responses	1,379	100.00
9	Not Ascertained	857	
	Total	2,236	

Q23c. Looking at an area map on the navigation screen while driving.

Category	Description	Count	Percentage
1	Not at all demanding	440	31.61
2	Slightly demanding	387	27.80
3	Somewhat demanding	304	21.84
4	Very demanding	106	7.61
5	Extremely demanding	69	4.96
6	Not applicable	86	6.18
	Subtotal Valid Responses	1,392	100.00
9	Not Ascertained	844	
	Total	2,236	

Q23d. Reading turn-by-turn directions displayed on the navigation screen while driving.

Category	Description	Count	Percentage
1	Not at all demanding	357	25.74
2	Slightly demanding	358	25.81
3	Somewhat demanding	272	19.61
4	Very demanding	132	9.52
5	Extremely demanding	70	5.05
6	Not applicable	198	14.28
	Subtotal Valid Responses	1,387	100.00
9	Not Ascertained	849	
	Total	2,236	

Q23e. Listening to turn-by-turn directions while driving.

Category	Description	Count	Percentage
1	Not at all demanding	879	62.92
2	Slightly demanding	153	10.95
3	Somewhat demanding	86	6.16
4	Very demanding	72	5.15
5	Extremely demanding	70	5.01
6	Not applicable	137	9.81
	Subtotal Valid Responses	1,397	100.00
9	Not Ascertained	839	
	Total	2,236	

Q23f. Choosing an alternative route while driving.

Category	Description	Count	Percentage
1	Not at all demanding	253	18.31
2	Slightly demanding	279	20.19
3	Somewhat demanding	282	20.41
4	Very demanding	148	10.71
5	Extremely demanding	112	8.10
6	Not applicable	308	22.29
	Subtotal Valid Responses	1,382	100.00
9	Not Ascertained	854	
	Total	2,236	

Q24. Is there anything about the navigation system that you think should be improved or changed?

Category	Description	Count	Percentage
1	Yes	690	54.29
2	No	567	44.61
	Subtotal Valid Responses	1,271	100.00
8	Don't Know (written on form)	14	1.10
9	Not Ascertained	965	

	Total	2236	

Q24. If yes, please explain.

Category	Description	Count	Percentage
1	*Improve voice output*	22	3.19
2	*Make system easier to operate/program/simplify*	216	31.30
3	*Include a voice recognition system*	172	24.93
4	*Allow for passenger to make changes while vehicle is in motion*	72	10.43
5	*Larger, clearer screen, easy to operate by touch*	123	17.83
6	*More frequent address updates*	59	8.55
7	*Improve operation (does it do its job)/provide correct route information*	92	13.33
8	*Add real time traffic data*	48	6.96
94	*Other*	98	14.20
	Subtotal Valid Responses	902	
	Total respondents who responded “yes” to Q24	690	100.00
95	Response did not pertain to the question	9	1.16
96	Text response not reported	16	2.06

Q25. In general, do you believe that car manufacturers are doing enough to design vehicles to accommodate an aging population?

Category	Description	Count	Percentage	Count With Navigation	Percentage With Navigation
1	Yes	1,512	74.41	1,014	74.18
2	No	458	22.54	304	22.24
3	Subtotal Valid Responses	2,032	100.00	1,367	100.00
4	Don't Know (written on form)	62	3.05	49	3.58
5	Not Ascertained	204		127	
6	Total	2,236		1,494	

Q25. If you answered no, then what more do you believe could be done?

Category	Description	Count	Percentage
1	*Improve user interface (displays/controls)/Simplified and larger controls*	98	21.40
2	*Improved visibility around vehicle/reducing blind spots/Improve mirrors*	58	12.66
3	*Improved safety features (backing aids)*	48	10.48
4	*Improved entry/exit access*	42	9.17
5	*Seating/seatbelt (size and comfort)*	30	6.55
6	*Reduce cost for safety features*	9	1.97
7	*Make safety features available on all vehicles (not just high end vehicles)*	15	3.28
8	*Improved gas mileage*	7	1.53
9	*Increased automation*	10	2.18
10	*Minimize pedal confusion*	0	0.00
94	*Other*	131	
	Subtotal Valid Responses	448	
	Total respondents who responded “no” to Q25	458	100.00
95	Response did not pertain to question	23	4.93
96	Text response not reported	78	16.70

APPENDIX C: DISCUSSION GUIDE FOR TELEPHONE INTERVIEWS WITH OWNERS OF NAVIGATION SYSTEMS

Navigation System

Telephone Interview Discussion Guide

Hello— (introduce yourself, and identify you are from the Automobile Club of Southern California and you are an Automotive Research Specialist in the Club's Automotive Research Center.)

Some time back we sent you a survey about your experience with the (Navigation system) in your Year/Make/Model. You indicated you would like to participate in our follow-up telephone interviews. This will only take a few minutes, is now a good time, or can you suggest a better time?

On your survey you indicated that the (Navigation system) on your car could be improved—read comment from written questionnaire. Probe further into this comment.

Ask if they have any specific examples of when the (Navigation system) was particularly helpful or caused a problem.

Have you changed your driving habits as a result of the (Navigation system)? If so how? How long did that take?

If they answered no to the last question, "In general, do you believe that car manufacturers are doing enough to design vehicles to accommodate an aging population? Probe into what they think can be done.

