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AAA Foundation for Traffic Safety

Measuring Cognitive Distraction in the Automobile

Roadmap to Safer Systems:

Pointing the Way to Implementing In-Vehicle Infotainment & Communications Technologies that Minimize Cognitive Distractions

Saving lives through research and education

Background

- In-vehicle infotainment and communications systems are proliferating in new vehicles, and allow drivers to perform a number of non-driving tasks while behind the wheel (e.g., placing calls, listening to email/text messages, etc.)
- Though these technologies are generally voice-activated, ongoing AAA Foundation and University of Utah research demonstrates that "hands-free" doesn't mean "risk-free."[1]
- In the interest of working toward safer implementation of these systems, the AAA Foundation offers the following recommendations based on recent research.

Safer Systems: A "Blueprint"

1. *Reduce Task Duration*

- Duration appears to be the most critical element of workload,[2] and includes:
  - Dialogue requirements; and
  - Accuracy of speech comprehension.
- Systems requiring more task steps but which make fewer errors fare better than those with fewer steps but lower accuracy.
- Cooper et al. found that the music selection task (vs. call placement) is what separated the systems in terms of error rates.[2]
- This table compares the least and most cognitively distracting systems:[2]

System	Workload Rating	Avg. Time to Place Call	Avg. Time to Make Music Selection
Toyota Entune	1.7	20 sec.	22 sec.
Chevrolet MyLink	3.7	29 sec.	43 sec.

- Ranking the systems according to interaction errors yields precisely the same ordering as when ranking by overall distraction score, and the correlation is statistically significant.
- Based on the limits of working memory capacity, the number of items in any given menu should be limited to four or five.[3]

2. *Improve System Flexibility*

- Generally, drivers give more favorable preference ratings to systems that are easy to use and respond accurately to flexible inputs (e.g., systems that recognize both "Tune to FM 99.5" and "Change to 99.5 FM").[2]
- Getting accustomed to more rigid systems can feel like learning a new language.
  - Mercedes COMAND got the worst participant feedback, requiring numerous steps and highly-specific inputs that appeared to irritate drivers.
- Duration and accuracy, however, are still the most important factors.
  - Even though COMAND was subjectively rated the least favorite, it was quite accurate when the proper inputs were provided; this resulted in a mid-range distraction score.

3. *The Type of Voice Used by the System Is Not a Concern*

- Speech technologies have advanced to the point that there is no difference between utilizing synthetic/computerized voices and pre-recorded natural human ones to interact with drivers.[3]

4. *Limit Driver Access to High-Demand Functions*

- Allowing drivers to compose appropriate responses to text/email messages, as opposed to allowing them to listen to messages only, raises the distraction level from a category 2 to a category 3.[3]
- Issuing simple car commands (e.g., adjusting climate control), however, is only about as cognitively distracting as listening to an audiobook (category 1).[3]

The Bottom Line

When in-vehicle infotainment and communications systems are well executed, performing certain tasks on them may not be any more distracting than listening to the radio. This suggests, therefore, that research can lead to a nuanced understanding of how to implement these technologies in a way that satisfies consumer demand without compromising safety.

References

1. Strayer, D.L., Cooper, J.M., Turrill, J., Coleman, J., Medeiros-Ward, and N., Biondi, F. (2013). *Measuring Cognitive Distraction in the Automobile.* Washington, DC: AAA Foundation for Traffic Safety. Available: http://aaafoundation.org/measuring-cognitive-distraction-automobile/.

2. Cooper, J.M., Ingebretsen, H., and Strayer, D.L. (2014). *Mental Workload of Common Voice-Based Vehicle Interactions across Six Different Vehicle Systems*. Washington, DC: AAA Foundation for Traffic Safety. Available: http://aaafoundation.org/mental-workload-common-voice-based-vehicle-interactions-across-six-different-vehicle-systems/.

3. Strayer, D.L., Turrill, J., Coleman, J.R., Ortiz, E.V., and Cooper, J.M. (2014). *Measuring Cognitive Distraction in the Automobile II: Assessing In-Vehicle Voice-Based Interactive Technologies*. Washington, DC: AAA Foundation for Traffic Safety. Available: http://aaafoundation.org/measuring-cognitive-distraction-automobile-ii-assessing-vehicle-voice-based-interactive-technologies/.

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