Status Report

Insurance Institute for Highway Safety | Highway Loss Data Institute

Say the word

Voice systems can reduce some types of distraction

Vol. 50, No. 2
March 3, 2015

It's hard to resist the temptation to do two things at once, even when one of those things is driving. To make multitasking easier and safer, automakers and technology companies have provided drivers with the ability to use voice commands to operate smartphones and infotainment systems.

Voice systems do help drivers keep their eyes on the road when compared with manual interfaces, but they don't eliminate visual distraction altogether, a new study by researchers from IIHS and the Massachusetts Institute of Technology's AgeLab shows. And when researchers compared embedded voice systems from two vehicle makes and the voice interface of a smartphone, they found considerable differences among the three in terms of the visual demand, time involved and accuracy.

"In an ideal world, drivers wouldn't do anything but drive while the vehicle is moving. But people are increasingly plugged in at all times, and automakers have responded by installing systems to make it easier to use technology on the go," says Ian Reagan, an IIHS senior research scientist and a co-author of a pair of papers based on the experimental study. "While you can't completely eliminate the distracting nature of these types of tasks, this study shows it's possible to reduce some types of distraction through system design."

The study was conducted on interstates in the Boston area with 80 participants ages 20-66. Half of the group drove a 2013 Chevrolet Equinox equipped with the Chevrolet MyLink system, and half drove a 2013 Volvo XC60 with the Volvo Sensus system. All participants used a Samsung Galaxy S4 smartphone programmed with the same list of more than 100 contacts and mounted in the center console area.

MyLink and Sensus were chosen for the experiment after an earlier IIHS study revealed big differences between them. In that study, researchers counted the steps involved in calling a contact via four vehicle infotainment systems. Calling a contact using voice commands with Sensus required multiple statements to navigate through different system menus, while the same task required a single detailed voice command with MyLink. The systems' visual-manual interfaces also differed. To call a contact manually, Sensus required the driver to scroll through the contact list using a rotary knob, while, with MyLink, the driver used a rotary knob and push-button to access the alphabetical range containing the desired contact and then scroll through that more limited list.

In the Boston experiment, each driver was trained in the use of the vehicle system while parked and then had to use the system to

Voice interface design

Two approaches to entering an address

Chevrolet MyLink | 2013 Equinox

STEP 1

PRESS: voice recognition button

STEP 2

SAY: "navigation"

STEP 3

SAY: "destination address"

STEP 4

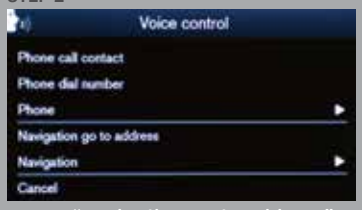
SAY: "177 Massachusetts Avenue, Cambridge, Massachusetts"

Volvo Sensus | 2013 XC60

STEP 1

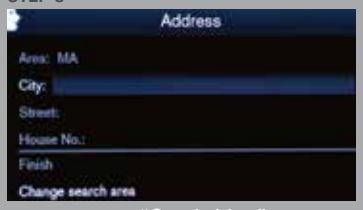
PRESS: voice recognition button

STEP 2



SAY: "navigation go to address"

STEP 3



SAY: "Cambridge"

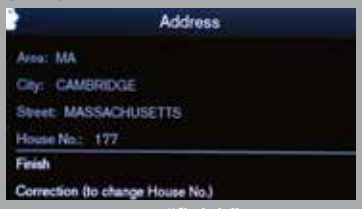
STEP 4

SAY: "Massachusetts Avenue" or "correction"

STEP 5

SAY: "177" or "correction"

STEP 6



SAY: "finish" or "correction"

STEP 7

SAY: "enter destination"

Volvo's voice system required more steps to enter an address than Chevrolet's but gave drivers the chance to correct errors along the way.