APPENDIX D: COMMENTS FROM TELEPHONE INTERVIEWEES WHO OWN NAVIGATION SYSTEMS

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
26309	81	M	2004 Cadillac XLR - It's too difficult to program it; gives too much detail - rest stops, etc. There is no choice to select freeway or not.	Hurtful - recently it took me to the wrong place, ten blocks away, ending up in a cemetery. I'm a little distrustful of it. It can be a big help, but it's too complex to program. I've tried to enter just an intersection only, but it wants to know a street number. (He was going to a construction site and there were no numbers assigned yet.)	Yes - I used to have the NAV sound on, but found it too distracting.	He has adaptive cruise control and rear parking aid. But he feels a system in the front to aid in parking would be beneficial.	
29197	47	M	2004 BMW 645 - Does not have ability to verbally enter data - system needs user input via a keyboard; have to go letter by letter.	No problem, but cannot input verbally while driving.	Yes, I have begun to rely on it after 6-8 months. But, it is difficult to use – I only use it when I have time to use it. Infrequent use still. You have to spell out every letter. (He feels he doesn't need to go back to any stored information after he uses it for a particular address the first time.) After the first use, he knows how to get there. However, for a new destination, it just takes too long to input data. His car is complicated	His answer means better variable speed cruise control systems - he's seeing more and more of this as time progresses.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
					enough with its radio, etc.		
24738	57	M	2003 ML - no longer owned - was DVD based. Has 2004 CLK, CD-based, and 2007 DVD-based - better system. NAV system slow to get updates from factory in beginning. Better now - pay $250 for 1-time update. Newer version (2007) with DVD has much more detail than earlier systems.	Not really a problem, but it took him out of the way. It told him to make a bunch of right turns, and he ended up on the same street. Not sure if that's the way it was programmed, or the street didn't go through at the time the program was written.	No change in driving habit. It is a convenience factor to have it.	Small font used for some controls make it hard to recognize what the control is. Other controls are just not easy to reach.	
28644	60	M	2003 M-B CL. Vehicle has many problems for over $100,000. He's been into dealer probably 40 times for various problems, e.g., transmission would not go into gear, motor or transmission mounts. M-B had the "Worst Car of the Year" award, beating Land Rover.	System is always helpful, but it uses an obsolete data entry technique. Voice activation is needed. System has GPS, and knows where you are now. Slow data entry for new entries. He would like to be able to easily program in a starting location, instead of just have to accept where the GPS says you are now as the start location. “I would never buy a car without NAV now.” It is extremely expensive for what you get.	No change in driving habit - he instantly adapted - says it is like air conditioning - once you use one, you never get another car without it. All systems operate the same way.	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
22576	45	M	2005 M-B 645Ci - DVD-based. Doesn't give current traffic information, or optional route he should take because of a SIG-alert. Newer (2007?) models supposed to have this.	Always helpful - no examples.	No change in driving habits	N/A	
23693	67	M	745Li - Also has Lexus with touch-screen. BMW does not have touch screen (said no BMW has those). Brightness is too low. Programming is very hard, slow, letter by letter.	Difficult to manipulate beyond entering the letters for the address. Also, simply switching from FM to AM radio is too complex.	Not even 1 day to adapt to NAV system. Only problem is that it is cumbersome and very time consuming. Lexus has a much better system with their touch screen.	Automatic GPS sensing should be on all vehicles when you are entering an area where the speed limit is now lower. He said many people don't see the signs for reduced speed limit ahead. His vehicle has backing aid sensor (red/yellow warning). When it's red, you are 1 foot to 18 inches from an object. This also works for the front of the vehicle.	
28823	73	M	ML55 - has voice activation for phone, but not for NAV system. Has to enter letters one at a time - navigate through the system, then push a button. Quote: "With all the hands-free stuff, it would be nice to have voice activation - Mercedes-Benz has all	More helpful than a problem. Had Thomas Guides before NAV. NAV is a great item to have in a car. He's owned Mercedes vehicles since the 1970's.	Yes. He doesn't have to look at the screen while he's driving. Had to leave earlier for a destination before he had NAV. With NAV, he gets live updates when freeway is closed, or if there is heavy traffic ahead. However, with the NAV system, not always a quicker route	Things needed: easier access (has that with wife's S500 - they take that one for vacations and longer trips). Other things, in order of importance are: 1. Rear View Video; 2. Adaptive Cruise Control; 3. Remote deck lid opening/closing; 4. Adaptive Headlights.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
			the latest stuff, but not in their cars yet."		is selected, but it will get you there.		
30503	48	F	S500 - Quote: "M-B navigation "sucks" compared to Toyota's." The car is very pretty, but the NAV system has minor problems.	Not enough time to react for making turns - can be dangerous. NAV should tell you a minute or two before you get to an intersection.	No change - easy to program and use, but NAV programming is slow on response.	N/A	
26614	45	M	Series of different steps are needed to get an alternate route. A fixed route is known in the software. If he knows a shortcut, it will tell him how to get back "on track."	Whenever he uses it, it is helpful. CD-based system with satellite. It has not given him any route that would avoid traffic delays, so the system does not appear to have any live updates.	No change in driving habits, but it took him about a year to adapt to the technology.	N/A	
32332	62	M	System is either CD or DVD-based. Actually got new updated CD/DVD on day of phone interview by ACSC. System does give different options for alternate routes, but no live update for traffic congestion.	No specific examples either helpful or causing a problem.	No change in driving habits	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
22993	71	M	LX470 - full size SUV - Improvements to system require DVD updates.	Outside of California, it is great. Quote: "Things are too dynamic here - things are changing too rapidly here. It's best to rely on an AAA map." Also, NAV system is most helpful in Northern California - navigating through the Bay area and all the bridges there - it directs you to left freeway exit ahead, then second traffic light, turn right, etc. Also very helpful if you think you may be close to your destination, but can't see the street number for the road you are on. You hit the map button, and it says you are at 2700 X Street, then 2600 X Street, etc. This also tells you that you are going the right direction (if you are looking for 2500 X Street).	No change in driving habits. Adapted instantly to using the NAV system.	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
24268	74	M	Also has a Lexus - NAV screen is 1-1.5" inside the dash, and there's no glare on that. Sun from the back or side windows can come in and wash out the Cadillac's (surveyed vehicle) screen.	On 2 occasions, it gave wrong directions. Always most helpful. While in Glendale looking for a McDonalds, it said he was "too close". It was in the downstairs area of an office building, not a "stand-alone" version of McDonalds.	No change in driving habits. Using it was very intuitive. Would not buy a car now without it.	N/A	
21594	47	F	Need to pull off to the side of the road to enter letters, one at a time - inconvenient. Voice commands would be great.	Particularly useful compared to Thomas Guide - you need to get Los Angeles/Orange County/San Diego to get it all. (She goes to L.A./Santa Ana frequently.) System talks to you; it gives you an idea that something is coming up…exit in 100 feet, exit on left side, etc.	No real change in driving habits.	She also mentioned another good idea is reverse backing aids. She said, as an attorney, she sees people backing into others who can't see them because of blind spots; she cited an example of horrible accident where a parent backed up and didn't see their child behind the car before impact.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
32368	72	M	System does not allow verbal input. You have to turn a dial/push a button, etc. - very time consuming. The new M-B uses a DVD; his 2002 only has a CD-based NAV system.	Most of the time it is quite helpful. Few errors, relatively rare. Use quite often and certainly on a trip. 3 years ago he bought another CD for Oregon - expensive - about $200 for update. System has in-dash installation for NAV system CD update. Music CDs are in the changer in the trunk.	He has learned that you don't look at it while driving. No change to driving habits. System offers voice commands back to driver; verbiage, "so many feet 'til turn, turn left 1/4-mile, etc."	It is difficult to read not only the NAV screen but all the dash instruments at a certain time of day. As an older person, he said the problem is dimness and lack of contrast of the letters/character/dials on the dash. A friend of his has a Lexus, and its display is up higher and easier to read, with better contrast.	
22049	32	M	S430 - System provides voice back directions, but no voice entry. Have to turn a dial, push a button, repeat - very time consuming.	Wife and he had a 6000-mile cross-country trip 2 years ago. In most cases, it gave him directions that were accurate. However, it did direct him to a commercial business area (actually a business park) when he was searching for a restaurant, but there were no restaurants there.	Yes, I listen to the on-board NAV system, but I also use a map on-line. (There are several options he's used.) I have an after-market NAV system that I attach to the windshield – it has more information than M-B system.	New Acura's have lots of technology. The RL/TLs have Bluetooth with voice activation for NAV. But, you need to send somebody to school to learn it. His system has 6 CDs for cross-country usage. He said many cars have new technology, but it's too complex. He's a "tech junky" and doesn't mind spending an hour programming something in his car, but many people can't or don't know how to do all the steps required.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
