

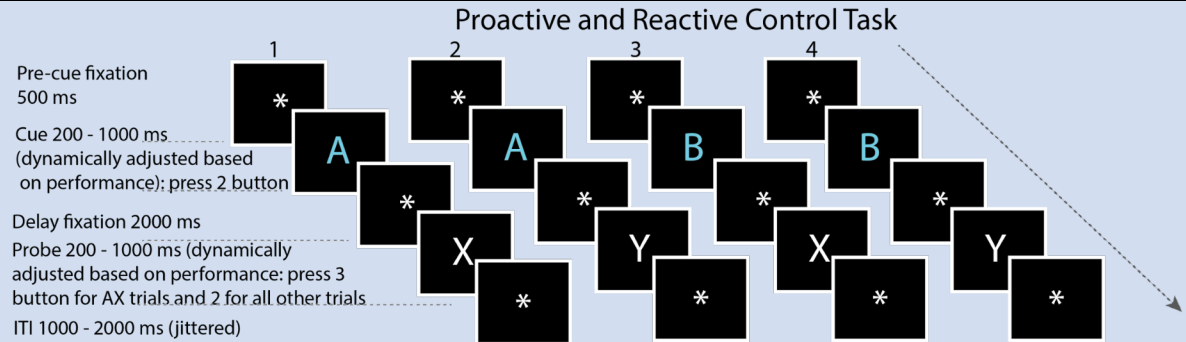
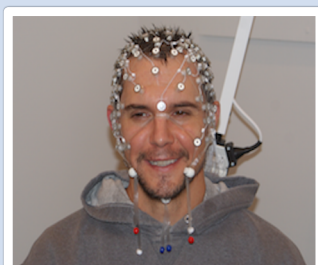
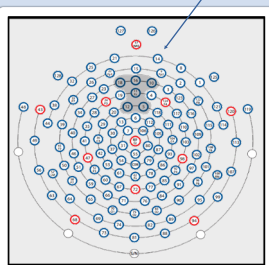
Elevated Prefrontal Neural Functioning underlying Proactive Control is Associated with Enhanced Working Memory in Children

Background

- Proactive control is defined as the active maintenance of information in working memory (Braver, Paxton, Locke, & Barch, 2009).
- Studies of younger and older adults have shown associations between proactive strategies in cognitive control and working memory performances (Braver, Gray, & Burgess, 2007).
- Few studies, however, have looked at this association in children.
- The current study examines the association between proactive control and working memory in children using dense-array EEG
- Specifically, we measured N2 activation, an event-related potential (ERP) associated with various aspects of cognitive control. The N2 was measured in the context of applying proactive control.

Methods

- 17 (9 male) Participants: Aged 8-17 (mean age = 13.2 ± 3.00)
- An AX-Continuous Performance Task (CPT) was used to measure proactive cognitive control, i.e. to assess how much neurocognitive activation is used in order to effortfully maintain key information. Proactive control was measured during BX trials (trial type 3).
- Digit Span Assessment: Forward and Backward were used to measure working memory
- N2 was measured as peak activation roughly 300ms after cue onset.
- Mediofrontal electrodes were clustered and averaged for statistical analysis



Four trial types. 1) AX is propensity setting trial type (70% of trials) and requires participant to press 2 after the cue event and 3 after the probe event. All other trial types are presented for only 10% of trials (30% total across all remaining trial types) and require the participant to press 2 after the cue and probe events. A and X events are always presented as As and Xs. B and Y events are replaced by any letter of the alphabet except A and X. In trial type 2, participants see the A and prepare for an X. However, a Y is presented instead of an X, so the participant needs to quickly change their planned action strategy. In trial type 3, participants have to keep in mind that they saw a B event for the cue to accurately respond to the probe. People with a reactive style of responding do well on BX trials and poorly on AY trials. People with a proactive style of responding do well on BX trials and poorly on AY trials.

Results and Discussion

Results revealed better digit span performance was associated with:

- Higher task performance Forward: $\beta = .52, t(14) = 2.30, p = 0.04$
- Greater (more negative) N2 amplitudes Forward: $\beta = -0.73, t(14) = -3.19, p = 0.008$ Backward: $\beta = -0.78, t(14) = -2.07, p = 0.06$

- These results indicate that enhanced working memory is associated with greater (more negative) N2 activation, suggesting more proactive-control-related prefrontal cortical resources are recruited to effectively manipulate information in working memory
- Additionally, that children, and not just adults, apply proactive control when manipulating information in working memory
- Though these results are only correlational, educators might consider having children practice proactive control to help improve working memory capacity
- Future studies should apply training of proactive control to see if these strategies enhance working memory capacity
- Additionally, future studies should examine the developmental trajectory of proactive control using longitudinal data

For additional information contact:
dahobbs1@uno.edu or carmes@uno.edu

