

Time Course of Inhibitory Control During Analogical Reasoning: An Event-Related Potential Approach

Brian M. Sweis, Krishna L. Bharani, & Robert G. Morrison

Department of Psychology, Loyola University Chicago

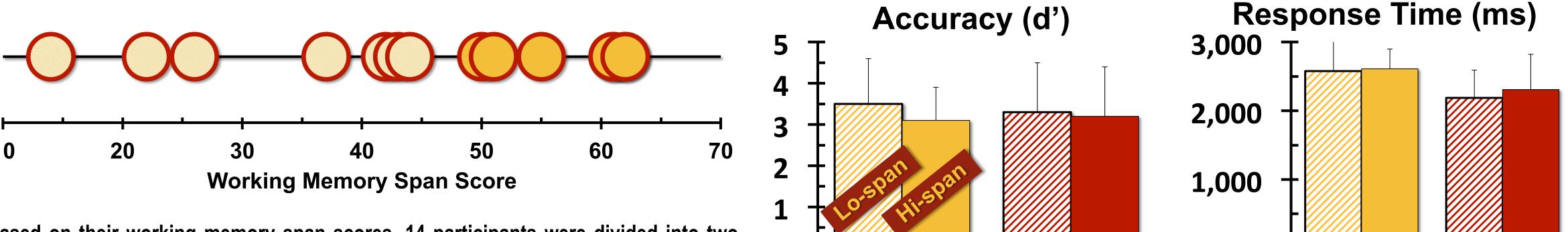
Introduction

•Analogical reasoning fosters human understanding and learning by enabling one to establish a link between two sources of structured information and to use this link to make comparisons and inferences. •Previous neuropsychological and neuroimaging studies

have emphasized the importance of several areas of prefrontal cortex (PFC) for inhibitory control and

Results

No differences were observed in accuracy or response times across distraction conditions or working memory capacity groups.



relational integration during analogy.

•Using EEG recording, this experiment aims to explore the time course of the neural correlates for inhibitory control during analogy and begin to understand how they are affected by individual differences in working memory (WM).