32187	72	F	She believes she has a CD version - bought the vehicle used - took it to a repair shop where they told her there were no updates available for the NAV system. She has not checked with the dealer to see if this is true.	System won't allow you to change destination while you are driving. She's noticed a problem/difficulty when you put in the street number, and then the street, but it wouldn't accept the city she was going to. (E.g., she found Union Street, East and West, but could not find "Pasadena"). She said it would be nice if the system had a car location like GPS or an On-Star system.	No change in driving habits. Her system will recalculate if she goes a way she already knows that is different than the directions the system is giving her. Said it would be nice if the system had live traffic updates. She indicated you have to have the radio on before you can use the NAV system, at least as far as she knows. It would be nice if you didn't have to go through the radio first.	A lot of newer technology (NAV, for instance) is not user friendly - comes with a huge manual for NAV system, but has "quick start" guide for important items - on/off/wipers, etc.	
29806	65	F	Does not have any information for traffic problems. Thinks newer models do. Thinks she would have to take vehicle back to dealer to get any upgrade for newer information (new roads/on and off ramps, etc.).	Particularly helpful when traveling in evening with street repairs, and they throw her off the freeway. Very helpful in downtown Los Angeles at night - had to exit the freeway, and NAV system helped her get back on the freeway later. Did not know a particular on-ramp existed.	No real change in driving habits, however she now uses NAV instead of looking addresses/direction up on the Internet or using the "dreaded Thomas Guide."	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
28418	70	M	2004 Cadillac SUV - Voice command available on vehicle is only for "Radio on/Navigation on, etc." System gives voice feedback to him, "Turn right, 500 feet", but it won't let you enter information while driving. He has a NAV system on his 2005 700-series BMW, and it allows you to plug in new information as you drive.	Helpful - you can select an alternate route - particularly helpful when driving to Laughlin, Nevada. If he sees congestion up ahead, he can select an alternate route, saving him time. BMW doesn't have that.	No change in driving habits.	He is a little overweight, and it is hard to get in and out of vehicles. He's getting rid of his BMW (too low) for this reason.	
28060	77	M	(Spoke to wife). NAV uses a CD version, was outdated when it was new. Bought the vehicle in Stuttgart, Germany. You need to push a button then enter each letter/number one at a time.	Always been helpful, but now outdated. A lot of times, it brings you around the area, but not always directly to the destination you programmed in. Confusing in Phoenix, Arizona. System worked better, and was more exact in foreign countries (Italy) than here in the U.S. She received some training in Germany on how to use the NAV system. Vehicle is actually her car. Husband doesn't know how to use the NAV system.	No change in driving habits - system seemed very intuitive. Direct training in Germany when we bought the car helped a lot.	Manufacturers should provide updates at no cost to vehicle owners. No other ideas come to mind.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
25039	61	F	M-B S540 or S440? - System allows no voice command to enter destination. System gives voice feedback, "but it drives you nuts." The after-market device, Tom-Tom is very good, and simple. It has no voice command either, but it's "very 1-2-3." There is no need for a thick manual to program it. Quote: "Women like simple and to-the-point things while guys like gadgets, and lots of details."	“My husband likes to play with it while I am driving - this frustrates me.”	No, not at all.	Quote: "We as a society have become very car-oriented. In foreign countries, cars have been reduced in size to accommodate narrow roads, but not here."	
32632	62	M	Has Lexus and BMW was well. In 2001, this was old technology. Have to use 1 button/1 character at a time entry - slow - no verbal entry, but provides verbal back to driver.	He has given up on Mercedes-Benz, because of reliability issues. NAV has always been helpful. He is a big fan of NAV systems, and thinks they should be in all cars.	Yes, immediately. You don't have to figure out where you need to go ahead of time. I trust NAV to get me there. It is real helpful at night, or for rainy weather driving, especially for poorly lit streets or freeways. It is helpful to tell you where a curve in the road is ahead of you when you can't see it yet.	Both cars he has now have NAV systems as well as back up devices: BMW has audible back-up, and is a better system - all cars should have it. Lexus has a camera, and the problem with using it is you are looking at the camera and not where you are going.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
23222	51	F	System uses a knob, turn it left or right, it's slow, often it passes where you want to enter data and goes onto the next line and you have to back up. It is too much hassle and too much work to use it!	One time, she was lost. Found out she was going the wrong way. Had to pull over to a parking area, punch in the destination and it was a life saver for this one instance only in the 4-5 years she's owned vehicle.	No change, whatsoever.	Quote: "Keep things simple. A computer with MapQuest is a lot easier to use."	
28660	35	M	It's a pain to have to enter only one letter at a time. Very slow and cumbersome.	NAV system is really limited - it sometimes does not respond to his entries. The system uses a CD inside the NAV system. It has a problem when he crosses state lines - it quits working - he only has a CD for California.	Yes, immediately. My NAV system is always on - to look for quicker exit, or a restaurant. His system is used daily as part of my normal driving routine.	Verbal entry would be great, also live traffic updates like newer models have.	
28117	59	M	Volume for voice feedback is too low. He took car into dealer and they said it had no problems. System is letter-by-letter - no verbal input option.	He was taking a trip and a road had been closed. He did not know the area. The road closure was not recognized by NAV. Had to find an alternate route. No changes are recognized. The NAV system will give you an alternate route. System gets confused (10 Freeway in Ontario, CA), perhaps by bad signals.	It takes 10 minutes to figure out a course for a trip. No actual change in driving habits.	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
22634	44	F	DVD or CD-based system - not sure. Never has updated the system. She's going into repair facility on May 3rd, and will ask if an update is available.	Time saving as a general example of being helpful. If you enter a wrong address, it won't come up.	No changes in driving habits. Less time to get to a destination because it directs you and gives an alternate route if you request it.	N/A	
22332	76	F	No verbal input available. You have to enter each letter separately. Time consuming. System is either CD or DVD-based, member is not sure. It takes forever to get information into the system.	Have not used NAV in so many years - too much bother to use it anymore. My husband would know a shorter route than the system would show.	No changes, but they used it a lot for the first year, to get used to it, and see what it would do. Quote: "It's more of a novelty item than anything else."	N/A	
28833	80	M	330Ci NAV system is tied in with another option - expensive package. You have to enter information 1 letter at a time - time consuming. Quote: "It's a nuisance, sometimes."	Very good and very precise on location most of the time, except once in finding an address in Fresno for a funeral. It was a newly developed area, NAV could not find his destination - had to call and get directions directly.	No, but I don't always use it. “I never try to enter a destination while he's driving. My wife does that so I can drive.” His system uses cartridges. Now he has all of the USA and Canada, as a gift from his wife. It has about 6 or 7 disks.	Vehicle he has does not have any BAS or RVV. However, it has 3 different setting for seats/mirrors, etc. Right rearview mirror tilts down to view curb in reverse. Because of this, he felt he didn't need the optional BAS. What he'd like to see, in place of a standard rear view mirror, is a rearward viewing camera that functions while you are driving forward. It would give a good live view to the rear of the vehicle, and eliminate blind spots.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
						He's mentioned this in other arenas as well, such as to BMW, to no avail.	
31954	63	F	Light from side window may cause difficulty in seeing screen. Physically she feels the display is just too dim during the day. There is no brightness control that he knows of. At night it dims automatically because headlights are on and you don't need it as brightly lit.	Both helpful and bad: Helpful at night when exiting a concert hall when you are just driving around in circles inside the parking structure, trying to get out to a street. When you get to the street, you don't have a clue what street it is, or which direction to turn. Bad - going from point A to point B - probably the best route is the freeway, but the system does not always select the best way. He said it would be better to have an easier way to start with, and an easier, more convenient and simpler way to program in your desired route.	No - said the system's primary use is either 1: system tells me precisely where I want to go at the end of my trip (I know how to get in the general vicinity already), or 2: I'm lost in downtown Los Angeles and just want to go home. I plug in "Home" and the system gets him to the closest freeway to start the trip home. Once I'm on the freeway going the right direction, I know how to get there "from here".	N/A	
31837	36	M	Should be able to change destination by voice when you are driving. Says his system has this capability but he hasn't used it or enabled it, or figured it out.	Helpful when he's in an unfamiliar area. Never a problem.	Yes - immediately. "Now I don't have to MapQuest or Google my destination."	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
31741	49	M	Letter by letter data entry only - blocks out unavailable characters so you only have correct choices to enter the next one. No verbal entries are possible.	System has caused confusion at times - particularly on the 101 North at the 134 split - it tells you "get in the left lane" and then when you are at that point, it tells you "get in the right lane."	No change in driving habits at all.	N/A	
29742	44	F	Knob in the middle goes any of 8 different directions: up, down, left, right, and at right angles to those. You have to turn the dial to scroll - Quote: "too touchy" - very easy to get into the wrong menu in a hurry. There is only one dial, but it has too many things that it controls. She doesn't have the car any more. NAV system didn't work very well - certainly not a reliable device for a very expensive car.	She's a realtor. She's used it about 10 times, and only 2 of those times it actually got her to the correct place. Very embarrassing with a client in the car, going around in circles. Said she never used it after that.	No, but NAV is a great help for street signs that are not really well lit - good idea for a vehicle to have, but very poorly executed - too elaborate and complicated to use, and then it's not reliable.	N/A	Member also said she bought car when it was approximately 2 years old - the NAV system may have needed servicing or upgrading then.

