Benjamin Wilson

Nonadjacent Dependency Learning in Humans and Monkeys

Abstract:
Learning and processing natural language requires the ability to track syntactic relationships between words and phrases, often separated by intervening material in a sentence. Sequence processing tasks (including artificial grammar learning paradigms and statistical learning experiments) can be designed to emulate similar phonotactic and syntactic dependencies, including between adjacent or more distantly separated stimuli. Importantly, the non-linguistic nature of these approaches makes them ideally suited to study pre-verbal infants (e.g., Saffran et al., 1996) or nonhuman primates (e.g., Fitch and Hauser, 2004). Cross-species comparative approaches can provide insights into the evolution of these language-relevant abilities, identifying domain-general cognitive processes and neural systems that might be broadly evolutionarily conserved, and those which might have specialised in humans.

Nonhuman primates are able to implicitly detect dependencies between adjacent elements in sequences of auditory or visual stimuli. Moreover, these processes appear to be supported by homologous brain areas in humans and monkeys, suggesting a common evolutionary origin (reviewed in Wilson et al., 2017). However, in language, syntactic relationships exist not only between adjacent words, but also across longer distances, requiring the processing of more complex nonadjacent dependencies.

Evidence from a number of sources suggests that monkeys and humans are also able to detect nonadjacent dependencies between certain types of stimuli (e.g., Newport et al., 2004). However, there appear to be constraints on the circumstances in which the learning of nonadjacent dependencies occurs (Wilson et al., 2018), as I will discuss. I will show data from comparative experiments demonstrating that monkeys, but also many humans, fail to detect nonadjacent dependencies when informative adjacent dependencies are also available (Wilson et al., 2015; Milne et al., 2018). Finally, I will present new data, directly comparing the learning of adjacent and nonadjacent dependencies in adult humans and macaque monkeys. The results demonstrate important similarities but also intriguing differences across the species, shedding light on the evolutionary origins of the ability of these abilities. These experiments pave the way for comparative neuroimaging studies, which will clarify the brain networks which support the learning and processing of different types of dependencies in humans and monkeys. This comparative approach can provide valuable insights into the evolution of the language system, identifying both evolutionarily conserved, domain-general cognitive and neural systems and those which may have specialised in humans for language.
References:


