Neurocognitive Mechanisms of Sequential Learning and Language: An ERP Study

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Introduction

Although language acquisition and processing is typically associated with the development of language-specific mechanisms, like syntactic and semantic processing, the role of domain-general mechanisms in language learning is being increasingly recognized. Sequential learning is the implicit ability to acquire and process patterns of information from the environment over time (Cleeremans et al., 1998; Conway et al., 2010) and may allow the learner to discover the structure inherit in language such as morphology and syntax (Ullman, 2004). However, there is little direct neural evidence for this claim. The purpose of this study, therefore, was to investigate the relation between sequential learning and natural language processing by comparing the underlying neural mechanisms elicited for each.

Method

In the present study, healthy adult participants completed both a visual (non-linguistic) sequential learning task and a written language (comprehension) task. Both were designed to cause violations in expectations of items occurring in a series (e.g., either a violation of grammar in the language task or a violation of the learned sequence in the sequential learning task). Event-related potentials (ERPs) were used to record and examine the underlying neurophysiological responses associated with these expectancy violations.

Results

For the visual sequential learning task, we observed a P3a-like component at ~300ms, which was frontally distributed and more positive for the violation condition versus the grammatical condition. For the language task, we observed a P600 component at ~550ms, which was widely distributed and more positive for the violation condition versus the grammatical condition. Furthermore, the correlation between the visual sequential P3a and the language-related P600 approached significance [$r(32) = .291$, $p = .106$] in the right anterior region.

Conclusion/Discussion

These findings could suggest that the neural mechanisms supporting language are co-extensive with mechanisms of sequential learning. If so, this could have implications for understanding and treating language and communication disorders.

KEYWORDS:

1. Language
2. Sequential Learning
3. ERP (Event Related Potential)
4. P3a
5. P600
6. Syntax