Nathan Fried-Lipski/MIT AgeLab

complete a series of tasks while driving: calling a contact manually, calling a contact using voice commands and entering an address for navigation using voice commands. The drivers also were trained in use of the Galaxy S4 and completed the same tasks using the smartphone directly.

Researchers later used video footage and vehicle performance data to analyze off-road glances, task completion time, errors, vehicle speed, speed variability and steering wheel reversal rates. EKG and skin conductance sensors were used to measure the drivers' physiological responses, and drivers also rated the workload involved in each task. Participants were told "workload" could include both mental and physical effort, as well as things like distraction and frustration.

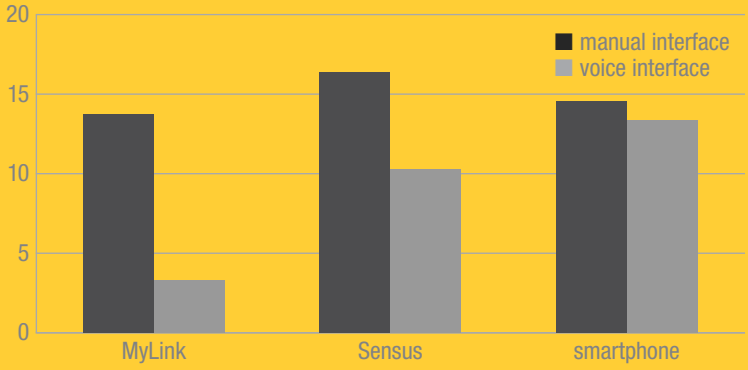
The participants were instructed to give priority to safe driving. Before the driving began, eight people were excluded from the study: two because one of the systems couldn't interpret their speech, two who said they were uncomfortable performing the tasks while driving and four who had difficulty learning how to use the systems. Three participants were withdrawn because of safety concerns about their driving. None of these are included in the final count of 80.

None of the voice interfaces eliminated all glances away from the road when calling a contact, but all of them reduced total eyes-off-the-road time to some extent compared with manual calling. When using the smartphone with voice commands, drivers looked away for a total of 13 seconds on average, compared with 15 seconds when dialing a contact manually. The reduction was more substantial for both of the embedded systems, particularly MyLink. The Chevrolet system required an average of 14 seconds of off-road glances for the manual interface and 3 seconds for the voice interface.

The picture was more complicated when it came to entering an address. Drivers looked away from the roadway for much more time with the Sensus system than with either MyLink or the smartphone. That's because Sensus' menu-based design required each element of the address to be entered separately and allowed the driver to look at a center-mounted display to verify that the previous component was interpreted correctly and fix it if necessary. While the

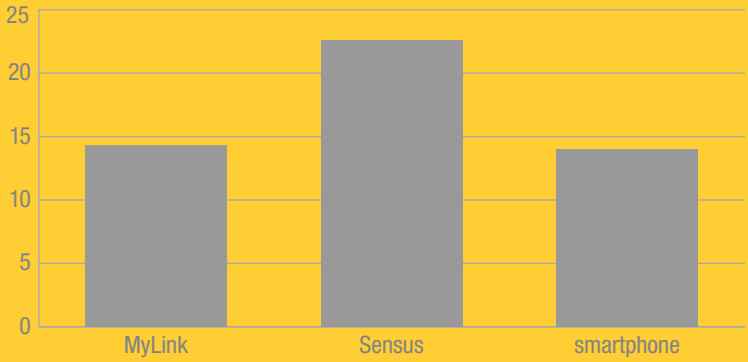
Phone contact calling

Average total number of seconds drivers' eyes were off forward roadway



Entering address with voice interface

Average total number of seconds drivers' eyes were off forward roadway



For calling a contact, the embedded vehicle systems reduced total eyes-off-the-road time compared with manual calling more than the smartphone voice interface. For entering an address, Volvo's Sensus system required the most time looking away but made few errors.

design had higher visual demand, it resulted in relatively few errors.