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
29441	56	M	M-B S430 - Destination data entry is cumbersome, one character at a time. He says Lexus has a superior system. No voice entry is possible on his system.	System keeps the address in memory - this is a positive point, probably a common thing on other NAV systems as well. What is irksome is the way you have to enter information. Said, quote: "It's one thing to do it sitting still, but adjusting it while driving is even worse and dangerous."	Yes, immediately. He now maps his destination first before he starts the trip.	N/A	
24400	80	M	M-B ML500 - Voice feedback only, no voice input permitted. He said the Acura MDX also has seat and steering wheel that move out of the way to ease entry/exit. His vehicle does not have touch tone. Biggest problem is the program shuts off when the key is turned off, and you have to start over again. Says system requires him to use a joystick and button to program one letter at a time. He also has a C230 (wife's car) which has a Tom-Tom with active screen.	Voice feedback on his ML500 is very good - better than Tom-Tom. He is happy with it, except for the problem programming it.	No, I still use a map.	He can adjust brightness, but can't turn the NAV screen towards him. He listens to the voice only while driving - doesn't look at the screen because of the danger. He feels that cars are designed for younger people. Quote: "American car manufacturers need to listen to consumers. Japanese car manufacturers have listened and have already responded."	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
319	67	F	There is no verbal input possible; has verbal feedback. She uses NAV rarely - it's a pain to use it. It doesn't work well. Recently, she put in an address where she knew where she was going. She stopped during the drive at a restaurant, and then went around the block so she was headed back in the correct direction. The NAV system then told her to go the wrong way. She says the system gets confused - it tells you "turn left" and it should be "turn right".	Other than perhaps once, it has never been helpful. (Husband's NAV system has been very helpful - he has an Acura MDX - it has a map you can move to show a close street - this helps you figure out where you are or are headed). She said she needs to go through several programs to get it to work properly. It did help her find her way home once. She spent a lot of time recently programming NAV for directions from home to Descanso Gardens the night before her trip. She finally gave up and used a map and had no problems.	No change in driving habits.	N/A	
24889	77	M	No adjustments are available to increase/decrease the brightness of the screen, or turn it towards the driver.	It is helpful if you want to go somewhere. However, on 2 occasions he entered data and it took him somewhere else, totally in a different direction.	No change in driving habits.	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
32004	56	F	You need to come to a complete stop before you or a passenger can add or change anything on NAV system	Very helpful when you are going somewhere new. Also, when you are in a strange city and don't know where you need to be or how to get there. It's very helpful when you need to get there in a hurry or don't have time to drag out a map.	No change in driving habits.	N/A	
24706	57	F	No voice activation is available.	It did tell her once the wrong direction. Thing to change would be a bigger screen. Her son's has a map with a touch screen and you can move the map around - very nice (his car is a Lexus hybrid 4-dr. sedan). Her car has a "stick figure map" - very old style.	No change in driving habits - she was able to adapt to the NAV system and its operation instantly - it's very intuitive, just slow - 1 letter or number at a time, etc.	N/A	
25899	51	M	Enter 1 letter at a time - SLOW. New Infiniti is vastly improved with voice commands - you say, "Navigation" and it prompts you for city, the type of establishment, etc.	Helpful usually, but he rarely uses it around home. It was of great help on a trip to Houston/Dallas in finding a gym or restaurants, since he didn't know his way around. He wasn't sure it took him the best way there, but it got him to his destination O.K.	No change in driving habits.	No comments.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
25553	67	M	His Lexus will not let you do any input while driving. He has a Honda Pilot - it's different, but similar. A nice feature he would like to see is the ability to use computer software program to design and layout a map, etc. for a trip, then upload this to the car's NAV system. The after-market product, Tom-Tom or Garmin has updates that are available for software/routes/maps, etc., but you still are not able to upload any of this to the car's NAV system.	NAV has really helped a couple of times. He has an issue with his internal navigation. He always gets lost in downtown Los Angeles. On a couple of occasions, the NAV system has really helped get him out of the city.	No change in driving habits.	N/A	
32166	69	M	NAV provides verbal directions back, but accepts no verbal input. You have to enter 1 letter/character at a time - very archaic and VERY slow!	Helpful? Yes, in Modesto they took a drive into the country-side, and got lost. Cloudy day with no sun to direct them, NAV was very helpful to get them back. Also, when going to Temecula to visit relatives, he has it programmed (along with about 10 other destinations), and NAV gives him turn-by-turn directions.	No. If it were easier to do, I would definitely use the NAV system in the car, instead of having to spend time at the computer on Google.	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
29916	50	M	Lexus SC430 - System gives excellent verbal directions, but it won't accept verbal input from driver.	Particularly helpful all the time. Occasionally it gets mixed up - brings you to a wrong place. You need to have it updated every year. If you don't get a new DVD, you won't have up-to-date road conditions or will be guided the wrong way if the street you want is not in the database.	Yes, immediately - he is much more able to just get in his Lexus than his Camry Solara, especially if he's going somewhere he's not familiar with, e.g., San Francisco (he lives in San Diego), and he knows the Lexus NAV will get him there, if he has the latest software DVD.	Yes and No: Yes - Put his car in Reverse, both outside mirrors tilt down. He works in sales and needs to back up frequently. This feature has saved him from accidents, allows him to see other people and cars behind his car easier. His car also has an auto-dimming rear-view mirror. It should be fairly inexpensive compared to other features/options. Why can't all cars have this? No - Quote: "American car manufacturers build cars they want to build. Japanese manufacturers build cars that we want. This is where U.S. car manufacturers are missing the boat! Also, in fuel economy. Who wants a Lincoln Navigator with poor fuel economy, now with gas pushing $4.00 a gallon?"	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
22367	73	F	"Simpler instructions." She doesn't know how to use it. She had a stroke 5 years ago, and the instructions are hard to follow.	Hurtful - destination did not register or was not recognized. She said the system would tell her how far to go on the freeway, but she was on surface streets.	No change in driving habits. She just doesn't use it any more. Said she did get a letter from Lexus about updating it some time ago.	N/A	
30030	75	M	Chrysler Town & Country - No verbal input allowed for NAV - have to enter one letter at a time - very slow. Cadillac he has does have a problem with backing aid system - dealer doesn't seem to be able to find problem - works for them backing up.	Very helpful - used several times. You have to key in the address before you start a trip, because you can't enter or change anything while you are driving.	No real change in driving habits, just now he doesn't have to take a map with him.	N/A	
22276	67	M	It is confusing finding activity at a location. His wife has a Toyota Highlander, and a couple of buttons later, she has the information needed.	Extremely helpful for unfamiliar locations; it tells him he is traveling in the right direction. In heavy traffic, he can change the route easily to take an alternate route and avoid freeway congestion.	No change in driving habits.	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
29054	64	M	You have to be stopped or parked before you can enter destination - no voice entry - have to enter one character/letter at a time.	Very helpful - particularly when traveling to newer locations in South Orange County. Also to second home in Palm Desert where there been a lot of changes in the last 2-3 years.	No change at all in driving habits.	N/A	
27703	72	M	You have to dial to a letter or a number, push a button. System gives you choices for next character or letter. Wife's 2001 [system] is very slow, letter by letter. The verbal input on his vehicle is sporadic. A touch screen would be a big improvement.	No specific example - always helpful.	No change in driving habits	Verbal commands don't work well - it's awkward and you have to do it several times before it "takes". However, it's very good for the telephone - system understands verbal commands fine for that.	
31736	44	M	He is OK with what we have now. But he would like the NAV screen display visible on the windshield, like a heads-up display or in the speedometer cluster area, so eyes remain on the road more.	No problem, other than he needs to get a new disk, so he has the latest, updated map and roads for California and Nevada.	No change - Quote: "It's so helpful and so safe." However, he feels it would be great to have it controllable (on/off) by buttons on the steering wheel, like existing audio controls.	N/A	
29225	69	M	The NAV system is too complicated, and it gives you wrong directions. It is useless.	No specific examples either way, just that he does not use it.	No change in driving habits, because he refuses to use it.	He feels the NAV system is a rip-off, and the $3500 he paid for the NAV system should be refunded to him by the Auto Club.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
30865	46	F	Can't enter any destination or update while you are driving. Have to stop and then it's entering data one character/letter at a time.	NAV has gotten her out of places where she was in Los Angeles area and not familiar with circumstances - she got lost and felt uncomfortable about getting out and asking for directions.	Yes - immediately - she is more aware of where she it. Might take an alternate route when she is stuck in heavy traffic where she is not familiar with the area. She wouldn't do this without her NAV system.	There are features on her car that her parents would be afraid to use/would not use, because they are not computer "savvy".	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
27605	68	M	Daylight illumination of NAV screen auto-dims when he goes into a tunnel or through a thick grove of trees (when headlights come on) - it would be good if it stayed at normal (headlight off) brightness during the day. Also, NAV screen does the same thing for rainy weather - if you turn on headlights (required if wipers are on), screen dims.	Needed for a couple of times when he got lost. Also, if he knows a short cut/alternate route, the NAV system squawks at him. "Shortest time/shortest distance" doesn't always equate this correctly. Thought it would be a waste of time to have it. Dealer said, "You get it with this car, take it or leave it." A few times it wanted to know a route number, such as CA111, but he only knew it by name, such as Redondo Highway. It has an issue - there is no way to identify where you need to be. It is confused if you don't know the actual street number, but you just want to enter, or only know a street name and you don't know a specific number. He said it needs a cross reference between street/highway names and route number designation (E.g., San Diego Freeway versus 405 Freeway).	No, not really. Now that he's retired, he doesn't do as much driving. He's gotten used to telling the NAV computer, "No".	He would like to see a "heads-up" display on the windshield, at least for vehicle speed. The speedometer display is blocked by the tilt wheel in a certain position - typically the speed you need to drive on the freeway to keep from getting run over is blocked. Quote: "Safety is paramount for older people." But, manufacturers are more concerned with building their cars so they can go faster than the competition, and safety is more of an afterthought, or just an additional expense for something that should be installed on vehicles without a price tag.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
22521	32	M	Screen display is too small. NAV system allows no verbal input. You have to enter one digit/one character at a time. Display also has no brightness adjustment. Adjusting the dash lights does not change intensity of NAV screen. During the day, the display is in color; at night it's pretty much just black and white only.	Always helpful - never a problem	No change in driving habits.	N/A	
27712	29	M	You have to be going less than 8 mph in order to enter or change the destination, or input a restaurant, etc.	No problem - always helpful.	Yes - immediately. He had to keep stopping to change NAV or settings. This definitely was a distraction.	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
31201	51	M	Visibility of display - I have the brightness set on "max" and it is still hard to read. The screen brightness is adjustable, but not the contrast. NAV screen has an anti-glare screen/cover and I'm careful to clean it, but the least amount of sunlight that strikes it washes it out completely.	Helpful - NAV system encourages him to drive to Los Angeles. He would not venture into L.A. without it. L.A. has many freeway interchanges that would be a nightmare to get through.	Yes - immediately. He would be inhibited without a NAV system, and would not buy another car without NAV system. But…he can't rely on it 100% because of errors in the database. He says the problem is the database is so old, it's obsolete. He has also found at least a few clear errors - "turn right" - there is no right turn possible, only a left turn. M-B says the database comes from a 10 year-old satellite image that "everyone uses." He bought a complete upgrade and saw absolutely no difference in it. Streets that have been used and that he's driven for 5-10 years are not displayed, still not shown in upgraded database.	He feels a heads-up display that's easy to use; people will pay a premium for it, if it works. What he would like from his NAV system, the #1 feature, would be to be able to force the system to pick an alternate route and have it accept that route, rather than just pester him, "off route, off route". Also the constant reminding him to "turn here, exit 500 feet", etc., are annoying and interrupts his radio listening. A minimum display heads-up would be great.	Final comments - he tells everyone to buy a NAV system with a car purchase - says you only need to use it once to bail you out of an "I'm lost" situation for it to be of value.

