



## **Investigating the Roles of Touchscreen and Physical Control Interface Characteristics on Driver Distraction and Multitasking Performance**

Thomas K. Ferris, Youngbo Suh, and Jeffrey D. Miles

ATLAS-2015-08

March 30, 2016

Motor-vehicle manufacturers are increasingly installing touchscreen devices for controlling various systems (such as comfort controls or GPS systems) that are secondary to the task of driving. These interfaces are replacing so-called physical interfaces—the knobs, buttons, and levers that have been used prior to the introduction of touchscreen interfaces. Although touchscreens provide more flexibility in functionality, the synthetic vibrations and sounds emitted from a touchscreen controller are cheap approximations of the rich sensory experience of feeling and hearing the activation of a physical button or knob. To compensate for the impoverished feedback provided to the senses of touch and hearing, more visual attention (more eyes-off-road time) may be required when drivers interact with touchscreens.

Researchers in this study set out to test the assumption that sensory feedback received by drivers when interacting with touchscreens inside the vehicle may affect their ability to pay attention to locations outside the vehicle. Compared with touchscreens with only visual feedback, those with richer or more natural auditory and/or vibrating feedback cues were expected to better support driver performance on both in-vehicle tasks and in the detection of cues at safety-critical locations along the roadway. A physical button interface was expected to support the best performance overall.

To test these expectations, a driving experiment was conducted in an instrumented vehicle on a closed-course testing track at Texas A&M University. While navigating the course at approximately 20 mph, drivers detected and responded to hidden signs along the roadway while performing a data entry task on a touchscreen or physical keyboard mounted on the center console. Experimental conditions varied the type of control (touchscreen or physical) as well as the button sizes (large or small) and types of synthetic feedback provided by the touchscreen (combinations of visual, auditory, and vibrotactile cues).

The researchers employed a variety of statistical methods to analyze the collected data. The results revealed that the richer feedback reduced driver distraction, supporting better performance in both the data-entry task and in detecting and responding to roadside signs. The best performance in both tasks was observed with the physical interface. The study's findings suggest that touchscreens that provide richer synthetic feedback to drivers can reduce distraction while multitasking.