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Abstract Title:
The effect of emotional conversation on visual detection during simulated driving: An ERP study

We used behavioral, event-related potential (ERP) and other measures to assess performance and physiological differences among three conditions of multitasking situations: driving without cellular conversations, driving with cellular conversations spoken in a neutral tone, driving with cellular conversations spoken in an angry tone. We employed a validated event-detection paradigm with lane-tracking to measure driving performance. 20 participants viewed a video recording of a driving scene while using a foot pedal to respond to visual events occurring in the periphery of the display. Lane-tracking, using a steering wheel, was employed to ensure participants were engaged with the video recording. RTs to visual events were recorded, while ERPs of individual brain activations were averaged on these events. Behavioral analyses based on 20 subjects showed that the conversation conditions had slightly longer RTs than the driving only condition. In addition, the emotional tone of the conversation seems to moderate the changes in RTs; events occurring during angry conversations were responded to significantly faster than events occurring during neutral conversations, and were only marginally slower than events occurring in driving only condition. Preliminary ERP analysis confirms this distinction between events occurring during angry and neutral events. N200 and P300 with the amplitude with a minimum of 5 µV were found in the visual detection during angry and neutral conversations in the anterior and posterior cortical locations, respectively. Implications for theories of multitasking and emotional modulation of visual processing are discussed.
The Effect of Emotional Conversation on Visual Detection During Simulated Driving

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What Influences Driving Performance?

Speech
Emotion
Attention
Cognitive Complexity
Memory
Introduction

• Recent research in emotion and cognition suggests that emotion can influence perceptual processing.
• Does emotion interact with the use of a cellular phone in influencing driving performance?

Introduction

• Phelps et al. (2006) observed that contrast sensitivity functions are enhanced when cued by an emotional stimulus.
  – The authors concluded that early visual processes may be modulated by emotion.
• Zeelenberg et al. (2006) used a perceptual identification task to tease apart the effects of enhanced processing from emotional perceptual biases.
  – The authors concluded that it is likely that a non-discriminative perceptual bias is behind enhanced performance in emotional tasks.
Objectives of Current Study

- To investigate the conversation effect on simulated driving and event detection by using natural speech.
- To manipulate emotional content.
- To develop a sensitive and reliable simulated driving protocol which provides an economical and efficient way to test new products or new concepts for automotive design and evaluation of driving safety.

Working Hypotheses

- Speech may have minimal or no impact on driving performance in terms of miss rates.
- Speech may cause a slight delay in reaction times, between 50 and 700 msec.
- The emotional content of speech may enhance or degrade perceptual processing of event detection stimuli.
Preliminary Study

- 11 naïve subjects recruited
- Age range: 22 – 60
- 5 females, 6 males
- 10 subjects performed 4 runs (1 performed 5) completing a number of tasks designed to engage the participant with the scene.
  - Baseline
  - Speed limit counting (twice)
  - Tone counting or car horn counting (to control for counting effects)
- Subjects were to press the brake pedal in response to a red light; and were told not to press during a green light

Preliminary Study

- Each subject performed a 5-minute practice session with short conversations.
- Subjects were told to hold a non-functioning steering wheel during the task.
- Event light responses were made using a foot pedal; phone answering responses made using a mouse button.
- Subjects were debriefed following each run for task difficulty feedback.
RT as a Function of Emotion

Red Light Misses as a Function of Emotion

These miss rates were statistically identical.
Current Study

- Participants performed simulated hands-free phone conversations during simulated driving.
- Four different calls were received (each lasting 1 minute) in each 9 minute block.
- Each run contained 2 conversations containing angry stimuli and 2 conversations containing neutral stimuli.
- In the angry speech condition, simple questions were asked using an “angry” speech tone (only stimuli that were consistently rated as “angry” in a preliminary rating task were used).
- In the neutral speech condition, simple questions were asked using a “neutral” speech tone.
- Each participant completed 3 runs (4 conversations each), and a baseline run (without any conversation).
- We contrast data collected in lab with preliminary data collected in an on-road study at UMTRI.
The Current Task

Conversation + Driving Scene (repeated 4 times, 58.125 seconds)

Driving Scene alone (repeated 5 times, 36.325-58.120 seconds)

Total length of one session: 9:00.

# Hits as a function of site, speech-type and emotion

![Bar chart showing the number of hits per subject for different combinations of site, speech-type, and emotion.](chart.png)
Conclusions

- Small reaction time (RT) effects were observed in all contrasts between speech and no speech.
- In all comparisons, angry RTs were statistically significantly shorter than neutral RTs.
- There was no statistically significant difference between neutral, angry, or silent red light accuracy rates.
- Neutral green light false alarms were marginally more common than angry green light false alarms – this was also observed in our preliminary study.
- Our data supports the conclusion of Zeelenberg et al. (2006): there appears to be a general overall processing advantage when emotionally arousing stimuli are presented.
Acknowledgments

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