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
23571	46	F	Lexus SC430 - Technology is now old compared to newer models' capability. It is very annoying to have to be stopped to enter or change destination, but she feels you should not do that when you are driving anyway.	No problems. But NAV is not used as much as when the car was new. It has gotten her from A-Z many times and for that, it is good.	No change in driving habits, other than giving her a sense of security, knowing if she is in an uncomfortable area where she would not want to get out and ask for directions, it will guide her to safety or to home.	N/A	
30943	52	M	His son is driving that car now. He owns 8 cars. As he remembers it, the map did not give enough street names. It may perhaps be something than can be turned on or off or disabled.	Doesn't use NAV that much. He knows his way around very well. He can't think of any specific example where it was either very helpful or a problem.	Yes - immediately - it's great to know your ETA when planning a trip. Also indispensable for looking for on-ramps for freeways. He may know a freeway pretty well, but not the names of on-ramps.	N/A	
28536	59	M	M-B ML500 - No verbal input but verbal feedback. Information is entered one digit/character at a time. With his car, he can input new/updated data, a second route, etc., while he is driving, with a toggle switch. He said Lexus will not let you do this; that's why he didn't buy one.	The database in M-B is not as good as portable GPS units. Garmin GPS has more details and abilities than his M-B with its DVD system.	No change, but system could be more user friendly. If you make an error, you have to go back to square one.	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
26698	51	M	Member no longer owns this vehicle. Combination of things were distracting: 1. The voice part - keeps telling him turn here, turn there; 2. Also, the map keeps moving and distracting your vision to watch it instead of the road ahead.	Never a problem; can't think of any particularly good thing or problem area.	No change at all in driving habits.	N/A	
27267	36	F	Insufficient notice of upcoming turn makes it hard to react in enough time to change lanes safely. Data entry - you scroll up or down, it prompts you for the city it thinks you want or excludes names or letters that don't match what you have already entered. Data entry is slow.	Problem - it often tells you that you are 100 feet from a street, but that's not enough notice. Also, the NAV screen display many times does not let you see the full route easily. You have to scroll up or down.	Yes - immediately. She does rely on the NAV system much more now than when she first purchased her vehicle.	N/A	
31194	53	M	System is a non-touch screen device of Alpine design, like the other two portable units he has. Cadillac uses push-button entry. You cannot override it without stopping the vehicle completely.	Helpful all the time. System on his vehicle is GPS, and DVD-based (says CDs are too slow - basically non-functional, and they cannot keep up with the speed you are driving.) The older systems used 12 CDs, while the newer systems use 1 DVD.	No change in driving habits.	N/A	

