The impact of lexical competition and response inhibition control on performance on a sentence span task in children SLI

Elina Mainela-Arnold1, Julia L. Evans2, & Jeffry A. Coady3
1Pennsylvania State University. 2San Diego State University. 3Boston University

Abstract
Many investigations have suggested that the underlying impairment in specific language impairment (SLI) might be limited verbal working memory capacity (e.g., Ellis-Van Creveld et al., 1999; Leonard et al., 2007). Recently, children with SLI have been reported to exhibit poor suppression or greater activation of competitors in tasks that are apparently low in working memory demands. In the current study, we investigated the hypothesis that children with SLI perform in working memory tasks can be explained by vulnerability to lexical competition and/or response inhibition control. 16 children with SLI and 16 CA peers (ages 8;5-12;3) participated. Three measures were collected: (1) Sentence Span, words recalled in a working memory task, (2) Competition, the number of non-target competitor words produced in gating tasks, and (3) Response Control, ability to delay word repetition response until a signal. For the SLI group, a significant association between Sentence Span and the ability to inhibit potential responses (Response Control) was found. This suggests that working memory deficits in children with SLI may not be strong enough to inhibit irrelevant competitors, i.e., that lexical representations of children with SLI may resemble those of newly learned words in the lexicons of typically developing children. It is also possible that children with SLI experience weaker top-down PFC control. Results suggest that what has been referred to as working memory developments in connectionist modeling and neuroscience might be more appropriate for a new working memory framework in SLI.

Tasks and Variables
All children completed three different experimental tasks for which the target word stimuli were the same 48 words. The following three measures were collected corresponding to the three tasks:

(1) Sentence Span, the number of words recalled in a sentence span task. (2) Children listened to lists of true and false sentences. After a list of sentences, children recalled the target last words of each sentence. The lists included an increasing number of sentences per list, thus this task included an increasing working memory component.

(2) Competition, the mean number of non-target competitor words produced in a gating task. Children heard segments of words, differing in duration (10 gates, 120ms – 600ms duration) and guessed after each gate, what the word might be. Competition measure gave us an insight to susceptibility lexical competition in a situation that is low in working memory demands.

(3) Response Control, the number of times the child correctly waited before responding when presented with a delayed response signal. Children were asked to repeat a word after waiting for a response signal that was either presented with a short delay (300ms) or long delay (1000ms). Correct responses in the long delay condition were calculated. Response Control measure gave us a measure of top-down control corresponding to task instructions in a situation that is otherwise low in working memory demands.

Finding

Children with SLI produced significantly more competitor words in the gating task, (t(39) = 3.240, p < .05) and had significantly difficulty inhibiting their responses until the response signal when compared to the CA peers, (t(23.26) = 2.60, p < .05, unequal variances assumed).

Do children with SLI differ from their peers in their ability (1) to inhibit lexical competitors and (2) to control their responses according to simple task directions?

CA group is inhibition of lexical competitors and response control associated with performance in working memory tasks in children with SLI?

Partial correlations for the SLI group revealed a significant correlation between Sentence Span and Response Control with Competition controlled for, r = .56, p < .05.

Summary
Children with SLI exhibited significant difficulty inhibiting lexical competitors and top-down response control. Response Control was significantly associated with working memory performance and the association between lexical competition and working memory performance in children with SLI. These associations were not found in typically developing children. Now we will turn to the discussion of these results.

Discussion
The results indicate that word recall performance in verbal working memory task in children with SLI is significantly influenced by the ability to inhibit potential responses. The working memory deficit children with SLI exhibit, can be at least in part, explained by (1) lower top-down response inhibition control, (2) lexical states that are not strong enough to inhibit or overcome irrelevant competing processes, and (3) the interaction between the two. Future research should investigate how these inhibition processes change as a function of increasing skill levels in both in typically developing children and children with SLI.