

Older and Younger Drivers' Beliefs about Motor Vehicle Features to Benefit Their Safe Driving

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Because there are age-related perceptual, motor, and cognitive declines and because people are living longer, there has been increased concern about older drivers' ability to operate motor vehicles safely. This research examined older and younger adults' perceptions regarding a set of 28 motor vehicle features/aspects according to the extent to which they believed it may help their safe driving. Several features were judged as more important than others regarding safe driving. Although both age groups predominately gave similar evaluations, some features/aspects differed significantly between the two age groups. Older adults believed that vehicle door openings should be easier to get into and out of, preferred analog displays, and labels on the dashboard that were bigger and brighter, and held less strong beliefs that current vehicle controls and displays are easy to use than did younger adults. Implications and design recommendations are discussed. A list of vehicle features that are potentially beneficial to older drivers is presented.

INTRODUCTION

Older adults as a relative percentage of the population are growing. In the U.S., demographic estimates indicate that by 2025, older adults aged 55 years and over will account for 103 million or approximately 30% of the population (U.S. General Accounting Office, 2003).

Considerable empirical research has documented age-related perceptual, motor, and cognitive declines that co-occur with chronological age (see Fisk and Rogers, 1997, for a review). For example, by age 60, most older adults' muscle strength and range of motion decrease. Other age-related musculoskeletal declines include greater difficulty turning one's head to look over shoulders. By age 70, many older adults have arthritic joints, making movement painful (Bohr, 2008).

The motoric, perceptual, and cognitive declines in older adults may negatively influence their ability to operate motor vehicles safely (National Highway Traffic Safety Administration (NHTSA), 1989). According to NHTSA (2007), there were 30 million older licensed drivers in 2006 and it is estimated that by 2020 there will be more than 40 million licensed drivers aged 65 and older. Some research has shown that after age 55, accident and fatality rates begin to rise (Ball & Owsley, 1991). Although they are not the highest risk group to be involved in automobile accidents, older drivers are at the greatest risk compared to other age groups for serious injury or death when they are involved in traffic crashes (NHTSA, 1989). One explanation for why older drivers are not the highest risk group is that they frequently compensate for their decreased abilities by trying to maximize the capabilities that they possess.

Many proposed solutions have been offered to decrease the risks associated with older drivers on roadways. One of the suggestions include increased driver testing of older adults over a certain age at or near the time of the license renewal process. However, this and other suggestions do not provide complete and satisfactory solutions. For example, driving cessation creates a need for alternative methods of transportation. In addition, removal of driver's license has been linked to decreased participation in out-of-home activities and increased frequency of depressive symptoms (Marmelaria, Godinho, & Peter, 2009).

Intelligent transportation systems (ITS) involving enhancements in motor vehicles and roadways are a potential means of mitigating age-related declines in driving performance. However, full scale employment of many promising ideas is several years away from actual implementation (Charness, 2008; Shaheen & Niemeier, 2001).

The promises of large scale ITS changes are likely to change the paradigms of transportation, but in the meantime, there may be relatively easy ways to make driving safer for older adults. Moreover, those improvements for older adults may be potentially beneficial for younger adults as well. One option is to examine aspects of motor vehicles themselves to determine if they can be changed to benefit safe driving by older drivers. Changes beneficial for older adults may also be useful for younger adults as well. Drivers of both age groups may have consistent beliefs about hindrances concerning design features or aspects of motor vehicles that might be changed or improved. Benefits might arise from matching features or aspects with adults' capabilities in their lifespan. Design

features could make greater use of the intact capabilities possessed by older drivers (or that are less likely to decline with age), while making lesser use of limited or declining abilities. For example, large and wide-angle mirrors might benefit those who have difficulty in turning or twisting to look to the rear when changing lanes or backing up (Bohr, 2008). Because older adults and other drivers may have limited motion in head turning, this feature would allow older drivers to see a larger view behind and to the side of their vehicles. Thus, having motor vehicle features that better fit user needs may be beneficial at reducing crashes. Fitting features to older adults' needs should be beneficial for improving their driving safety.

The purpose of the present research is to explore older adults' needs and preferences in motor vehicle features that contribute to safe driving. A comparison group of younger adults was included to examine age differences in perceptions of automotive feature to benefit safe driving. Participants evaluated a list of 28 features/aspects of motor vehicles with regard to safety. It was expected that the evaluation of features would show a broad range of responses across the dimensions asked and the two age groups would have some different beliefs about the utility of different motor vehicle features/aspects.

METHOD

Participants

Two different age groups of participants were recruited. The older adult group was comprised of 20 individuals (7 males and 13 females) from retirement community centers. Their average age was 80.05 years ($SD = 8.6$) and ages ranged from 62 to 93. Ninety percent were Caucasian and 10% were Native American. All of them reported owning their own vehicles or having access to one. The older adults reported an average of 64.7 years ($SD = 8.6$) of driving experience and 95% had a valid license and continued to drive at the point of assessment. One participant stopped driving 2 years previously.