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25615	79	M	Quote: "Don't use it because it's so cumbersome." He uses the scrolling map to keep track of where he is. He also has a Garmin device, and uses it on his motorcycle (had this device first). Garmin device is waterproof and shows vehicle speed. This should show on the NAV screen on the Audi.	Both helpful and a problem. Helpful: On a recent Palo Alto trip, he was on the 5 North then he went west to the 101 North. There is an interchange there which has an off-ramp on the left - the black arrow on the screen directed him. Say GPS is great for back roads which he prefers to travel. Problem: The display for the rolling map has a white background, and uses red and blue lines for major streets and freeways. However, back roads are in yellow, and he can't see them. He said he turns on the headlights, which fools the system, and the background screen goes to black. The yellow back roads are very visible now.	No, not really.	Audi has lots of chrome - he painted the center console and shift gate black - they had beautiful chrome but the glare was intense.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
27241	56	F	If light hits screen the wrong way, you cannot see it to even program it.	Very helpful if she doesn't know where she is going. Had one problem in Los Angeles - it told her to "exit"; she did and it changed it's mind; she's not sure if there were 2 exits very close together or not, but the NAV system helped her get out of a bad area in Los Angeles.	Not really; however, she is not using the Thomas Guides as often. Have to be at a complete stop before you can change the program and this is an inconvenience, but she feels it's that way as a safety feature. She said you have to act responsibly; however, another person in front seat (spouse) could program it while the driver is driving the vehicle; for that reason it is a nuisance.	N/A	
24862	55	M	Data entry is one letter at a time. First you enter the number, then the street, then the city. Newer models let you put in a phone number, or punch in "Disneyland." Older models (like his car) take a long time to program.	Never a problem, other than one time when he was trying to visit someone in Bass Lake. He said when you get past a certain point, you get false signals from the GPS, and cannot get to your destination.	Yes, immediately. Says now he doesn't get maps printed out online - doesn't need them.	Voice activation would be great for NAV system. He said using the system in its current configuration; it may take as long as a minute to change the program. You can do it while you are driving, but this can be dangerous. Also, the text on the NAV screen is small, plus it is 2 to 2.5 feet away from the driver. Your eyes are focused on the road ahead, and then they have to focus at a closer distance to read the small letters on the screen.	

