

# Evidence for a Domain-General Cognitive Mechanism in the Construction of Basic Linguistic Meaning

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Fundamentally, language is a vehicle for conveying and constructing complex meanings out of simple pieces. Consequently, characterizing the core mechanisms responsible for this combinatorial process should be a central goal in the cognitive neuroscience of language. However, to date, there has been little research directed at the heart of this problem with past work focused mostly on phenomena such as complex syntactic constructions [1], semantically unexpected expressions [2], and semantic mismatches [3]. Therefore, in the present research, we introduce a novel paradigm investigating the processing evoked by a straightforward, minimal combinatorial context – a simple adjective-noun phrase. We used magnetoencephalography to track brain activity during the comprehension of a noun, both in the presence and absence of a combinable adjective. Previous research suggests that the ventro-medial prefrontal cortex (vmPFC) is involved in semantic composition [3] while the left anterior temporal lobe (LATL) plays a central role in syntactic structure building [4]. If these regions subserved basic linguistic combinatorial processing, we expect to see an increase in their activity during the combinatorial condition.

**Exp. 1:** 20 subjects were asked to judge whether a colored shape matched a preceding verbal description. We used a 2x2 design with Task (Composition, List) and Number of words (One, Two) as factors. Subjects had to determine either if the following shape matched the entire description (Composition) or any part of it (List). Processing of the noun showed significantly more activity in the LATL from 200-300ms and the vmPFC from 300-500ms for the Two-word Composition condition ('red boat') compared to the other conditions ('xhl boat', 'cup boat'). This suggests that the vmPFC and LATL subserved operations active during basic linguistic combination. Furthermore, the temporal ordering of the effects conforms to a broad class of models positing initial syntactic operations prior to semantic composition [5].

**Exp. 2:** The extent to which language processing relies upon domain-general mechanisms has recently been speculation upon [6], though little direct empirical data has yet been uncovered. Recent research has focused on parallels between syntactic and musical parsing, though primarily within incongruous situations [7]. By substituting analogous non-linguistic stimuli for our previous verbal descriptions, we were able to approach this problem more directly. Our task still required conceptual integration of both shape and color from the phrasal replacements and extraction of shape alone from the control condition. Therefore, if increased activity observed during linguistic combination reflects domain-general operations, we expect to see similar increases for this comparison. 19 subjects were shown either a colored shape and asked to determine if the following picture was of the same shape and color or a silhouette on a colored background and asked to judge if the following picture was of the same shape, with color being irrelevant. We found significantly more vmPFC activity during the processing of Colored shapes as compared to Silhouettes, but no LATL effects. This suggests that syntactic processes are comparatively language-specific, while semantic operations reflect a more domain-general conceptual combination mechanism.

## References:

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