

AGE-RELATED DIFFERENCES IN THE COGNITIVE, VISUAL AND TEMPORAL DEMANDS OF IN-VEHICLE INFORMATION SYSTEMS

INTRODUCTION

Drivers are now able to use In-Vehicle Information Systems (IVIS) to perform a wide variety of tasks while behind the wheel, involving complex and multimodal interactions. These IVIS interactions may distract motorists from the primary task of driving by diverting the eyes, hands and/or mind from the roadway. Previous research sponsored by the AAA Foundation for Traffic Safety provided a comprehensive assessment of the cognitive, visual and temporal demands associated with different tasks, modes of interaction, in-vehicle infotainment systems and vehicles. However, many of these studies examined young drivers; it is less well-understood how older drivers react to and perform with new IVIS technologies.

Researchers at the University of Utah carried out a study for the AAA Foundation for Traffic Safety to address the following questions:

- How demanding are different tasks for older and younger drivers using different systems? The tasks include calling/dialing, sending a text message, programming music or programming navigation.
- How demanding are different modes of interaction with these systems for older and younger drivers, including auditory vocal commands, center stack touchscreens and center console controls?
- How does the demand vary across different types of vehicles for older and younger drivers?

KEY FINDINGS

With respect to different types of tasks (calling or dialing, text messaging, programming music or programming navigation):

- Older drivers took longer to complete IVIS tasks; older drivers also showed more prolonged task completion times for the navigation task compared to the other tasks.
- On average, both younger and older drivers completed the music programming and the calling/dialing tasks faster than text messaging or navigation; which took more than 24 seconds for both age groups to complete.
- Overall, older drivers experienced higher levels of cognitive and visual demand, compared to younger drivers, for both IVIS tasks and baseline tasks. These differences were even more pronounced for older drivers when completing any IVIS task.

ABOUT

Established in 1947 by AAA, the AAA Foundation for Traffic Safety is a nonprofit, publicly funded, 501(c)(3) charitable research and educational organization. The AAA Foundation's mission is to prevent traffic deaths and injuries by conducting research into their causes and by educating the public about strategies to prevent crashes and reduce injuries when they do occur. This research is used to develop educational materials for drivers, pedestrians, bicyclists and other road users. Visit www.AAAFoundation.org for more information.

SUGGESTED CITATION

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AAA FOUNDATION FOR
TRAFFIC SAFETY
607 14th Street, NW, Suite 201
Washington, DC 20005
202-638-5944

VIEW REPORT



- All drivers reported that the calling and dialing and text messaging tasks felt less demanding to perform than the navigation and music programming tasks. But older drivers reported all IVIS task interactions felt more demanding than younger drivers.

With respect to the mode of interaction (using a center stack display, center console, auditory/vocal commands):

- Tasks completed using auditory/vocal commands took the longest to complete, followed by center console controls. The center stack interactions were the shortest, on average.
- Both older and younger drivers reported they felt voice commands were less demanding to use than the center console or center stack controls.
- Older drivers took longer to complete tasks across all modes of interaction, regardless of how the task was completed (i.e. center stack, center console, or voice command).
- Visual demand was higher for older drivers using all modes of interaction compared to younger drivers. This difference was more pronounced than in single task conditions as well as the high-demand benchmark tasks.

With respect to the different vehicle makes and models:

- Task completion times and visual demand for both younger and older drivers varied considerably across vehicle type. With respect to task completion, for some vehicles, both groups completed the tasks in under 24 seconds. For other vehicles, both groups took longer on average or fell on opposite sides of this threshold.
- Age-related differences in drivers' subjective workload was dependent on the vehicle being driven. That is, for some vehicles, older drivers' ratings of demands were similar to those of younger drivers, but for other vehicles, their ratings were different.

IMPLICATIONS

Older drivers may benefit from interface designs that promote their continued visual attention on or near the forward roadway (e.g., careful placement and implementation of physical controls and dials, screen placement closer to their forward vision, effective use of voice controls, etc.).

Technology companies and automakers can leverage these results to isolate the most significant sources of driver demand generated by use of their products, and to enhance

these designs such that they minimize the demands placed on people who use them while driving. Considering the demands experienced by older drivers, along with utilizing better design principles, may provide important insights and a framework for improvement of IVIS design.

Given the demands associated with IVIS tasks, drivers of all ages should use these infotainment technologies only for legitimate emergencies or urgent, driving-related purposes.

METHODOLOGY

Six vehicles from different manufacturers were tested in the current study (model year 2018). Each vehicle offered two modes of interaction, including auditory/vocal commands and either a center stack display or center console controls. Four types of tasks were evaluated using the different systems and modes of interaction, including (a) selecting or programming music, (b) calling and dialing, (c) text messaging, and (d) programming a destination in the navigation system.

Participants included 128 licensed drivers who had normal or corrected-to-normal vision and a clean driving history. Drivers were divided into two age groups: younger drivers between 21-36 years of age ($M = 24.8$ yrs), and older drivers between 55-75 years of age ($M = 65.8$ yrs). A total of 24 drivers from each age group were tested in each vehicle in the study (48 total per vehicle), and the majority of drivers were tested on multiple vehicles on separate occasions.

Testing and evaluation took place on a 2-mile stretch of residential road with a posted speed limit of 25 mph and generally low traffic patterns. A study investigator was present in the passenger seat during the entire session for safety monitoring and data collection. After familiarization with the road, the vehicle, the systems, the tasks and the modes of interaction, testing commenced. Participants were instructed to drive the designated route from one end to another, repeating the assigned tasks several times on each drive.

Drivers also completed three benchmark trials. The first was a single-task baseline condition, where participants drove without performing any IVIS tasks. The second was a highly demanding cognitive task that has been used in many previous laboratory and on-road studies. The third was a highly demanding visual task — also used in many previous studies — that was presented on an in-vehicle display.

A number of objective and subjective measures were gathered both during and after each drive, in order to assess the visual and cognitive demands of the tasks as well as the task completion time, including two variants of the Detection Response Task (DRT, International Organization for Standardization No. 17488) as well as the NASA Task Load Index.