



Impact of Smart Phones' Interaction Modality on Driving Performance for Conventional and Autonomous Vehicles

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Drivers' distraction related to cell phone usage ranks among the top three causes of potentially dangerous incidents on the road. Currently, no national ban on texting or using a wireless phone while driving exists, but most U.S. states have passed laws either banning texting or requiring the hands-free use of wireless phones while driving. While hands-free interfaces may seem an intuitive and convenient solution, scientific evidence substantiating the sought-after safety improvement is lacking, and there is no proof that drivers engaging with their personal devices on a hands-free basis are less distracted than those who engage with them manually. This study thus investigated how different modes of driver interaction with a smart phone (i.e., manual texting vs. vocal input) affect drivers' distraction and performance in both conventional and semiautonomous vehicles.

Study Methods

The study used a full-car integrated simulator capable of handling both manual driving and automated driving. A population of 32 drivers, equally split among male and female, participated in two scenarios: a suburban scenario with a regulated intersection stop subject to the reception of two text messages, and a highway scenario with autonomy disengagement at a highway exit subject to the reception of one text message. The drivers repeated each scenario twice, once asking them to reply through manual texting, and once through vocal dictation. While the interface (manual versus vocal) was the only independent variable, the study analyzed a host of dependent variables , including:

 Time-related metrics, such as: response times to stimuli (e.g., accelerating after a traffic light turns green, or engaging the steering wheel after the autonomous technology that was driving the car disengages); time spent looking at and resting the

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gaze on the road or on the cell phone; and time to engage with the cell phone.

- Vehicle-related metrics, such as: distances from other vehicles: lateral offset and drift from the intended lane of travel; speed of the vehicle while engaging with the personal device.
- Subjective metrics, such as: self-assessed levels of trust, comfort, perceived safety, and mental/ physical/temporal workload. All subjective metrics were measured from surveys provided to the participants before and after the test, as well as in between repetition of the scenarios with the two interfaces.

Drivers felt safer when replying vocally to a text, but their driving performance did not improve.

Findings

The study used statistical tests to analyze the differences for all dependent variables investigated as a function of the two tested interfaces (i.e., manual text reply and vocal reply). The main conclusion of the study rests with the different nature of which variables were found to be statistically significant. In particular, two types of variables proved statistically significant:

- 1. Texting-related variables: composition time for a text was lower for the vocal interface. Length of text in terms of characters contained was similar for both interfaces, but the vocal interface (as intuitively thought) gave a shorter time of text composition. In other words, people were faster at composing a reply through the vocal interface. Furthermore, for the suburban scenario, the study found a marginal significance for the time of first click, or time-to-interaction, with drivers more likely to tap on the phone sooner with the manual interface.
- 2. Subjective measures: drivers perceived less required effort for the vocal interface, and participants expressed a clear preference for this interface, furthermore indicating that the level of "compromised safety" was higher for the manual interface. In other words, participants felt safer and less tired by the vocal composition interface.

Despite these seeming advantages (i.e., shorter texting times and higher perceived safety with lower effort), the vocal interface did not provide any statistically significant improvement in participants' performance with respect to the objective engineering metrics investigated in the study, including response times and drift/lateral offset.

Policy/Practice Recommendations

While participants preferred the vocal interface and perceived it the safer option, their actual performance in the vehicle did not statistically differ between the manual and the vocal interfaces. This conclusion presents serious implications for the current state of driving regulations in the U.S., which overwhelmingly enforce a texting ban while making no stipulations regarding the use of voicereply technology. The authors thus bring forward the careful recommendation for further study into hands-free interfaces and urge caution with respect to the technological promises of vocal engagement interfaces coming out for infotainment purposes.

About the Authors

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To Learn More

For more details about the study, download the full report at transweb.sjsu.edu/project/1813



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