Re-examining the role of cognitive control in children’s sentence processing

Youngeon Choi¹, Hyeonju Son¹, Hwain Lee & John C. Trueswell²
¹Chung-Ang University, ²University of Pennsylvania, Philadelphia
contact: yochoi@cau.ac.kr

The cognitive control account of child sentence processing proposes that preschoolers’ difficulty recovering from garden paths may derive from underdeveloped inhibition skills (i.e., immature prefrontal cortex, associated with executive functions [1]). This has received partial support in that both Korean and English-learning 3-5-year-olds show a tendency to rely on early-arising information within a sentence (morphosyntax in Korean; verb information in English) and have difficulty overriding their initial sentence interpretation when later information required revision [2]. However, no direct relation between inhibition measures and children’s parsing abilities has been observed to date. For instance, no correlation was observed between children’s Snow-Grass task performance (a measure of preschooler’s inhibition [3]) and sentence interpretation errors [4]. This was unexpected since adult studies support such a relationship (e.g., with Stroop task, [5]). Prior child studies, however, were limited due to the small number and restricted age range of participants and limited inhibition measures (a single measure in [4]). Here we re-examine the relationship between cognitive control and parsing by testing a wider age range (3-6 years) and taking multiple cognitive control related measures.

Fifty-six Korean-speaking children (37-79 months) acted out temporarily ambiguous sentences such as “napkin-on tomato-accc pick up (‘Pick up the tomato on the napkin’),” where napkin-on could be interpreted initially as a Destination for a verb or a Modifier for a noun. The sentence was pronounced either with Destination-Prosody (major break between first and second phrase), or Modifier-Prosody (no break between first and second phrase). Unambiguous sentences were used as controls (see Examples). Like prior studies, children were more likely to make interpretation errors (e.g., taking ‘napkin’ as a destination) when the sentences were ambiguous, with the effect being largest in younger children. To measure inhibition, multiple tasks were administered: a Stroop task (Red/Blue dog: naming the dog not the color of the dog), a Dimensional Change Card Sorting (DCCS) task, and a Go-Stop task. Additionally, children’s working memory span (Visually Cued Recall (VCR) task) was obtained. We also asked parents to report on their child’s behavior regulation (e.g., the child can speak quietly when asked).

Among these measures, sentence interpretation accuracy in Modifier-Prosody condition showed a positive correlation with DCCS-inhibition score (higher score means better inhibition) ($r = .36$) and a negative one ($r = -.37$) with DCCS-perseveration score (higher score means more perseveration), suggesting that cognitive flexibility is associated with parsing accuracy. Also, interpretation error rates (i.e., destination-responses) in Destination-Prosody condition showed a negative correlation with parents’ observation on their child’s ability to regulate behaviors ($r = -.36$), suggesting that children who were better able to regulate their behaviors were less likely to make interpretation errors. However, other inhibitive measures (Stroop & Go-Stop task) and working memory (VCR) didn’t correlate with sentence measures, although inhibitive and working memory measures showed high correlations amongst them.

Taken together, these results uncover specific relations between cognitive control and developing sentence processing abilities. Past failures to find such connections may reflect the differing sensitivity of these tasks to measure cognitive control in children.
Example Sentences used in the Sentence Act-out Task:

1) Destination-Prosody condition (4 sentences total):
   \[ napkin-ey //\text{tomato-rul cipuseyo} \] (major break between 1\textsuperscript{st} and 2\textsuperscript{nd} phrase)
   napkin-on tomato-ACC pickup “Pick up the tomato on the napkin.”

2) Modifier-Prosody condition (4 sentences total):
   \[ napkin-ey\text{tomato-rul} //\text{cipuseyo} \] (no break between 1\textsuperscript{st} and 2\textsuperscript{nd} phrase)
   “Pick up the tomato on the napkin.”

3) Unambiguous control (4 sentences total):
   napkin-ey iss-nun tomato-rul cipuseyo
   napkin-on is-that tomato-ACC pickup
   “Pick up the tomato on the napkin.”

References


