Why Talking to Your Car Drives You to Distraction

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The Driver Distraction Triad

Visual
Eyes off the Road

Cognitive
Mind off the Drive

Moderate

Manual

High

Low

Hands off the Wheel
Developing a Metric of Cognitive Workload

• Problem: Measuring cognitive workload is notoriously difficult

• Objective: Develop robust instrument of cognitive workload
  - Older technologies (e.g., radio, cell phone, etc.)
  - Newer technologies (e.g., speech-based in-vehicle communication)

• Standardized rating system
  - Similar to other rating systems (e.g., Richter, Saffir-Simpson, etc.) where higher ratings are indicative of greater cognitive workload
Measuring Cognitive Workload: Phase I

- Phase I Study Objectives:

  - Develop robust cognitive workload scale for
    - Single-task (undistracted driving – Category 1)
    - Radio
    - Audio book
    - Passenger conversation
    - Hand-held cell phone conversation
    - Hands-free cell phone conversation
    - Speech-to-text email/text (perfect fidelity)
    - OSPAN (high workload memory/math task – Category 5)
Measures of Cognitive Workload

Workload

Primary

Secondary

Subjective

Physiological
Cognitive Workload Scale: Phase I
Use the workload metric to:

- Establish that the workload scale applies for all drivers
  - Across the age range (21-70)
  - Applicable for both genders

- Determine if practice reduces driving impairments

- Assess cognitive workload in
  - 2015 OEM voice-based interfaces
  - Intelligent personal assistants (Apple’s Siri, Google’s Now, Microsoft’s Cortana)
  - Commonly used tasks (dialing, music selection, voice texting)
In-Vehicle Information System Interactions

1. Call
2. Tune
3. Dial
4. Tune
5. Call
6. Dial
The Detection Reaction Time Task

- Large costs of IVIS interactions (Category 5)
The Detection Reaction Time Task

• Surprising residual costs of IVIS interactions
Effects of Practice

- Same basic patterns obtained after 1 week
Effects of Age

- Older drivers exhibit greatest costs (> 2X)
Phase IIIa Conclusions

- Cognitive demand for actual systems in line with Phase I
- Cognitive demands vary considerably between systems
  - Complexity
  - Intuitiveness
  - Time to complete tasks
- Well executed systems have the potential to create little additional demands
- Poorly executed systems can be very problematic
Comparing Intelligent Personal Assistants

Apple iPhone 6 with iOS 8.2

Nokia Lumia 635 running Windows 8.1

Google Nexus phone running Android 5.0.1
The Detection Reaction Time Task

- Large costs of Voice-based Interactions
Cognitive Workload Scale: Phase III

MENTAL DISTRACTION RANKINGS OF VOICE-ACTIVATED SYSTEMS*

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<th>Rank</th>
<th>Very High Distraction</th>
<th>High Distraction</th>
<th>MODERATE DISTRACTION</th>
<th>MILD DISTRACTION</th>
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Source: AAA Foundation for Traffic Safety

*Mental distraction rankings when using voice-commands to make calls or change music while driving. Includes 2015 model-year vehicles.
Talking to your Car Drives You to Distraction

- Voice-based interactions associated with high levels of workload
- Surprisingly long-lasting residual switch costs
- Practice improves performance, but does not eliminate impairment
- All age-groups show impairment, but older adults find voice-based interactions more difficult
- Vehicles/IVIS systems vary in difficulty – systems with short and robust interactions have lower levels of workload
"I wasn't texting. I was building this ship in a bottle."