Both Perceptual and Central Interference Contribute to Dual-Task Costs

Omar AlHashimi, MD1, Joaquin A. Anguera, PhD2, and Adam Gazzaley MD, PhD3
1Department of Bioengineering UCSF/UCB, Neurology UCSF, 2Departments of Neurology and Physiology, UCSF, 3Departments of Neurology, Physiology, Psychiatry and Bioengineering, UCSF

INTRO/METHODS

Task interference has been previously characterized as distraction and interruption, underpinned by two neurobehaviorally distinct mechanisms (Clapp & Gazzaley, 2010).

The psychological refractory period (PRP) task (Pashler, 1994) uses stimulus onset asynchrony (SOA) to determine the loci (perceptual, central, motor) of interference.

Here we use a novel version of a PRP task with complex continuous tracking while recording EEG to determine the neural mechanisms of task interference.

Participant’s (N=20, 20-29 yrs old) tracking and discrimination ability were thresholded respectively on a Tracking and Discrimination task.

- Participants performed three mixed blocks of the following conditions:
  - Distracted Discrimination (car on auto-pilot, passive view of road)
  - Distracted Tracking (signs passively viewed)
  - Dual-Tasking (both tasks)

All these conditions were perceptually matched.

Electroencephalography (EEG) was collected using a 64-channel Biosemi cap.

BEHAVIORAL RESULTS

Fig. 1 Interference on discrimination performance
(ANOVA SOA: p = 2.7x10^-2; Condition 7.5x10^-2; Interaction: 0.33)

Discrimination Performance

- Equivalent impact of graded temporal effect on distraction and dual-tasking on discrimination RT suggests a perceptual source of interference.
- Impact on discrimination performance when dual-tasking when compared to distracted tasking occurs as an additional central process or a centrally-mediated attentional impact of dual-tasking on discrimination RT.

Fig. 2 Interference on P100 amplitude locked to sign onset
Current Source Density (CSD) filtered sign-locked P100
(ANOVA SOA: p = 2.4x10^-6; Condition 9.2; Interaction: 7.9x10^-4)

P100 Correlated to Reaction Time

- Differential attenuation of neural activity when dual-tasking during sign processing at 300 ms (frontal theta burst locked to sign onset) compared to perceptually matched single-task suggests that neural processing of a task is impacted by central interference during dual-tasking.

NEURAL RESULTS

Fig. 3 Interference on midline frontal theta activity locked to sign onset
(ANOVA Condition p = 0.026; SOA: 0.31; Interaction: 1.6x10^-5)

Maximum P100 Amplitude Correlated to Reaction Time

- Maximum peak activity for midline frontal theta taken from -500 ms to 1000 ms locked to sign onset.

CORRELATIONAL RESULTS

- Across all SOAs and Conditions: \( r = 0.46, p = 0.041 \)

- Degraded neural signal of early visual perception of signs requires increased processing time of subsequent neural processes.

CONCLUSIONS

- Task interference diminishes performance as a result of an interaction of two tasks. The neurobehavioral nature of task interference manifests as perceptual and central interference.

Perceptual Interference: Increasing temporal overlap of stimuli impacts discrimination performance through degraded early visual perception.

This neurobehavioral effect occurs even in the context of single-tasking when tracking stimuli are irrelevant.

Central Interference: Central control processes such as attention are negatively impacted while dual-tasking and can be seen as an attenuated theta burst during discrimination.

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References: