Study on assessment method using tracking task as subsidiary probe task to estimate the demand of operating an in-vehicle information device

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[Background]
In-vehicle use of information device (i.e., smartphones) possibly induces "driver distraction" and impacts on driving behaviors. Existing laboratory surrogate assessment tech.;

- Occlusion (ISO16673) : sensitive to visual-manual demands !
- Lane Change Test (LCT) (ISO26022) ; is fit to cognitive demands ?
  1. Dual task (assessmen-task + lane change task), but not emphasize task priorities. (= not a subsidiary probe-task procedure !)
  2. Participant's "strategies" (e.g., time sharing) would harm sensitivity !

\[
\text{Lane change (LC) task} = \text{Lane change} + \text{Lane keep} \\
\quad \quad \quad \quad \quad \text{(demanding !)} \quad \text{(easy !)}
\]

\[
\text{(resource allocation )} : \quad \text{LC task } \leftrightarrow \text{Assess. task}
\]

\[\Rightarrow \text{Simple probe-task would be profitable.}\]

[Purpose / Hypotheses]
Clarification of appropriate properties of probe-task to assess cognitive demand caused by in-vehicle information device.

- Hypothesized properties: "not competing operation modality " "needing to spend participant's cognitive resources"

<table>
<thead>
<tr>
<th>Assessment-tasks; (tasks to be assessed)</th>
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</thead>
<tbody>
<tr>
<td>Display</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Visual-Manual only</td>
</tr>
<tr>
<td>VM1: Menu selection</td>
</tr>
<tr>
<td>VM2: Map scrolling</td>
</tr>
<tr>
<td>VM3: Search and point (8 times)</td>
</tr>
<tr>
<td>VM4: Text reading (19 characters)</td>
</tr>
<tr>
<td>Voice-Input included</td>
</tr>
<tr>
<td>VI1: Menu selection</td>
</tr>
<tr>
<td>VI2: Map scrolling</td>
</tr>
<tr>
<td>VI3: Facility names voice input (4 steps of long sentences)</td>
</tr>
</tbody>
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Reference "driving impact" data;

- Following proceeding car on a 2-lanes rural roadway
- 20 male drivers (21-61 yr)

[Experiment I]
- Suitable properties as probe-task
  - Probe-task candidates; 4 tracking tasks
    - Operation modality (Steering / Pedal)
    - Predictability (With / Without visual preview)
  - Significance task diff. in "Pedal" modality
  - Less time-sharing strategy

[Experiment II]
- Validation of assessment result
  - Probe-task:
    - Pedal tracking without preview
  - Assessment-tasks:
    - All 7 tasks
  - Participants: 15 drivers (23-62 yr)

[Discussion / Conclusion]
Appropriate properties of subsidiary probe-task:
- Hard to use participant's strategies
- Needing participant's "prediction" (cognitive resources)
- Not competing operation modality with assessment-task

"Pedal tracking without preview" has the following advantages as probe-task to assess impact of cognitive demand:

- Continuous manipulation
- Spend cognitive processing resources
- Operation modality