The younger adult was comprised of 21 students from (12 males and 9 females) from North Carolina State University who participated for research credit in an introductory psychology course. They had an average age of 19.9 years ($SD = 3.1$) ranging from 18 to 29 years. All of the younger participants reported owning their own vehicles or having access to one. Mean reported driving experience was 6.5 years ($SD = 3.0$). All of the younger participants had valid licenses and reported having driven in the past month.

Materials

Participants were asked to complete an informed consent form, a demographics form, and a questionnaire concerning motor-vehicle features. A total of 28 features were generated from several sources: a preliminary study, various motor-vehicle oriented magazines and automotive-related research reports. Each feature or aspect was included in sentence statements, such as "I prefer larger control buttons and knobs." The statements were intended to provide specific context regarding how each feature might be used. Specifically, participants rated the statements according to how much they agreed with each statement in helping them drive safely. A 5-point rating scale (from 0 to 4) was used with the anchors: (0) "I do not at all agree that it will help me to drive safely," (2) "I somewhat agree that it will help me to drive safely," and (4) "I completely agree that it will help me to drive safely." Three photographs were presented in the instructions to illustrate some features that they would be evaluating. One photograph depicted a digital-type speedometer whereas another showed an analog-type speedometer. A third photo showed knobs, dials, and buttons of a climate/audio console.

Procedure

Several retirement communities in central North Carolina were visited, and volunteers were asked to complete an informed consent form, a demographics form, and a questionnaire about motor vehicle-related items. For younger adults, these same materials were provided in a room on the NC State University main campus.

All participants regardless of age were instructed that they would be rating a set of motor vehicle features on the extent to which they might benefit their safe driving. Two orders of features were used: one was a randomized order and the other was the reverse of that order. Participants were encouraged to read through the entire list of items before beginning to record their ratings. Participants were provided as much time as they needed to complete all of the ratings. After completing their ratings participants were asked to describe any other features not included in the rated list that they thought might benefit their safe driving. Afterwards, participants were thanked and debriefed.

RESULTS

Descriptive summary statistics were produced for each item of the feature rating task. Vehicle features ratings are shown from high to low overall mean rating in Table 1.

Table 1
Mean agreement ratings of motor-vehicles features/ for older drivers and younger drivers according to be beliefs about their benefit for safe driving. Standard deviations (SD) are shown in parentheses.

Motor-vehicle features/aspects	Older Mean (SD)	Younger Mean (SD)	Overall Mean (SD)
1) Controls easily reachable.	3.95 (.2)	3.86 (.4)	3.90 (.1)
2) Indicators (such as a small light) on the side mirrors when a vehicle is in the blind spot.	3.60 (.9)	3.48 (.9)	3.52 (.2)
3) Driver’s seat should be adjustable by height (up and down).	3.60 (.8)	3.29 (1.2)	3.49 (.2)
4) Headlights and dashboards lights should be automatically turned on when dark.	3.60 (.9)	3.43 (1.1)	3.47 (.2)
5) Larger side-view mirrors to reduce blind spots.	3.35 (1.3)	3.29 (.9)	3.29 (.2)
6) Tilt steering wheel that adjusts upward and downward.	3.35 (1.0)	3.24 (1.1)	3.26 (.2)
7) Mirrors that dim automatically to respond to bright headlights to reduce glare.	3.30 (1.2)	3.33 (1.1)	3.22 (.2)
8) Bigger and brighter labels (such as symbols or text) on the dashboard.*	3.55 (.7)	2.90 (1.1)	3.21 (.1)
9) Both symbols (icons) and text (words) for control labels.	3.10 (1.0)	3.00 (1.2)	3.14 (.2)
10) Power windows and locks.	3.05 (1.5)	3.24 (1.4)	3.14 (.2)
11) Larger, wide-angle rear-view mirror to see the full view behind a vehicle.	3.33 (1.2)	3.19 (1.1)	3.12 (.2)
12) Side-airbags for driver and front passenger.	3.00 (1.5)	3.00 (1.2)	3.10 (.2)
13) Larger controls, buttons, and knobs.	3.28 (1.3)	2.81 (1.2)	3.01 (.2)
14) Navigation system to guide with an electronic map to destination.	2.85 (1.5)	3.00 (1.2)	2.99 (.2)
15) Controls on the steering wheel.	2.67 (1.3)	3.10 (1.2)	2.95 (.2)
16) Controls that are easy to operate.*	2.42 (1.2)	3.10 (.9)	2.87 (.2)

