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UTC Spotlight

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Disruption in the Driver's Seat: How Technological Advancements are Changing What We Do in the Car and on the Road

The explosion of mobile computing in the last few years has fundamentally changed how people interact with technology on the roadway and the information it provides. Scenes that would have been the stuff of science fiction only a few years ago are now commonplace realities: a train full of commuters reading customized news feeds on handheld computer screens, a tourist speaking to his iPhone to ask for directions or translations of local signage, and advertisements that are "aware" of the audience's location and demographics in real-time.

The transportation enterprise has been quick to adapt the advancements of mobile computing to in-vehicle aides, entertainment systems, and other devices. These new technologies have disrupted our traditional understanding of how drivers interact with their vehicles and the surrounding roadway, simultaneously creating new challenges and opportunities for design innovation, enhanced mobility, and safety. To address these issues, the Massachusetts Institute of Technology, as part of the New England University Transportation Center, has focused research on developing an understanding of how in-vehicle voice interfaces and on screen typography impact driver behavior, as well as how driver attention is affected by high salience digital billboards.

A typical interface that a driver might use when entering an address into a navigation system. This particular interface was specially designed to test the effects of the menu's font on driver behavior.

Consider first the proliferation of voice-based interfaces and the developing NHTSA Phase III driver distraction guidelines. It is now possible for a driver to "talk" to the vehicle to ask for directions, change the radio station, or make a phone call. The voice interface is dynamic, presenting the driver with different options depending on the task at hand. This is a much more complex and cognitively oriented type of interaction than turning a knob or memorizing the locations of a limited set of buttons on the vehicle console. However, limited research to date has effectively explored the holistic, visual, cognitive, and manipulative demands associated with these interactions.

Preliminary research from the center suggests that the cognitive processing demands induced by voice-based tasks are comparable to that of traditional manual tasks. Several ongoing research projects are currently investigating how task-induced workload might interact with off-road glance behavior, task completion time, and other behavioral characteristics in altering driver attention to the roadway.

The MIT AwareCar, a specially instrumented vehicle designed to measure a driver's behavior in real-time on the roadway.

Just as speech has become an increasingly common interaction behavior in the vehicle, so has reading. Where once the odometer and fuel gauge represented the beginning and end of the driver's in-vehicle reading material, the same in-vehicle dashboard is now equipped with an electronic display that contains a rapidly increasing amount of textual content. The driver must read the menus and information panels on these displays in short glances. In doing so, the driver is taking his or her eyes off the road, and it is crucial that the display be designed to maximize legibility for rapid, efficient reading. Legibility research has yet to fully address the effect of pixilation of typography on electronic displays or the short "glance based" reading that is now commonplace in the vehicle. Center research has found that even a factor as subtle as the interface's chosen typeface—whether the text is displayed in one font or another common to automotive manufacturers—can make a quantifiable difference in overall glance demands among male drivers. Interestingly, far weaker effects were observed among women. The optimization of on screen in-vehicle typefaces, much like the effort placed on the development of the Clearview typeface for highway signage, may play a key role in reducing one coefficient of driver distraction.

Lastly, innovation is occurring in the display of information around the roadway itself. Modern developments in electronics and lighting technology have allowed a recent increase in the number of dynamic, digital billboards in the environment around roadways. While conclusive results await further study, a recent Center-supported analysis found significant shifts in the number and length of glances toward the digital billboards when they are in view compared to similar sections of road without them. These results are particularly pronounced in older drivers, perhaps because they are more accustomed to thinking of any type of motion on the roadway as something that should be attended to.

Recent advancements in vehicle technology present exciting opportunities to greatly enhance both the experience of driving, access to critical information and safety. As integrated technology becomes a fact of our daily lives, it will be important to continue developing a more in-depth understanding of how age and gender impact the utilization of these technologies.

A typical digital billboard.