Demands of Voice Based In-Vehicle Interface
MIT Voice Interface Project

Dr. Bryan Reimer; Research Scientist
MIT AgeLab &
New England Transportation Center

Dr. Jim Foley; Sr. Principal Engineer
CSRC

Quantitative Evaluation of Voice Interface
Goals

1. Develop quantitative metrics for evaluating cognitive demand of voice interface
2. Share results with NHTSA for consideration when developing guidelines for voice interfaces

What is the demand with a voice interface?
The MIT n-back

An Evolving International Procedure for Grading Cognitive Workload

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>6 9 1 7 0 8 4 3 5 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (0-back)</td>
<td>6 9 1 7 0 8 4 3 5 2</td>
</tr>
<tr>
<td>Moderate (1-back)</td>
<td>. 6 9 1 7 0 8 4 3 5</td>
</tr>
<tr>
<td>High (2-back)</td>
<td>. . 6 9 1 7 0 8 4 3</td>
</tr>
</tbody>
</table>

• **ISO** – A international standardization committee is using the task as a staged demand level for the evaluation of distraction detection response metrics (8 labs across, Europe, North America and Asia)

• **Other labs** – Researchers in Korea have replicated the research findings and others in US, France, Germany, Belgium have requested information this year

• **NHTSA** – Tom Ranney (NHTSA) in his recent 2011 report on driver distraction noted the most difficult demand level (2-back) established through this work should be considered as a first stage threshold for an acceptable dose of cognitive demand

• **MIT / CSRC project on voice systems** – research is currently using the tasks as benchmarks to evaluate the demand of voice based in-vehicle systems (Toyota CSRC / UTC funded work that will be available to NHTSA for 2014 voice interface guidelines)
More Demanding Cognitive Interactions Show a Increased Physiological Effect

• Consider the “relative” level of demand with voice control (radio, song, and navigation) as compared to established benchmarks (n-back)

• Evaluate driver interaction using traditional visual manipulative radio interaction and voice radio control

• Comparisons across physiology, eye tracking, vehicle telemetry, task performance and subjective report
Instrumented Vehicle

- Cameras for monitoring driver & traffic
- Physiology (HR, GSR)
- Lane tracking
- Audio recording
- GPS
- Eye tracking
- PC based data acquisition system
- Rear seat for overseeing experiment
- Vehicle telemetry via CAN bus link
Experiencing the effect of cognitive demand:

Come see how the n-back task impacts your reaction time

*Data from 53 subjects 60 – 74 (M= x, SD-y)