17) Analog-type speedometer display.*	3.60 (.9)	2.24 (1.2)	2.86 (.2)
18) Most vehicles have labels for controls that are visible and easy to read.*	1.95 (1.3)	2.86 (1.2)	2.53 (.2)
19) Auditory information by voice (speech) instead of tones or beeps when the door is open, gas is low, etc.	2.28 (1.6)	2.90 (1.2)	2.48 (.2)
20) Knobs better than buttons for controls.	2.28 (1.3)	2.35 (1.2)	2.42 (.2)
21) Text (words) preferred over symbols (icons) for control labels.	2.35 (1.3)	2.14 (1.1)	2.36 (.2)
22) High and wide doors to get in and out of a vehicle easily.*	2.80 (1.5)	1.62 (1.3)	2.23 (.2)
23) Digital-type speedometer display.	1.56 (1.3)	2.38 (1.4)	2.11 (.2)
24) I sometimes have difficulty using the audio system controls.	2.25 (1.2)	1.62 (1.0)	2.00 (.2)
25) I sometimes have difficulty using the climate controls.	1.85 (1.4)	1.48 (1.2)	1.71 (.2)
26) Shorter and lighter doors.	1.60 (1.4)	1.76 (1.5)	1.54 (.2)
27) Thicker steering wheel.	1.11 (1.3)	1.81 (1.3)	1.35 (.2)
28) I sometimes have difficulty finding the gas cap release on vehicles.	1.15 (1.5)	1.24 (1.1)	1.16 (.2)

Note. Asterisks (*) indicate significant difference between age groups, $p < .05$.

The data were analyzed using a 2 (age group) X 28 (motor-vehicle features) mixed model ANOVA, where age group was a between subjects variable and vehicle features was the within subjects factor. A significant main effect of motor-vehicle features indicated that different features evoked different ratings as affecting safe driving, $F(27, 945) = 14.68$, $MSe = 1.25$, $p < .0001$. Tukey’s Honestly Significant Difference (HSD) at $p = .05$ test was .80. This value can be used to compare means along the far right column of Table 1. Any mean difference greater than this value is statistically significant. For example, “I prefer having all controls easily reachable,” was given significantly higher ratings than “most vehicles have labels for control that are easy to read and visible.”

The main effect for age was not significant; however, there was a significant interaction of vehicle features and age, $F(27, 945) = 2.11$, $MSe = 1.25$, $p < .05$, indicating there were differences in how older and younger drivers rated certain features. Simple effects analysis was used to make comparisons between age groups for each of the features. Examination of the

interaction means revealed five significant differences ($p_s < .05$):

- (a) "I prefer high and wide doors to get in and out of a vehicle easily" in which older drivers ($M=2.80$) gave higher ratings than younger drivers ($M=1.62$);
- (b) "I prefer an analog-type displays" in which older drivers ($M=3.60$) gave higher ratings than younger drivers ($M=2.24$);
- (c) "I prefer bigger and brighter labels (such as symbols or text) on the dashboard" in which older drivers ($M=3.55$) gave higher ratings than younger drivers ($M=2.90$);
- (d) "Most vehicles have controls that are easy to operate" in which younger drivers ($M=3.10$) gave higher ratings than older drivers ($M=2.42$);
- (e) "Most vehicles have labels for controls that are visible and easy to read" in which younger drivers ($M=2.86$) gave higher ratings than older drivers ($M=1.95$).

These significant differences are indicated with asterisks in Table 1.

DISCUSSION

This research explored whether younger and older drivers have different beliefs about motor vehicle features in benefiting safe driving. Overall, the five highest rated items were "Controls easily reachable," "An indicator (such as a small light) on the side mirror when a vehicle is in the blind spot," "Driver's seat should be adjusted by height," "Headlights and dashboard lights should be automatically turned on," "Larger side-view mirrors to reduce blind spots" respectively. The five lowest rated items were "I sometimes have difficulty using the audio system controls," "I sometimes have difficulty using the climate controls," "Shorter and lighter doors," "Thicker steering wheel," "I sometimes have difficulty finding the gas cap release on vehicles" respectively. Also, there were features/aspects that differed between the two age groups.

Older drivers prefer high and wide doors, analog displays, and bigger and brighter labels on the dashboard than younger drivers. Moreover, older drivers had greater disagreement compared to younger adults with statements that current motor vehicle controls are easy to operate and that labels for controls are easy to read and visible.

Twenty-eight motor-vehicle features ratings were categorized into 5 different groups by three researchers' agreement: visual-aid features (e.g., mirrors, headlights), controls (e.g., climate/audio system, steering

wheel), displays (visual and auditory), driver's seat and doors, and other. The summary is shown in Table 2.

Most visual-aid features were rated relatively highly in overall ratings. Not surprisingly, this indicated that visual-related features/aspects are perceived beneficial for improving safe driving in both age groups.

