When Analogy is Like Priming: The N400 in Verbal Analogical Reasoning

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Introduction

Analogue reasoning fosters human understanding and learning by enabling a reasoner to establish a link between two sources of structured information and use this link to make comparisons and inferences. Previous studies with brain-damaged patients and fMRI studies have emphasized the importance of dynamic filtering (Morrison et al., 2004) or relational integration/analogue mapping (Bunge et al., 2005; Green et al., 2009) as implemented in human prefrontal cortex.

A recent connectionist model of analogy (Leech, Mareschal, & Cooper, 2008) has argued that 4-term verbal analogy problems are better conceived as analogical priming (Spellman, Holyoak, & Morrison, 2001), whereby the relation retrieved from the A:B pair can prime access to the C:D pair. This approach avoids the need for relational integration.

To test whether analogue priming is sufficient to accomplish 4-term verbal analogy problem solving we used the stimuli and methods of Bunge et al. (2005) with continuous EEG recording to evaluate the time course of relational integration.

Methods

We adapted a four term analogy task coupled with a semantic retrieval task based on the methods of Bunge et al., (2005) for use with scalp electroencephalography (EEG).

Participants retrieved the semantic relation for a first pair of words and then either judged the semantic relatedness (semantic condition) or verified an analogy with the first pair of words (analogy condition).

2/3 of trials required were valid semantic judgments or analogy verifications

EEG data were collected using a 32-channel Biossemi Active2 EEG system with 6 additional electrodes to monitor eye movements and mastoid activity for digital re-referencing.

Results

Verbal Analogy

Stimulus-Locked

Response-Locked

Visual Analogy

Stimulus-Locked

Response-Locked

Discussion

In this study we present evidence when participants are required to perform verbal analogy verification (i.e., does this pair of words have the same relation as another pair of words), 4-term verbal analogies may better conceived of as analogical priming rather than analogue mapping.

It is possible that the balance between priming and mapping in verbal analogy may be a function of semantic distance (Green et al., 2010) and these analogies were sufficiently near as to allow for priming.

Future studies will vary semantic distance to test this hypothesis.

References


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