Vehicle Communications Human Factors Performance Metrics Task

Dan McGehee
Sue Chrysler
Linda Angell
Joel Cooper
Christine Yager
Neil Lerner

January 26, 2011
Goals for Vehicle Communications Human Factors Project

• Develop guidelines to ensure interfaces are effective without increasing distraction

• Human factors aspects of integrating connectivity into the vehicle (VTTI)
What is a driver performance metric?

• Can help us understand how distracted a driver is
  – Frequency and glance duration away from the forward roadway
  – Reaction time to events on the road (or in-vehicle)
  – Awareness of surrounding traffic and roadway – and ability to project/anticipate what will happen next (where to look next)
What makes an interface effective?

• Captures the driver’s attention so that is directed to the threat
• Quick and accurate response
Scope: Performance Metrics

- **Goal**: Develop and select driver performance metrics to examine distraction potential within the context of Vehicle Communications

- **Main tasks**:
  - Review current guidelines (SAE, ISO, Alliance, etc) and test procedures
  - Conduct driving studies to support new design guidelines and test procedures
  - Develop best practices for Vehicle Communications interface design

- **Outcomes**: Develop test procedures that can be used with production vehicles and nomadic technologies to assess distraction potential within Vehicle Communication systems
Distraction for future vehicle communications systems

• Increasingly frequent and dynamic flow of messages, warnings, and information to the driver from connected vehicles and infrastructure during driving
  – Multiple dimensions and modalities
  – Unknown levels of integration and prioritization

• Implications for safety alerts, messages, and increasing driver awareness
Distraction Issues Unique to Future Systems

Distraction potential may arise from several sources for future vehicles:

- Safety notifications, alerts, warnings, messages
- Mobility notifications and messages
- Sustainability notifications and messages
- Information management principles within advanced systems or components
  - those that govern when and how often the driver may be interrupted with information, those that establish priorities and timing of presentations among notifications, alerts, warnings, and messages)
- Other sources in the vehicle (e.g., nomadic devices) that may present information which prevents or modulates driver attention to messages
Definition of Driver Distraction

“Driver distraction is a diversion of attention away from activities critical for safe driving toward a competing activity.”

Lee, Young, & Regan (2009)
Distraction and Safety Systems

• The goal is to develop smart systems that guide driver attention toward avoiding potential safety threats
• The effectiveness of a safety warning system can be thought of as appropriately attracting driver attention under conditions of an imminent threat
• The effectiveness of a safety warning can be measured separately from whether the safety warning system is distracting (diverts attention away from the threat to be avoided)
• And in future vehicles, the focus is on not just one warning, but on information and warnings within a dynamic flow of information
Near Crashes and Crashes

Adapted from USDOT/ACAT Programs

- Information to the driver changes across this spectrum
- Effective safety messaging systems communicate across most phases of this sequence
- Future systems may make information available earlier
- Giving information earlier – or more often -- does not necessarily make a warning more effective
Research Gaps

Current metrics
• Lateral control measures
• Longitudinal control measures
• Object and event detection
• Gap acceptance
• Subjective mental workload
• Physiological measures
• Surrogates (e.g. eye tracking)

Missing metrics in driving
• Whole vs. Part system evaluation
• Discrete metrics evaluation
• Situation Awareness Development
Selected Functions

**Safety**
- Road and Travel Condition Warning
- Blind Spot Warning
- Do Not Pass Warning
- Emergency Brake Lights
- Intersection Movement Assist
- Loss of Control Warning
- Curve Speed Warning
- Signal and Stop Sign Violation
- Emergency Vehicle Warning
- In-Vehicle Signing
- Collision Avoidance

**Mobility**
- Travel Time Route Optimization
- Dynamic Capacity Routing
- Dynamic Cost Adjustment
- Dynamic Insurance
- Parking Availability / Reservation

**Sustainability**
- Environmental Footprint
- Signal Phase and Timing
- Time-To-Red
- Eco Driving Feedback/ Guidance
Driver Studies

System Interaction Tasks
- Visual and Auditory detection task
- Situation Awareness Task
- Visual Manual Search Task

Driving Tasks
- Simulator
- Test track
- Areas of interest
  - Driving difficulty
    - Traffic density
    - Construction zone
    - Miscellaneous obstacles
  - Age: Younger and older drivers
## How gaps map to studies

<table>
<thead>
<tr>
<th>Gaps</th>
<th>Functions</th>
<th>Drivers Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Discrete metrics evaluation</td>
<td>• Discrete onset warnings/alerts</td>
<td>• Visual/auditory detection task</td>
</tr>
<tr>
<td>• Situation Awareness Development</td>
<td>• In-Vehicle Signing</td>
<td>• Situation Awareness task</td>
</tr>
<tr>
<td>• Whole vs. Part system evaluation</td>
<td>• Travel time route optimization</td>
<td>• Visual manual search task</td>
</tr>
<tr>
<td></td>
<td>• Parking availability/reservation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Environmental footprint</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Eco driving options</td>
<td></td>
</tr>
</tbody>
</table>
Summary

• Distraction potential may arise from the inappropriate diversion of attention

• Within advanced communication systems, this potential may arise from several sources within the dynamic flow of information and warnings that will be enabled

• Current research gaps include
  – Little whole system perspective
  – Metrics needed for very brief alerts/warnings
  – Situation awareness development

• Method for tying it all together in a meaningful way