Methods

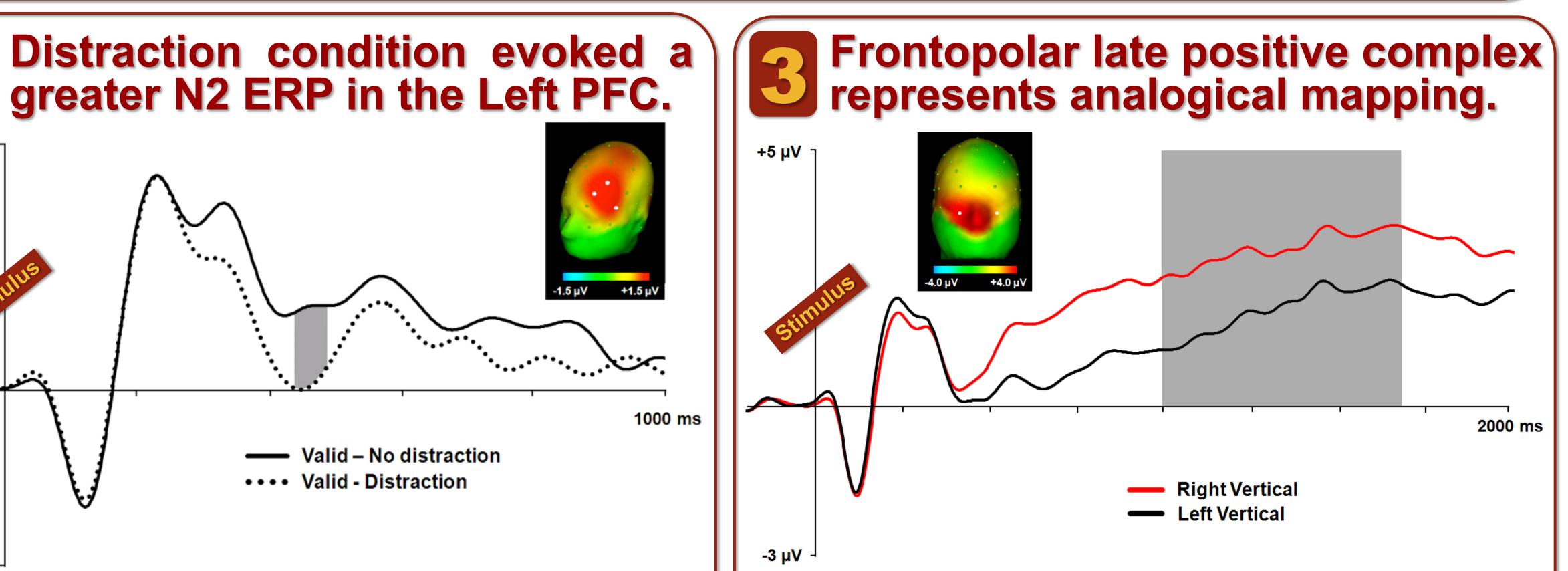
Visual Analogy Task

•Objects possessed three varying properties (luminance, orientation, and number).

•Participants judged if the relation between objects in the top pair matched the relation in the bottom pair, with respect to a single, cued property (Valid = match, Invalid = mismatch). •Relations of the unattended properties disagreed with the relations of the cued properties in the "Distraction" condition. Working Memory Task •Participants were asked to verify simple math problems while remembering strings of letters. Scalp electroencephalography (EEG) Brain activity was recorded using a 32-channel Biosemi Active2 EEG system.

Based on their working memory span scores, 14 participants were divided into two groups (via median split): Lo-Span and Hi-Span individuals. Behavioral data (accuracy and response times) and neurophysiology data were analyzed with individual differences in working memory capacity taken into account.

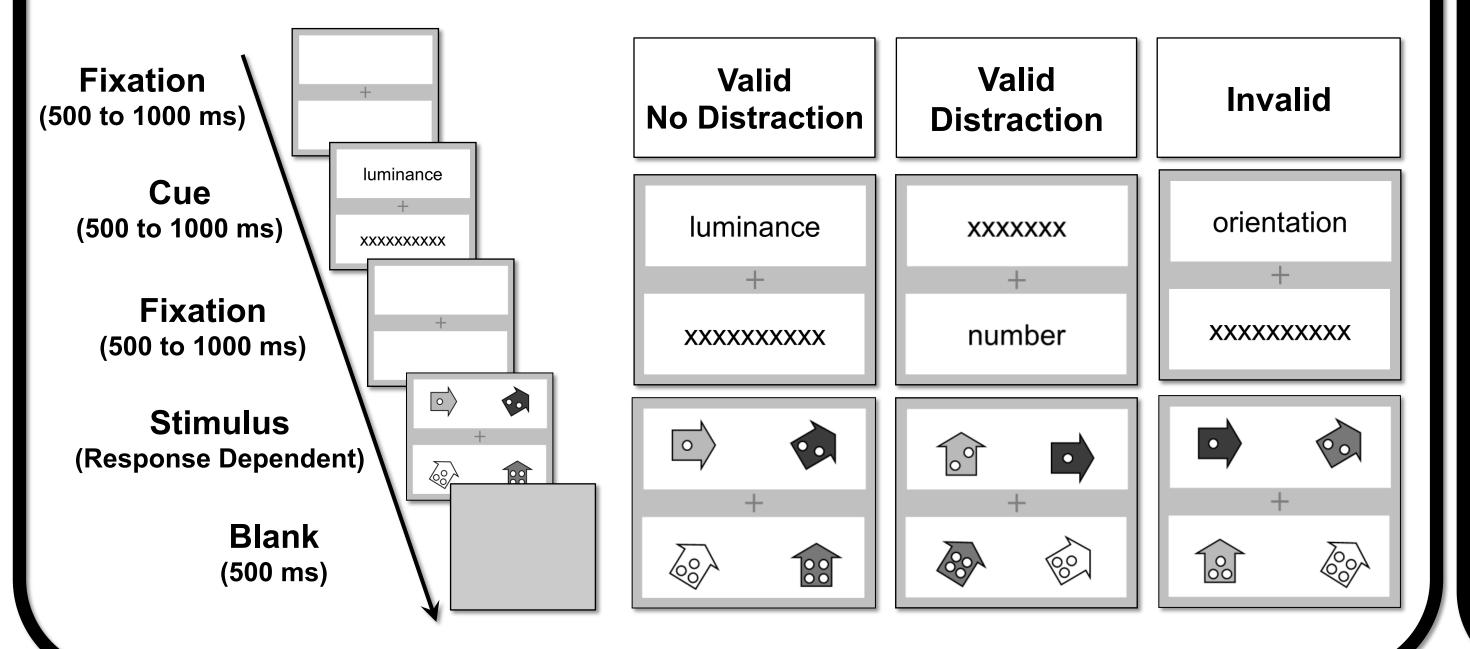
Valid Valid Valid No Valid No **Distraction Distraction** Distraction Distraction



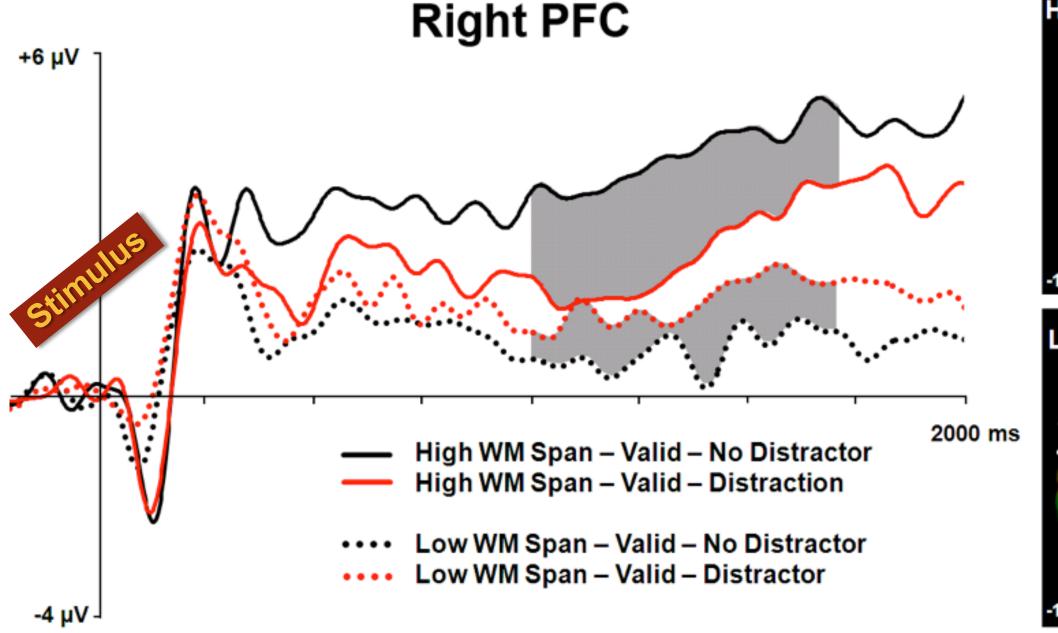
The N2 is an ERP during early visual processing that was modulated by the presence of goal-irrelevant, distracting information. Subtraction of peak amplitudes between conditions (indicated by the gray area) revealed differences in left PFC activation (shown in the topographic map), suggesting that left PFC is important in inhibitory processing.

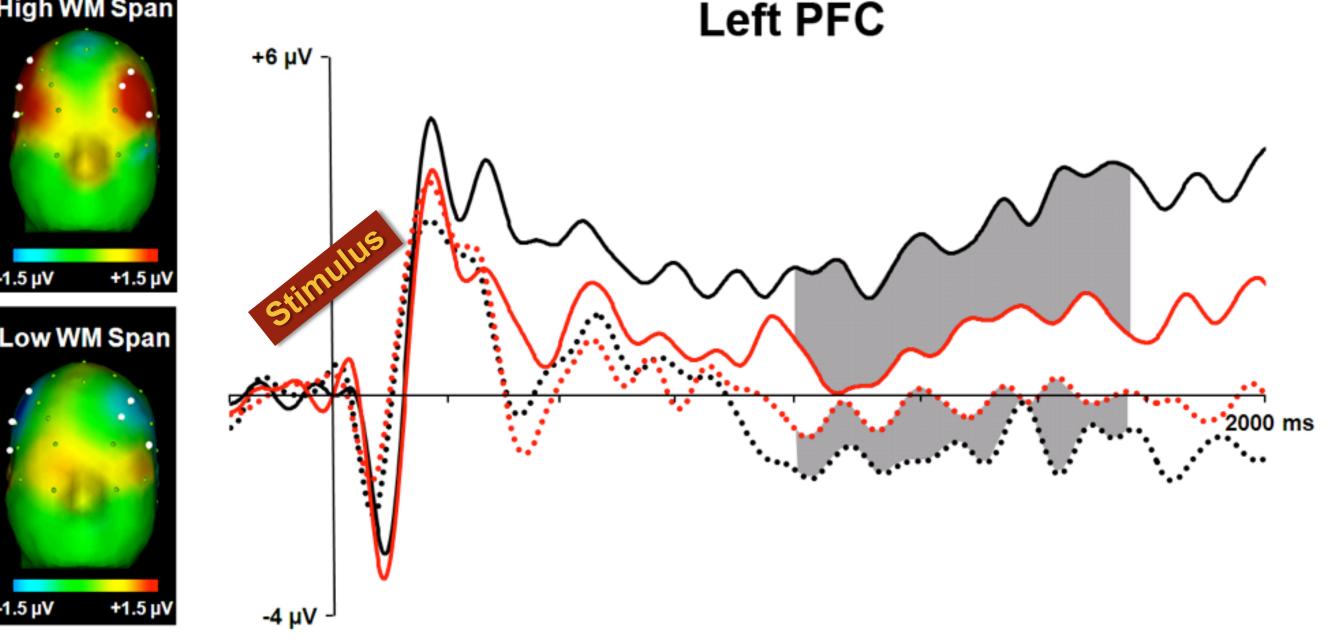
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In previous studies, analogical mapping / relational integration was measured as an ERP by contrasting activation between a simple featural comparison task and an analogical comparison task. Results yielded a late positive complex, shown again here, in rostrolateral PFC. Gray area shows activation collapsed across distraction conditions.



Individual differences in working memory capacity revealed asymmetries underlying neural processing of distracting information during reasoning. ligh WM Spa





High Span individuals showed greater differences in lateral PFC activation (in both the N2 and LPC metrics) between distraction conditions when compared to Low Span individuals, suggesting that inhibitory processing and analogical mapping are cognitive mechanisms that are differentially activated in the presence of distracting information depending on the processing efficiency and working memory capacity of an individual as measured by one's WM span.

•While no behavioral differences were observed across distraction conditions or WM groups, measurements of neural correlates differed.

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•Goal-irrelevant information evoked a greater N2 ERP, an index of inhibitory processing, in left PFC early during analogy processing. •Frontopolar late positive complex ERP, a metric of analogical mapping / relational integration as demonstrated in previous experiments, was shown again in this study. Individual differences in WM span interacted with distraction N2 and LPC ERPs. •Differences in WM capabilities may govern how cognitive processes such as inhibitory control engage during analogical reasoning.

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