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Long-range sequential dependencies precede complex syntactic production in language acquisition

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Abstract

To convey meaning, language relies on hierarchically organized, long-range relationships spanning words, phrases, sentences, and discourse. As the distances between elements in language sequences increase, the strength of the long range relationships between those elements decays following a power law. This power-law relationship has been attributed variously to long-range sequential organization present in language syntax, semantics, and discourse structure. However, non-linguistic behaviors in numerous phylogenetically distant species, ranging from humpback whale song to fruit fly motility, demonstrate similar long-range statistical dependencies. Therefore, we hypothesized that long-range statistical dependencies in speech may occur independently of linguistic structure. To test this hypothesis, we measured long-range dependencies in speech corpora from children (aged 6 months – 12 years). We find that adult-like power-law statistical dependencies are present in human vocalizations prior to the production of complex linguistic structure. These linguistic structures cannot, therefore, be the sole cause of long-range statistical dependencies in language.