Early rise and lingering (post-response) inhibition of electromyography during failed stopping


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Background

Stop signal tasks are used to index reactive inhibition in a laboratory setting. Pairing behavioral tasks with electromyography can provide unique insights into timing.

We examined electromyography (EMG) in responding muscles during simple and choice stop tasks to address two questions:

1) Can we detect differences in EMG between successful and failed stopping in the 100ms preceding the stop signal?
2) Does motor inhibition persist after failed stopping?
   • Specifically does EMG peak to offset time vary across Going, Successful stopping and Failed stopping?

Task Design

Experiment 1: Simple stop task, n = 24

- N = 24, healthy adults (10 female) aged 23 ± 3 yr
- EMG recorded from both FDI muscles.
- 3 stop signal delay (SSD) staircases adjusted ± 50 ms based on performance.
- Go task: 30 trials. Stop task: 108 trials in 4 blocks, 1/3 stop trials.
- Feedback on failed stop trials: ‘Try to stop’. Feedback on slow go trials (>2.5 std.

Experiment 2: Choice stop task, n = 28

- N = 28, healthy adults (10 female) aged 24 ± 4 yr
- Choice between right index (FDI) or pinky (ADM) responses.
- 3 stop signal delay (SSD) staircases adjusted ± 50 ms based on performance.
- Go task: 60 trials in 2 blocks. Stop task: 216 trials in 8 blocks, 1/3 stop trials.

Experimental Setup

- Bipolar surface EMG recorded from bilateral FDI (E1 + E2) and ADM (E2).
- Button presses required lateral movement of index finger or downward movement of pinky finger.

Results

EMG activity preceding the stop signal differentiated successful and failed stop trials in both experiments (fig 2)
- Faster decline in EMG activity on failed stop vs Go trials suggests lingering inhibition in the motor system (fig 3)
- These non-invasive electrophysiological markers associated with stop task performance may be useful for isolating specific mechanisms engaged in reactive stopping and could improve our understanding of inhibitory control deficits in clinical populations.

Conclusions

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