In contrast, drivers using the MyLink system had to give the complete address all at once. This "one-shot" system was much quicker than the menu-based approach, but many drivers in the study had trouble getting the system to understand the address correctly or made mistakes as they recited the address in a single string. Researchers in the car noticed that some participants appeared to try to help the system by speaking slowly, but this only seemed to confuse it more. Out of 120 attempts to enter an address via MyLink, 38 had system errors, and 23 had user errors. In contrast, there were only five system errors and eight user errors with Sensus.

"The one-shot approach of MyLink's voice interface seemed to work well for contact calling, but a full address may be too complicated for that method," says David Kidd, an IIHS senior research scientist and study co-author. "A high error rate could negate some of the benefits of fewer off-road glances. When drivers become frustrated with technology, that itself can be distracting. Or they might give up on the system and resort to another, potentially more distracting navigation method."

In addition to the one-shot approach, another possible reason for the high error rate could be the fact that the Equinox had more ambient noise than the XC60. That could help explain why the smartphone, which was used identically in both vehicles, had a higher rate of system errors when used for voice-based address entry in the Chevrolet than in the Volvo.

"Would MyLink have performed better in a quieter vehicle?" Kidd asks. "That's an open question."

The wide variety of both smartphones and vehicle systems makes it difficult to generalize from the study, and the outcome might have been different if participants had been familiar with both the phone and the vehicle. What's clear, however, is that voice input has some benefits compared with manual input, and there are pluses and minuses in different designs.

When it comes to cellphones and infotainment systems, many safety advocates are concerned that hands-free and voice-activated systems don't eliminate cognitive distraction. In the current study, cognitive distraction wasn't specifically measured. The researchers used participants' self-reports about workload, as well as the physiological indicators and driving performance measures, to try to gauge how demanding the tasks were. The drivers rated the voice interfaces as less demanding than manual ones, but the voice interfaces still led to modest changes in driving performance and increases in stress levels relative to periods when drivers were just driving.

"Cognitive distraction is a real concern but a difficult one to study," Reagan says. "However, regarding visual distraction, there's no question that if you're at least looking at the road ahead, you have a better chance of not crashing into something in front of you than if you're looking at a vehicle infotainment display or at your cellphone."

Cognitive distraction can result from all kinds of behaviors, many of which would be impossible to eliminate, such as talking to passengers or daydreaming. Crash avoidance technologies that can prevent or mitigate impending crashes, no matter the cause, represent a promising solution to this problem, and more and more vehicles are being equipped with such systems (see *Status Report*, Oct. 24, 2014, at iihs.org).

For copies of "Multi-modal assessment of on-road demand of voice and manual phone calling and voice navigation entry across two embedded vehicle systems" by B. Mehler et al., "Multi-modal demands of a smartphone used to place calls and enter addresses during highway driving relative to two embedded systems" by B. Reimer at al., and "Using hierarchical task analysis to compare four vehicle manufacturers' infotainment systems" by I.J. Reagan and D.G. Kidd, email publications@iihs.org. ■

Decline in crash risk spurs better outlook for older drivers

Older drivers are more likely to crash for every mile they travel than middle-age drivers, but the overall crash outlook for older drivers has markedly improved during the past two decades. Two developments are helping lower the fatality rate among drivers age 75 and older: They are involved in fewer crashes per mile traveled, and they are surviving side impacts more often than prior generations, a new IIHS study indicates.

Prior IIHS studies have shown that older drivers have enjoyed bigger declines in fatal crash rates per licensed driver and per vehicle mile traveled than middle-age drivers since the mid-1990s (see *Status Report*, Feb. 20, 2014, at iihs.org). Researchers surmised then that the improvements were likely due in large part to a combination of safer vehicles and the fact that older adults are generally healthier and less fragile than prior generations.

The latest research delves further into the characteristics of the declines in older driver death rates. Using information from federal databases of fatal and police-reported crashes and of vehicle miles traveled, IIHS researchers examined how fatality rates per vehicle miles traveled for drivers age 75 and older compare with those of middle-age drivers ages 35-54 and quantified how changes in crash involvement (crash risk) and older driver survivability (death risk) contributed to changes in fatality rates from 1995-98 to 2005-08.

Compared with drivers ages 35-54, those age 75 and older experienced large declines in crash risk (police-reported crash involvements per mile traveled) and modest declines in death risk (driver deaths per police-reported crash involvement) from 1995-98 to 2005-08. Among drivers ages 75-79, crash risk declined 22 percent and death risk fell 11 percent relative to middle-age drivers. Among drivers 80 and older, crash risk dropped 31 percent and death risk fell 12 percent relative to middle-age drivers.

Drops in crash risk accounted for 68 percent and 74 percent, respectively, of the relative decline in fatalities per vehicle mile traveled among drivers 75-79 and 80 and older compared with middle-age drivers.

Many factors may have contributed to the large drop in crash risk among older drivers. One is that older adults are logging more miles than ever before. Average annual vehicle miles traveled per driver rose 60 percent for drivers 75-79 and 51 percent for drivers age 80 and older from 1995-06 to 2008. This suggests that the percentage of

The overall safety outlook for older drivers continues to improve. They are involved in fewer crashes per mile traveled, and they are surviving side impacts more often than prior generations. Intersection crashes, however, are still a problem.

low-mileage drivers may have declined during the period. Low-mileage drivers tend to have higher crash rates per vehicle mile traveled, possibly because they tend to drive a larger proportion of miles on local roads with more conflict points or because they have physical or cognitive impairments that have led them to self-limit their driving.

In the IIHS study, declines in death risk among drivers age 75 and older, relative to middle-age drivers, were much larger in side crashes than in front crashes (18 percent versus 5 percent).

"This is a good example of how changes in vehicle safety initiated many years ago are affecting crash outcomes today," says Jessica Cicchino, a senior research scientist at IIHS and the study's author. "Improvements in side impact protection are helping older drivers walk away from crashes that might have killed their parents or grandparents."

Airbags designed to deploy in side crashes and certain offset frontal ones have been standard on the majority of new vehicles since the 2008 model year. There is evidence that side airbags are more effective in preventing fatalities among front-seat occupants ages 70-96 than among those ages 13-49, while front airbags have equally benefited both demographics.

Older drivers also appear to be benefiting from vehicle designs that minimize the harm larger, heavier vehicles can inflict on smaller, lighter ones in crashes (see *Status Report*, Sept. 28, 2011).

"Safer vehicles are leveling the playing field, but older adults' fragility is still a big threat when it comes to surviving crashes, especially for drivers 75 and older. That physical vulnerability continues to be the leading contributor to older drivers' fatality rates," Cicchino says.

Fragility accounted for 77 percent of the elevated fatality rates for drivers ages 75-79 and 68 percent for drivers 80 and older relative to middle-age drivers during 2005-08, the study found.

For a copy of "Why have fatality rates among older drivers declined? The relative contributions of changes in survivability and crash involvement" by J. B. Cicchino, email publications@iihs.org. ■

Intersections challenge older drivers

Safely navigating intersections continues to vex older drivers, who look but don't always see conflicts with other vehicles, new IIHS research finds.

Numerous studies have shown that older drivers are overinvolved in angle, overtaking, merging and intersection crashes, especially those involving left turns (see *Status Report*, March 19, 2007, at iihs.org).

In the second of a pair of new studies on older drivers, IIHS researchers used information from a national in-depth study of passenger vehicle crashes to examine critical driver factors that led to crashes among drivers 70 and older, compared with those of drivers ages 35-54. Data are from the National Highway Traffic Safety Administration's National Motor Vehicle Crash Causation Survey (NMVCCS), a nationally representative sample of 5,470 police-reported passenger vehicle crashes during 2005-07 for which emergency medical services were dispatched.

