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Another look at the constituent structure of sentences in the human brain

Poster A47

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In an influential paper, Pallier and colleagues (2011) used fMRI to examine the sensitivity of the language system to constituent structure. They presented participants with 12-word-long sequences that varied in their internal composition between 12-word-long sentences, sequences of two 6-word-long constituents, sequences of three 4-word-long constituents, sequences of four 3-word-long constituents, sequences of six 2-word-long constituents, and finally, sequences of unconnected words. Every brain region in the fronto-temporal language network was found to respond more strongly to larger constituents. Critically, the inferior frontal and posterior temporal language regions—but not the anterior temporal areas—additionally showed these effects for meaningless "Jabberwocky" materials that consist of a syntactic frame made up of function words and morphological endings but are not interpretable (e.g., "Twas brillig, and the slithy toves did gyre and gimble in the wabe"). The authors therefore argued that this subset of the language network operates "autonomously of other language areas and can extract abstract syntactic frames". The goal of the current study was two-fold. First, in line with growing emphasis in the field on robust and replicable science, we sought to replicate the results reported in Pallier et al. (2011). Second, we tested whether constituency is special by looking for similar effects of chunk length in naturally-occurring contiguous word sequences that do not form constituents (an example string of three 4-word-long non-constituents: "to facilitate production of reach accurate conclusions about shining like bits of"; cf. a string of three 4-word-long constituents: "gave up most unwillingly shone from every window about visiting the well"). Across two fMRI experiments (n=15, and n=25), we replicated the basic result—stronger responses to longer constituents in materials with real words—but we challenge the critical claim that a subset of the language network is sensitive to abstract syntactic structure and not to word meanings. In particular, we find that every language region, including anterior temporal regions,

i) is sensitive to constituent structure in both real and Jabberwocky materials, and ii) exhibits a strong main effect of lexicality, with stronger responses to real-word than Jabberwocky materials. Furthermore, we find similarly robust sensitivity to the size of non-constituent strings, calling into question the privileged role of constituent structure in these effects. Overall, our results support the view of human language where syntactic structure is strongly integrated with word meanings (e.g., Dick et al., 2001; Fedorenko et al., 2020).

Topic Areas: Syntax, Meaning: Combinatorial Semantics

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