ABSTRACT

Exploring the Relationship between Sequence Learning, Motor Coordination, and Language Development

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Dual-route approaches to language acquisition posit separable mechanisms for acquisition of vocabulary and grammar. In contrast to the dual-route framework, single-route approaches to language development view vocabulary and grammar learning as intrinsically interconnected, as supported by very high correlations between measures of vocabulary diversity and grammatical complexity (e.g., mean utterance length) at all stages of development. Hence, according to single-route models, procedural learning should apply equally to the acquisition of words (vocabulary) and rules (grammar). Working within the dualistic framework, Ullman and Pierpont (2005) proposed the procedural deficit hypothesis, which proposes that impairments in rule-based aspects of language (e.g. grammar, phonology) in addition to motor difficulties observed in children with Specific Language Impairment (SLI) stem from an underlying impairment in the procedural memory system, with compensatory processing via the declarative memory system. In support of this hypothesis, recent reviews and meta-analyses indicate significant deficits in motor control (Diamond, 2000; Hill, 2001) and sequence learning (Lum et al., 2014) in children with SLI relative to controls. Further research has found deficits in nonword repetition among children who are language impaired. Nonword repetition has also been associated with children's vocabulary development (Gathercole & Baddeley, 1990) suggesting that while nonword repetition is hypothesized to be procedural in nature, it is highly associated with children's word learning, which is thought to be learned declaratively.

To examine the role of sequence learning and motor coordination (fine motor coordination in particular) in language development, we administered a battery of language and cognitive assessments to a diverse community sample of 63 children (33 girls, 30 boys), mean age 8 years; 2 months (SD 1;3). We used a commonly used measure of sequence learning in addition to the pegboard task to examine motor coordination and the nonword repetition task to assess phonological abilities. Results showed that using the traditional measures of sequence learning, we were unable to find a relationship with any measure of language. However, measures of motor coordination (as measured using the pegboard task) were related to individual differences in all aspects of language, including vocabulary, grammar, and phonology. In attempts to replicate these findings, we found associations between motor coordination (measured using accuracy on Block 1 of the SRT task) and measures of vocabulary and grammar. Post-hoc analyses also showed that nonverbal intelligence is associated with performance on the pegboard task. These results implicate fine-motor coordination as a factor contributing to variance in language and cognitive abilities, but fail to support the view that word-based (vocabulary) and rule-based (grammar and phonology) aspects of language are acquired via separable mechanisms. Our findings are in line with theories that argue for language development as a single route of learning.