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21156	85	M	His NAV is CD-ROM based (new ones are DVD). Mercedes-Benz sells a complete package for about $250 to cover the rest of the U.S.	It is always helpful. Quote: "Absolutely essential - we use it all the time." and "Even in Las Vegas, it saved me hours of time one night."	No, except only that you don't get lost anymore - it will literally take you to the front door.	N/A	
30695	58	F	System provides voice feedback only. System requires one character at a time data entry.	She uses it all the time - thought she would never use it when she first bought the car. But, it is annoying - if you go off route, it constantly repeats, "You are off route, make a U-turn." Eventually, it will get the point that you are not going to go back, and will re-route your destination. She says she can change the destination while moving, but it is not safe.	Yes, immediately. She now goes a lot of places by herself where she hasn't been before. She likes the maximize freeway or take surface street option the NAV system provides. Her NAV system has no live traffic updates. Husband has Magellan for his truck - portable - also useful in motor home as it gives live traffic updates.	N/A	
21614	69	M	Easier data entry - 2004 (survey vehicle) requires one letter at a time. Also has a 2005 - you must complete the trip you entered or it will stay there forever.	Said, "I don't use it much." No specific examples given where it was either helpful or a problem.	No change in driving habits at all.	N/A	

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23207	58	M	Technology for car navigation is behind. The only update (via DVD only) is for new routes. You cannot update or flash the ROM like you can with after-market versions. The after-market device is 1/3 the price for factory installed unit. Quote: "Manufacturers know the 'bleeding edge' of how much to charge before car owners will buy after-market instead." He said for factory systems, interconnectivity is bad and/or poor to upgrade the firmware.	One problem he has is around 15th/16th Street by Newport Blvd., if he punches in a location in Balboa Island, he is routed a couple of miles off from the actual destination desired. He says there are others that have also said the same thing - there is a flaw in the map database - it shows up in various manufacturers' maps, not just in Mercedes-Benz.	No change - says NAV is for occasional use only to go to unfamiliar areas. Living in Corona del Mar, he says he walks to a lot of places instead of driving now.	N/A	
26572	64	M	System is slow, manual data entry. E.g., you get a list of city names, and then you scroll down to the one you want. Wife's car allows verbal input of destination. On his car, you have to come to a complete stop before you can change your destination.	NAV is always helpful. He figures he's usually given 2 choices: go left or go right - and he would always choose the wrong one.	Yes - it is much easier than using maps - time saving. Immediate change since it's easier to find something now. No maps or AAA TripTiks are needed for longer trips now.	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
27695	57	F	If you put in the wrong number or street/city, you have to go back to square 1 and restart data entry.	No real problems with system. It is very helpful in finding a place she is not familiar with.	Yes - immediately - she won't use Thomas Guide and have it open to several pages, and have to read it while she is driving.	The problem with new technology is that older drivers don't really use a lot of computer stuff, so it's hard for them to figure out how to use the new stuff.	
28524	69	F	Town & Country - Enter one letter at a time. Scroll up or down to select the city. It's not real easy, and it's time consuming. NAV told her to get on the freeway and then off. She knew she could get to the next street by staying where she was. NAV didn't like that. She said there is no way to correct it if you are not following their directions perfectly.	She doesn't use NAV system unless she is going out of town. She knows her way around for local trips. No specific example of NAV system being particularly helpful or causing a problem.	No change in driving habits.	Unhappy that this vehicle does not have rear assist handles above the rear doors like previous Town & Country had (same model/same trim level). They have some elderly friends whom they transport, and the assist handles were a definite help for them. Why were they removed?	
27721	68	F	Her NAV system has touch-screen, but data entry is still character by character. Reading the manual is too involved - it's too thick.	Helpful – I am more comfortable driving in the evening. However, you have to stop to change destinations - you must be completely stopped.	Yes, soon after starting to use it. I am much more comfortable using the freeways now. I like the "up ahead, turn right" prompts.	N/A	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
22749	62	M	BMW 745 - Verbal input is OK, but not that great. His NAV system is CD-based. When he goes out of state, it gives major freeways only. The I-Drive is a pain to use. Data entry is one character/one number at a time.	Doesn't use NAV much. It's very helpful when you need to get off the freeway to get gas/food - it helps you get back on the freeway easily.	No change at all in driving habits	N/A	
27068	73	M	Town & Country - No verbal input available. Data entry is slow - it takes 5-10 minutes to enter destination, one character/one letter at a time. He has a Bluetooth phone - can enter phone number and get information directly. Says you should be able to have Bluetooth technology in your car.	Very helpful. Quote: "It takes all the concern out of finding some place you've never been" and "Technology is great and happy to have it." It allows him to be more attentive to driving.	Yes - no time at all to learn the technology. It makes driving easier - you do not look for street signs with NAV. Also, the map keeps changing and it gives you more warning time when you are going faster. He always rents a car with NAV because of its good features; it makes driving experience more enjoyable with NAV - he likes it because it tells him how far he's traveled, how far he has to go, and how long before he will get there.	N/A	

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24651	58	F	Turn dial and then icon moves through the entire row before you can get to the next row. Scrolling is very sensitive - you can zoom past where you want to be in no time at all. To enter data, you first enter street, then hit Enter, then dial in letters of the street address. Then you select number, press Enter, then the NAV system prompts you for possible cities that have that street and number available.	Never a problem. I did not want it at all. Dealer looked around but couldn't find a Town & Country without it. I did not like the technology, but now thoroughly enjoy using it. Now, I will not buy a car without it. It is very useful and I'm very comfortable to drive to a strange place at night alone. Said she would like NAV maps for Mexico, but dealer said they were not available.	No change in driving habits, but NAV makes her feel considerably safer when going to a new place (like finding an open house for home searching), and likes to have that to instruct her where to go.	N/A	

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28264	61	F	NAV system provides you with rows of letters. You turn a knob, push the button in, then you pick the next selection. System has no touch screen, and no voice activation or commands are available.	One of the things that's really weird about NAV is on a trip from Palm Springs to Los Angeles, it insists they go through Hemet. Every now and then, it tells you to turn some place where you know is wrong, and you can't convince it. She said it is, Quote: "our mind against her mind." It is very helpful to get somewhere where you've never been or you are unfamiliar with the area.	No change in driving habits at all.	Make NAV system easier to use. It is frustrating to have to go through a list of cities available. You have to enter city, and after you do that, it gives a list of cities that could be the one I want, and you have to highlight it and push the button to accept it. Then you enter the street, then the number. It reacts slowly when you push the button. Another frustration with her NAV system is that if you don't want it any more, Quote: "It won't go away. You can push a button to turn it on - Radio screen comes up first, and then you select NAVI - but it does not give you the option to shut it off."	
32250	59	M	He bought the car used (2001 Mercedes-Benz). It came with a thick NAV manual. He can't get it to a point where it will even let him lock in the destination. He has never been able to use his NAV system since he purchased the car.	N/A - See comment at left.	No change - See comment at left.	Member grew up in a time when muscle cars were king. Now we have cars with lots of horsepower, but clean emissions, thanks to onboard computers. He said, for manufacturers, Quote: "Everything is about speed" in	