For controls, 'all controls are easily reachable' was the highest rated item in overall. This implies that both age groups perceived reachable controls to be the most important aspect for safe driving. Moreover, older drivers had greater disagreement compared to younger drivers with the statement that current motor vehicle controls are easy to operate. This implies that older drivers may currently have difficulty operating the controls of their personal vehicles.

With regard to displays, older drivers were significantly more likely than younger drivers to prefer bigger and brighter labels (such as symbols or text) on the dashboard. These findings are consistent with previous research. Information legibility is an important concern for older adults (Vanderplas & Vanderplas, 1980). The quality or legibility of information on dashboard labels for controls and displays also appears to be an important factor for older drivers as compared to younger drivers. Also, whereas younger drivers preferred both analog and digital display, older drivers preferred analog-type speedometers significantly more than younger drivers did. The reverse pattern was apparent for digital displays between age groups although the difference was not significant. The preference for analog over digital displays by older adults may reflect their familiarity with these displays and that analog displays are larger and may be easier to read and use.

Both age groups gave high ratings for the statement that drivers' seats should be adjustable by height (up and down). Also, older drivers gave significantly higher ratings than younger drivers regarding their preference for high and wide vehicle doors for easier entry and exit. This finding is consistent with research concerning older adults' preferences concerning physical/body movement demands. One example is research by Fernie (1997) who demonstrated the effort in rising from a seated position was particularly difficult for many older adults. It offers a reason why doors were an important issue for older adults due to difficulty getting into and out of them.

Lastly, other aspects such as power windows and airbags were not rated highly in either age group. The gas cap feature was rated as the lowest item overall. Given the results of the current study, some preliminary guidelines could be developed. One is a checklist of features that assist drivers in choosing vehicles based on age-appropriate safety features. The same or similar list

Table 2*Categories of motor- vehicles features/aspects*

Category	Motor-vehicle Features/aspects
Visual-aids	(2) An indicator (such as a small light) on the side mirror [3.52]. (4) Headlights and dashboards lights should be automatically turned on where it begins to get dark outside [3.47]. (5) Larger side-view mirrors to reduce blind spots [3.29]. (7) Mirrors that dim automatically to respond to bright headlights to reduce glare [3.22]. (11) Larger, wide-angle rear-view mirror to see the full view behind a vehicle [3.12].
Controls	(1) All controls are easily reachable [3.90]. (6) Adjusting tilt steering wheel (upward and downward) [3.26]. (13) Larger controls buttons and knobs [3.01]. (15) Controls on the steering wheel [2.95]. (16) Controls that are easy to operate*[2.87]. (20) Knobs over buttons for controls [2.42]. (24) Sometimes have difficulty using the audio system controls [2.00]. (25) Sometimes have difficulty using the climate controls [1.71]. (27) Thicker steering wheel [1.35].
Displays	(8) Bigger and brighter labels (such as symbols or text) on the dashboard* [3.21]. (9) Both symbols (icons) and text (words) for control labels [3.14]. (14) Navigation system which guides my way with an electronic map displaying specific information about my location and destination [2.99]. (17) Analog-type speedometer display* [2.86]. (18) Most vehicles have labels for controls that are visible and easy to read* [2.53]. (19) Vehicle that gives me specific information by voice (speech) instead of tones or beeps when the door is open, etc [2.48]. (21) Text (words) preferred over symbols (icons) for control labels [2.36]. (23) Digital-type speedometer display [2.11].
Driver's seat and Doors	(3) Adjustable driver's seat (up and down) [3.49]. (22) High and wide doors to get in and out of a vehicle easily* [2.23]. (26) Shorter and lighter doors [1.54].
Other	(10) Power windows and locks [3.14]. (12) Side-airbags for driver and front passenger [3.10]. (28) Sometimes have difficulty finding the gas cap release on vehicles [1.16].

Note. Numbers in the brackets [] denote overall mean. Asterisks (*) denote significant difference between age groups, $p < .05$.

could be used by manufacturers in making available features for certain cars that older drivers might tend to purchase. Automobile manufacturers, dealers, and rental agencies could offer 'senior-friendly' features intended for the older drivers. By gaining an understanding on how specific automotive design features can be used to assist older adults to compensate for age-related declines, it may be possible to improve driving safety and comfort by making relatively easy improvements to vehicles. Relatively simple design changes in motor vehicles, most of which are technologies already available, can potentially enable older drivers to drive safely longer and serve as an interim safety program before substantial ITS improvements are eventually implemented. Armed with the knowledge that particular motor vehicle safety features are more useful to certain demographics than others, it may be possible to extend older adults' safe driving years. As demonstrated by research in other domains involving real-world tasks, such interventions designed to support task performance might be useful in assisting older adults to maintain their functional independence thereby improving their sense of self-empowerment (Morrell, Mayhorn, & Echt, 2004).

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