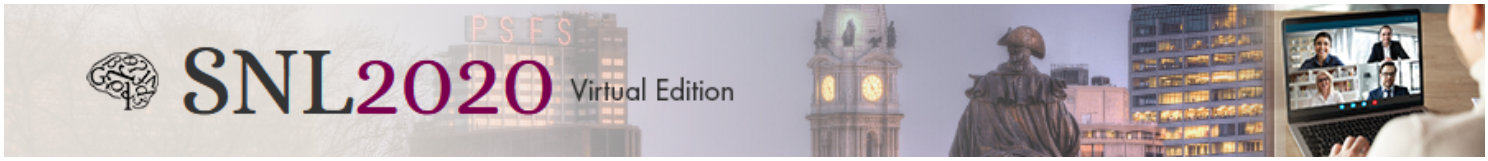

Wednesday, October 21, 3:00 pm EDT Set Timezone

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Linguistic and conceptual processing are dissociated during sentence comprehension

Poster A29

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The human mind stores a vast array of linguistic knowledge, including word meanings, word frequencies and co-occurrence patterns, and syntactic constructions. These different kinds of knowledge have to be efficiently accessed during incremental language comprehension. How dissociable are the memory stores and online processing of these different types of knowledge? And do different representations rely on language-specific capacities, domain-general ones, or both? To address these questions, we used representational similarity analysis (RSA; Kriegeskorte et al., 2008) to relate linguistic knowledge and processing and neural data. We used fMRI data from Pereira et al.'s (2018) experiment 3 (n=6, three 2-hour scanning sessions each). Stimuli consisted of 243 sentences spanning a broad range of content areas. Multi-voxel activation patterns were extracted from regions of interest in three large-scale brain networks spanning the association cortex: a) the language-specific network, and two domain-general networks: b) the multiple demand (MD) network that supports goal-directed behaviors, and c) the default mode network (DMN) that supports internally-directed cognition. Participant-specific representational similarity matrices (RSM) for the 243 sentences were constructed for each network. In addition, the sentences were represented in three feature spaces: (i) word-embedding, GloVe (Pennington et al., 2014), approximating lexical semantics); ii) lexical, using features that affect the difficulty of retrieving words from memory (e.g., frequency, age of acquisition); and (iii) syntactic, using features that affect the difficulty of sentence comprehension (e.g., dependency locality, syntactic surprisal). RSMs based on pairwise sentence similarity were used to predict neural RSMs using generalized additive models; the predictive contribution of each feature space was evaluated on held-out sentences (50%) using ablative bootstrap testing of the mean squared prediction error. Based on preliminary analyses, we found that similarity based on word-embeddings significantly explains neural similarity in all three networks (expected given the distributed decoding results reported in Pereira et al., 2018). However, lexical and syntactic similarity only show significant effects in the language-specific network ($p<0.0001$, ablative permutation testing) and not in the MD network or DMN. Under the

assumption that the word-embedding space encodes abstract conceptual information in addition to lexical semantics, these results support a distinction between conceptual processing and linguistic-form-based (lexical/syntactic) processing during comprehension. This work provides further evidence that the language network differs functionally from other large-scale cortical networks, and that those networks are not sensitive to linguistic processes (e.g., Blank & Fedorenko, 2017; Shain et al., 2020; Diachek et al., 2020). Thus, to the extent that the MD network or the DMN are active during linguistic tasks, this engagement likely reflects task demands or general conceptual processing evoked by linguistic representations. The current analyses were performed on a single, partitioned dataset, and demonstrate that reliable and independent signal can be obtained from the word-embedding, lexical, and syntactic feature spaces in the language network. In ongoing work, we are pre-registering our analyses and validating our models on a new, unseen dataset. Moreover, we aim to investigate the contributions of individual lexical and syntactic features in richer detail, as well as potential differences among the different language regions.

Topic Areas: Meaning: Lexical Semantics, Computational Approaches

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