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						designing new cars. He is concerned over the number of people we lose every year because, as they get older, they're more easily confused and miss-react to a situation, which may turn out deadly. Cars are so much easier to drive now. He feels car designers and new technology may be keeping older drivers on the road longer than they safely should be. He mentioned, perhaps with all the computer controls on the new cars, perhaps there could be a way to design or implement something in the software that would sense when a person reacts the wrong way in a certain scenario, and blocks the vehicle from doing something it senses is wrong. E.g., older person hitting the gas pedal instead of brake pedal, and mowing down a bunch of pedestrians.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
30393	61	F	BMW 545 - You cannot enter input data by plugging in a phone number. If she wants to get information on a local area, like a home improvement store, the system searches the local area, and gives you the names of all the stores of that type, but it is sorted by distance from where you are at the present time, not alphabetically by the store name you want to go to. For address search, data entry is one character at a time until you get most of the data in. Then it finishes the name for you. The system can also accept verbal input from the driver, but she has not figured it out yet.	It is always helpful, but the system can cause a problem - you cannot turn it off. If you are going somewhere and get off the beaten path, it keeps telling you, "make a legal U-turn." She has to turn the key off to get rid of or disable the destination, once she already has it programmed in.	Yes - She takes routes she would never have taken before, now that she has NAV system. It took her one Saturday with the CD and her computer, (approximately 4 hours) to learn the NAV and other things about the car, because she says, Quote: "The car is complicated."	The driver's seat doesn't go high enough so she is comfortable looking out through the windshield. She has the seat adjusted rearward pretty far, because she is scared of the air bag. She is only 5-feet tall, and has trouble reaching the pedals. The car has a heads-up display - but it can never be adjusted high enough for shorter drivers like her. She has returned it to the dealer and they have adjusted it as high on the windshield as it will go. She says you would have to take it back to the manufacturer and have them disassemble the dash to make it go any higher. Her car does not have height-adjustable brake/throttle pedals.	

ID	Age	Gender	Q24 - Improvements	Technology - Helpful/Hurtful?	Change driving habits?	Q25 - Mfg's not doing enough?	Other comments
22076	64	M	System permits no verbal input. Wife drives the surveyed car (Q45). She is somewhat frustrated by the NAV and it's slow, character-by-character data entry requirement.	No, I can't think of any examples where it's been either particularly helpful or caused a problem.	No change for himself; perhaps a little for his wife.	For his vehicle (Dodge Caravan) he has to fold the outside mirrors in when parking in the garage because the garage is very narrow. He says her car (surveyed Q45) has mirrors that fold in. Would be nice if all cars had that feature.	
21929	52	F	2004 Cadillac Escalade ESV is very safe, and she is used to driving it. However, you have to enter data into the NAV system one letter/character at a time - very time consuming. Also, the car has to be totally stopped before you can enter or change any destination. She says this is good, for safety reasons.	She has learned to rely on it 100% of the time. She still uses MapQuest ahead of time to get a clue as to where she's going. Helpful to get back home. If you have to make a detour (you see the freeway is stopped and you get off), once you exit, the system will automatically stop and readjust the route so you can continue to your destination via an alternate route. She said the only time she had a problem was late at night - she was in a brand new territory that was unmapped by the GPS.	She had NAV before on other vehicles, so there was no change in her driving habits. Say she relies on it more than ever. Her NAV system is never a problem.	N/A	

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22534	73	M	Surveyed vehicle was an LS430. Member also has 2005 Corvette - a newer car, also with NAV - it has a better system than the LS430 had. You had to enter the street address (name) first before you can enter the street number.	NAV system had him driving around in circles in the Montecito, California area.	Yes, immediately. He thinks he drives safer - keeps his eyes on the road. He depends on it. The NAV package is a lot more user friendly on his newer car.	Member feels that AAA should campaign against drunk drivers, and advertise what we do in the Automotive Research Center.	
32447	55	M	I received no help from the dealer in figuring out how to operate the NAV system. No verbal input is possible on this early a model NAV system. You have to enter one digit/one letter at a time, and scroll through lists.	He cannot get a map displayed easily when he inputs data. When entering an address, it doesn't show if the address is not in the system.	If he knows the area, he says he just figures out his own way, and ignores the GPS. He says the NAV system is a good idea, but user interface is lacking.	Japanese vehicles are ahead of U.S. in many areas - backing aid systems are available on lower cost vehicles. He said some of the problem getting technology, like Bluetooth, etc., on vehicles here is the legal issue.	

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21372	72	F	You have to enter one letter/one character at a time - very slow data entry. A map overview would be nice, showing the general area she is directed through. If she doesn't recognize the general area, she knows the NAV is wrong somewhere. While driving, she tends to ignore the map and listens to the verbal commands. It would be nice if the NAV screen would also pull out and turn towards the driver. In the lower left corner of the NAV screen, it shows the number of miles to her destination. This also gives her an idea if the destination shown is really where she wants to go. The only time you know if it calculates the right town is if the system has more than one street with that name in the database - then you can pick "Los Angeles", not "Bakersfield."	She says she gets down on her knees and thanks God for her NAV. However, it has one quirk - you have to know if the road you select is called "Street", "Road", "Avenue" or "Drive." Out here in California, we don't refer to streets with this designation. Most people just say, "Go south on Sepulveda" and everyone knows what you mean. She says you have to know the address is "Commonwealth Avenue, Bakersfield."	Yes - They bought the car on impulse after seeing it in the showroom. They noticed this Jaguar had NAV. Husband said wife was "geographically challenged" and "we have to get it for you." Husband died a year later, but wife said, Quote: "[NAV system] has given me an independence I did not have before. I have gone to Yosemite, Sequoia, Novato, San Diego, La Jolla. I've even used it for jury summons to get me to the courthouse. It's given me a sense of independence I would not have living alone."	N/A	Other comments member made: The yellow/green colored LED light on the message board on the dash is not readable during the daytime. She questioned: Why tachometers? Why not all-digital displays, such as oil pressure, outside temperature, even something like battery life expectancy remaining? It would be great to know this before a trip.

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31412	30	F	NAV system requires you to come to a complete stop before you can enter or change the data. System has touch screen, but it is one character at a time, with no verbal input available.	Helpful when going out of town, like to Los Angeles, and she is looking for a restaurant, gas station, etc. The information provided includes a phone number.	Yes - immediately. She does not have to print out a map the night before, or have to look at a piece of paper. She says she is not comfortable if she rents a car and it does not have NAV system.	N/A	
26257	44	M	Have to spell out destination very carefully, i.e., West 3rd. Street. He also has an Acura which has a good NAV system. It can do things the Lexus SC430 (surveyed vehicle) cannot do. Data entry is slow - letter by letter. The system does not offer any verbal input capability.	No major examples thought of where the NAV was either helpful or a problem.	Yes - immediately - No Thomas Guide is needed now.	Even though he's only 44, he feels, particularly for older drivers, it would help if car manufacturers would make larger, more visible gauges and instruments, and have louder commands for those options that provide auditory output to the driver.	

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