The Learning of Adjacent and Nonadjacent Dependencies in Visuo-Spatial and Visuo-Verbal Sequencing Tasks

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Introduction

Structured sequence processing (SSP) refers to the neurocognitive mechanisms used to learn the sequential structure of events that unfold over time. The underlying structure can include both adjacent dependencies (an item predicts the immediately following item) and nonadjacent dependencies (an item predicts another item at a distance). Non-adjacent dependencies appear more difficult to learn (Lany & Gomez, 2008) but can be learned with adjacent dependencies in visuo-verbal stimuli, given enough training (Vuong, Meyer, and Christiansen, 2016). Recent research suggests that learning these two dependencies taps different neurocognitive mechanisms (Daltrozzo & Conway, 2014). Here, we tested whether adults could learn adjacent and non-adjacent dependencies simultaneously during visuo-spatial and visuo-verbal SSP tasks and whether learning would differ for the two dependency types.

Method

Adults (N=58) completed both visuo-spatial and visuo-verbal computerized SSP tasks where they were asked to reproduce items presented in a sequence. Sequences followed an underlying structure consisting of adjacent and non-adjacent dependencies. Half the test sequences followed the structure (grammatical); the other half did not (ungrammatical). Learning is expected to result in a facilitation for grammatical sequences only.

Results

A 2(task) x 2(grammaticality) x 2(adjacency) repeated measures ANOVA revealed a significant main effect of grammaticality, F(1, 60)= 114.95, p < .001, and a significant interaction between grammaticality and adjacency, F(1,60)= 12.057, p=.001. Overall, participants performed better on grammatical than ungrammatical sequences. However, in ungrammatical sequences, performance was lower for adjacent dependency violations compared to nonadjacent dependency violations.

Conclusions
Results suggest it is possible to learn both adjacent and nonadjacent dependencies simultaneously. The larger reduction in accuracy for adjacent ungrammatical sequences suggests a higher level of learning for this type of pattern. This is similar to previous research suggesting that nonadjacent dependencies are more difficult to learn and may furthermore suggest separate processing mechanisms for the learning of two types of structures. Specifically, it is likely that the learning of non-adjacent dependencies is more cognitively effortful, requiring executive attention and/or working memory. Current research is testing whether these different structural dependencies are mediated by distinct neural subsystems.

KEYWORDS:

1. Structured Sequence Processing (SSP)
2. Adjacent dependencies
3. Pattern learning
4. Grammar