Designing Auditory Takeover Requests Under Different Automated Vehicle Operational Environments
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Background & Motivation
- CCAT Research Thrust: Human Factors
- Level 3 automated vehicles (AVs)
- Drivers can engage in non-driving related tasks (NDRTs)
- Requires a human driver as a fallback option
  - Shared responsibility for vehicle safety
- Takeover situations may arise if AV...
  - Ventures out of its operational boundaries
  - Experiences system failure
- Takeover situations can be time-critical
- Regaining situation awareness requires time and effort

Takeover request/alert
- Stimulus to prompt the driver to resume manual control
- Alert design can significantly impact takeover performance
- Multimodal alerts are generally superior to unimodal alerts
  - Auditory, visual, and haptic
- Mixed results on takeover performance within unimodal alerts
- Limited research comparing alert characteristics for the same modality
- This study analyzes different unimodal auditory alerts
  - Auditory alerts are common for in-vehicle critical warnings
    - Harder to miss (compared to visual)
    - Smaller chance of misinterpretation (compared to haptic)

Takeover Performance
- Existing studies evaluate one driving performance variable at a time
  - Did not consider non-linear relationships
- We use a comprehensive takeover performance metric
- Parameter selection based on literature and takeover situation

Experiment Design / Data Collection
- Four auditory alerts
  - 2 beeps (low and high frequencies) and 2 speech pitches (low and high pitch)
  - Participants indicate their preferred alert before the experiment
- Automated vehicle operational parameters
  - Two traffic densities (low and high)
  - Two takeover situations (blocked lane and missing lane markings)
- Non-driving related task
  - Music playlist creation task on a tablet
- Four driving simulator sessions on different days for each participant. In each session,
  - 4 simulated drives with different operational parameters
  - Single type of auditory alert to avoid psychological biases
    - Stimulus discrimination: which can lead to different response
    - Assimilation/contrast effects: response affected by previous stimulus
- Analysis
  - Takeover performance analysis for different alerts
  - Evaluate the effect of alert preference
- Research in progress...