

VISUAL AND COGNITIVE DEMANDS OF USING IN-VEHICLE INFOTAINMENT SYSTEMS

INTRODUCTION

The features of vehicle-based infotainment technology have greatly expanded in recent years, opening up a new array of tasks accessible to motorists while driving. Many of these new functions are unrelated to driving. Examples include voice commands to send a text message, check social media or surf the web. Furthermore, many tasks distract motorists from driving by diverting their eyes and attention from the road and hands from the steering wheel. Yet, surprisingly, little is known about how these interactions may affect a driver's performance when the demands are high.

Given the potential safety concerns, as part of its Center for Driving Safety and Technology, the AAA Foundation for Traffic Safety commissioned the University of Utah to carry out research to address three important questions:

1. Which task is the most demanding to complete while driving: calling/dialing, sending a text message, tuning the radio or programming navigation?
2. What level of demand is associated with completing these tasks using voice commands, touchscreens or other interactive technologies (e.g., buttons, rotary dial, writing pad)?
3. How does demand from these interactions vary across the infotainment systems found in different vehicle makes and models?

KEY FINDINGS

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

RESULTS	Implications
<ul style="list-style-type: none"> • Overall, navigation was found to be the most demanding task. • Text messaging was associated with a significantly higher level of overall demand than tuning the radio and calling/dialing. 	<p>Motorists should:</p> <ul style="list-style-type: none"> • Program their navigation system before starting their drive. • Avoid texting while driving even when technology for this purpose is available. <p>Automakers and other industry leaders should:</p> <ul style="list-style-type: none"> • Block the ability to program navigation and send text messages while driving.
<ul style="list-style-type: none"> • All tasks were associated with higher levels of cognitive (manual) demand. 	<p>Motorists should:</p> <ul style="list-style-type: none"> • Remember that keeping their hands on the wheel, their eyes on the road and mind on the drive is not necessarily the same as focused driving.
<ul style="list-style-type: none"> • The radio tuning and navigation tasks led to higher levels of visual (eyes off road) demand than the calling/dialing and text messaging tasks. • The text messaging and navigation tasks led to significantly longer task completion times than tuning the radio and calling/dialing tasks. 	<p>Automakers and other industry leaders should:</p> <ul style="list-style-type: none"> • Use enhanced system designs to reduce the visual demand and time required to complete the features accessible to motorists while driving.

With respect to the different vehicle makes and models, the analysis found surprisingly large differences between vehicles in the overall demand of infotainment system interactions:

RESULTS	Implications
<ul style="list-style-type: none"> • Of the 30 vehicles tested, 23 vehicles generated high or very high levels of overall demand on drivers. • Of the 30 vehicles tested, seven vehicles generated moderate levels of overall demand on drivers. • None of the 30 vehicles tested yielded low overall demand on drivers. 	<p>Motorists should:</p> <ul style="list-style-type: none"> • Remember that just because technologies come installed in a vehicle does not mean automaker testing has proven they are safe to use while driving. • Use these infotainment technologies only for legitimate emergencies or urgent, driving-related purposes. • Use these results to learn more about the system found in their current vehicle or to inform their next vehicle purchase. <p>Automakers and other industry leaders should:</p> <ul style="list-style-type: none"> • Improve their infotainment systems by designing systems that are no more demanding than listening to the radio or an audiobook.

With respect to mode of interaction, (using a center stack display, auditory vocal commands and/or using controls located in center console):

RESULTS	Implications
<ul style="list-style-type: none"> • All modes of interaction produced very high overall demand on drivers (higher than the high demand benchmark). • Using the center stack (e.g., touch screen, knobs/button built into the dashboard) was less demanding than using voice-commands, which were less demanding than center console (e.g., writing pads and dial) interactions. • Using voice-commands to control infotainment system functions resulted in lower levels of visual demand than the other modes. However, the benefits of reduced visual demand were offset by longer interaction times. 	<p>Motorists should:</p> <ul style="list-style-type: none"> • Remember that just because technologies come installed in a vehicle does not mean automaker testing has proven they are safe to use while driving. • Use these infotainment technologies only for legitimate emergencies or urgent, driving related purposes. <p>Automakers and other industry leaders should:</p> <ul style="list-style-type: none"> • Improve their infotainment systems by designing systems that are no more demanding than listening to the radio. • Use the results of this study to isolate the most significant sources of demand on drivers, and focus their efforts to remedy those design challenges first (e.g., simply blocking driver access to texting and navigation destination entry while driving would be a huge step forward).

- Consumers can use these results to learn more about the system found in their current vehicle and/or to inform their next vehicle purchase.
- Automakers and other industry players 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.

METHODOLOGY

Researchers tested 30 vehicles from a variety of manufacturers (model year 2017). Depending on the available features, each vehicle offered up to three modes of interaction, including voice-commands, center stack display and controls in the center console. Four types of tasks were evaluated using the different modes of interaction, including: (a) calling or dialing; (b) text messaging; (c) tuning the radio; or (d) programming navigation.

Participants included 120 licensed drivers aged 21 to 36 who had normal or corrected-to-normal vision and a clean driving history. A total of 24 drivers were tested in each vehicle in the study 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 roads 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 tasks and the modes of interaction, testing began. Participants were instructed to drive the designated route, repeating the tasks as instructed by the investigator several times on each drive. The session lasted approximately three hours, on average.

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

A number of objective and subjective measures were gathered both during and after each drive in order to generate the demand scores, including two variants of the Detection Response Task (DRT, International Organization for Standardization #17488) as well as the NASA Task Load Index.

ABOUT

Established in 1947 by AAA, the AAA Foundation for Traffic Safety is a not-for-profit, 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.

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