Resolving Interference One Component At A Time: Dissociation Between N2 and N450 in a Modified Continuous Performance Task

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Background

The limited-capacity nature of attention makes it vital to withstand and overcome the interference caused by distracting perceptual inputs and inappropriate response tendencies. Psychophysiological research has identified two event-related potentials generated by frontal cortices that relate to the implementation of this cognitive control:

• The N2 is a fronto-central negativity (peaking between 200-350 ms) observed in tasks requiring strategic monitoring.1
• The N450 is a fronto-central negativity (peaking between 350-500 ms) observed during incongruent Stroop trials2 and proactive interference trials during memory tasks.2

Present Study

We created a continuous performance task using Stroop stimuli that required participants to discriminate frequent congruent colour-words from three different types of infrequent stimuli each requiring the evaluation of different context contingencies:

- incongruent colour-words (feature contingency)
- a predefined congruent colour-word (memory contingency)
- conclusive congruent colour-words (repetition contingency)

Research Question: What are the corticospinal responses associated with the implementation of cognitive control across the various task contingencies (i.e., do they elicit N2 or N450 responses?)

Methods

Participants

- 15 healthy young adults (12 female; Mean age 20.9 yrs, sd = 2.0)
- Screened for medical, psychiatric, and neurological conditions

Procedure

- Participants completed 3 versions of a forced-choice continuous performance task that used colour-word Stroop stimuli (see Tasks)
- Stroop: Press “Accept” for congruents; “Reject” for incongruents.
- Repeat: As for Stroop but also “Reject” repeated congruents.
- Memory: As for Stroop but also “Reject” predefined congruents

Each of the 3 versions had 450 trials (50 practice + 400 test) and were counterbalanced across participants.

- 80% of trials required an “accept” response & 20% a “reject” response

EEG Recordings

- 128 Channel Biosemi Cap
- 30 Hz Low-Pass Filter
- Bipolar eye-regression
- ERPs presented with
- Correct trials only
- average reference

Tasks

1) STROOP (Congruent vs Incongruent)

- Feature Contingency
- Stimulus Presentation: 600 ms
- Inter-trial Interval: 700-900 ms

2) MEMORY STROOP (Congruent vs Incongruent)

- Memory Contingency
- Repeat or Memory
- Stimulus Presentation: 600 ms
- Inter-trial Interval: 700-900 ms

3) REPEAT STROOP (Congruent vs Incongruent)

- Repetition-based Contingency
- Stimulus Presentation: 600 ms
- Inter-trial Interval: 700-900 ms

ERP Results

- The N450 was measured as the average amplitude at site FCz from 300-500 ms after stimulus presentation

Discussion

• Behavioural data indicate that it is more difficult to identify incongruent colour-words than to identify the repetition of congruents (Repeat Condition) or a single predefined congruent (Memory Condition)
• Type of task contingency was an important determinant of cortical response to interference (N2 vs N450)
• This distinction likely reflects temporally dissociable cognitive control processes:
  - To-be-rejected items that are easily identified (Repeat or Memory lures) elicit an early N2 response, which may reflect a fast-acting, frontally mediated monitoring function that relies on up-regulation of attention1
  - To-be-rejected items that require attending to low-salience stimulus features (font colour vs word identity) elicit an N450, recently suggested to reflect a combination of response control and interference resolution3
• Together, these data show that different stimulus contingencies, even when existing within the same task, place distinct demands on behaviour and require dissociable forms of cognitive control

References


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