Crash investigators coded a driver factor as the critical reason in nearly all crashes involving drivers ages 35-54 and 70 and older. The NMVCCS database defines the critical reason as the cause of the critical pre-crash event, defined as the event that made the crash inevitable.

Errors that older drivers frequently make differ in important ways from those of middle-age drivers. The most common critical error among older drivers was inadequate surveillance (33 percent), followed by misjudging the length of a gap between vehicles or another vehicle's speed, failure to obey traffic controls or other illegal maneuvers, medical events, and daydreaming (6 percent each). Inadequate surveillance and gap or speed misjudgment errors were significantly more prevalent among older drivers than middle-age drivers.

Surveillance errors included looking but not seeing and failing to look. Drivers 70 and older had the most trouble with the former. Among older drivers who made critical surveillance errors, 71 percent of their crashes were attributed to looking but not seeing another vehicle or failing to see a traffic control as opposed to failing to look, compared with 40 percent of middle-age drivers. Middle-age drivers were more likely to fail to look at all.

About two-thirds of older drivers' inadequate surveillance errors and 77 percent of their gap or speed misjudgment errors were made when they turned left at intersections.

Compared with middle-age drivers, physical factors were most often the cause when older drivers left their lanes or traveled off the road prior to crashing, which occurred in about a quarter of crashes. Most of these physical-factor events involved blackouts, drowsiness or seizures. In contrast, when middle-age drivers were involved in these types of crashes it was more often due to distraction, speeding or overcompensating when drifting than a physical or medical factor.

Older drivers overall were less likely than middle-age drivers to have made overcompensation errors or to have driven too fast for conditions, a curve or to respond to others' actions.

"Errors older drivers commonly make stem from the typical issues associated with aging. These include declines in cognitive, perceptual and physical abilities," explains Anne McCartt, a co-author of the study and the Institute's senior vice president for research.

For example, the study suggests that visual impairments can affect a driver's ability to judge gaps between vehicles or how fast other vehicles are traveling. Older drivers who made this critical error were 7 times as likely to have a diagnosed visual impairment as older drivers who made other critical errors.

Countermeasures that simplify or remove the need to make left turns across traffic, such as roundabouts, protected left-turn signals and diverging diamond intersection designs could decrease the frequency of inadequate surveillance and gap or speed misjudgment errors. In the future, vehicle-to-vehicle and vehicle-to-infrastructure communications also may help protect older drivers from these errors.

Top driver factors in crashes, by driver age (percent)	ages 70+	ages 35-54
inadequate surveillance	33	22
gap/speed misjudgment	6	3
medical events	6	4
failure to obey traffic controls or other illegal maneuvers	6	4
daydreaming	6	4

Replacing a traffic signal or stop sign with a roundabout improves safety because the roundabout's tight circle forces drivers to slow down, and traffic flows in the same direction (see *Status Report*, Nov. 19, 2005). The most dangerous types of intersection crashes — right-angle, left-turn and head-on collisions — are essentially eliminated with roundabouts. Where roundabouts have been installed, crashes have declined about 40 percent, and those involving injuries have been reduced about 80 percent (see *Status Report*, May 13, 2000).

Despite the safety benefits, older drivers remain wary of roundabouts. Older drivers are less likely than younger drivers to favor roundabouts and may go out of their way to avoid them, IIHS research has shown (see *Status Report*, March 14, 2013).

For a copy of "Critical older driver errors in a national sample of serious U.S. crashes," by J.B. Cicchino and A.T. McCartt, email publications@iihs.org. ■

Insurance Institute for Highway Safety
Highway Loss Data Institute

Status Report

Vol. 50, No. 2
March 3, 2015

Inquiries/print subscriptions:
StatusReport@iihs.org

Editor: Kim Stewart
Writer: Sarah Karush
Art Director: Steve Ewens


iihs.org


iihs.org/rss


youtube.com/IIHS


@IIHS_autosafety

IIHS is an independent, nonprofit scientific and educational organization dedicated to reducing the losses — deaths, injuries and property damage — from crashes on the nation's roads.

HLDI shares and supports this mission through scientific studies of insurance data representing the human and economic losses resulting from the ownership and operation of different types of vehicles and by publishing insurance loss results by vehicle make and model.

Both organizations are wholly supported by the following auto insurers and funding associations:

MEMBER GROUPS

Acceptance Insurance
ACE Private Risk Services
Affirmative Insurance
Alfa Alliance Insurance Corporation
Alfa Insurance
Allstate Insurance Group
American Family Mutual Insurance Company
American National
Ameriprise Auto & Home
Amica Mutual Insurance Company
Auto Club Enterprises
Auto Club Group
Auto-Owners Insurance
Aviva Insurance
Bankers Insurance Group
Bitco Insurance Companies
California Casualty Group
Capital Insurance Group
Censtat Casualty Company
Chubb & Son
Colorado Farm Bureau Mutual Insurance Company
Concord Group Insurance Companies
Cotton States Insurance
COUNTRY Financial
CSAA Insurance Group
CSE Insurance Group
Direct General Corporation
Erie Insurance Group
Esurance
Farm Bureau Financial Services
Farm Bureau Insurance of Michigan
Farm Bureau Mutual Insurance Company of Idaho
Farmers Insurance Group
Farmers Mutual Hail Insurance Company of Iowa
Farmers Mutual of Nebraska
Florida Farm Bureau Insurance Companies
Frankenmuth Insurance
Gainsco Insurance
GEICO Corporation
The General Insurance
Georgia Farm Bureau Mutual Insurance Company
Goodville Mutual Casualty Company
Grange Insurance
Hallmark Insurance Company
Hanover Insurance Group
The Hartford
Haulers Insurance Company, Inc.
Horace Mann Insurance Companies
ICW Group
Imperial Fire & Casualty Insurance Company
Indiana Farmers Mutual Insurance Company
Infinity Property & Casualty
Kemper Corporation
Kentucky Farm Bureau Mutual Insurance Companies
Liberty Mutual Insurance Company
Louisiana Farm Bureau Mutual Insurance Company
Main Street America Insurance Group
Mercury Insurance Group
MetLife Auto & Home
Michigan Millers Mutual Insurance Company
MiddleOak
Mississippi Farm Bureau Casualty Insurance Company
MMG Insurance
Munich Reinsurance America, Inc.
Mutual of Enumclaw Insurance Company
Nationwide
New Jersey Manufacturers Insurance Group
Nodak Mutual Insurance Company
Norfolk & Dedham Group
North Carolina Farm Bureau Mutual Insurance Company
Northern Neck Insurance Company
Ohio Mutual Insurance Group
Old American County Mutual Fire Insurance
Oregon Mutual Insurance
Pekin Insurance
PEMCO Insurance
Plymouth Rock Assurance
Progressive Insurance
The Responsive Auto Insurance Company
Rockingham Group
Safe Auto Insurance Company
Safeco Insurance Companies
Samsung Fire & Marine Insurance Company
SECURA Insurance
Sentry Insurance
Shelter Insurance Companies
Sompo Japan Insurance Company of America
South Carolina Farm Bureau Mutual Insurance Company
Southern Farm Bureau Casualty Insurance Company
State Auto Insurance Companies
State Farm Insurance Companies
Tennessee Farmers Mutual Insurance Company
Texas Farm Bureau Insurance Companies
Tower Group Companies
The Travelers Companies
United Educators
USAA
Utica National Insurance Group
Virginia Farm Bureau Mutual Insurance
West Bend Mutual Insurance Company
Western National Insurance Group
Westfield Insurance
XL Group plc

FUNDING ASSOCIATIONS

American Insurance Association
National Association of Mutual Insurance Companies
Property Casualty Insurers Association of America