Experience-dependent predictive processes in learning novel verb bias: An ERP study
Zhenghan Qi & Susan Garnsey (University of Illinois, Urbana-Champaign)
zqi2@illinois.edu
Verb bias; Syntactic learning; Event Related Potentials (ERPs); English

Frequency-based accessibility of structural alternatives for particular verbs, also known as verb bias, plays an important role in comprehenders’ predictions about upcoming sentence structure [1, 2]. The current study investigated electrophysiological dynamics underlying learning new verb biases by asking two questions: 1) Do readers use newly learned verb biases to predict upcoming words in sentences?, and 2) How does ambiguity resolution contribute to learning?

Twenty-four participants completed four training blocks and were then tested in a forced-choice picture-matching task. EEG was recorded while participants read training sentences containing novel verbs. Training sentences provided strong context promoting either modifier or instrument attachment of a prepositional phrase, as in (1) and (2). In instrument-training sentences (1), tractor is clearly an instrument for an unknown action dakking, while in modifier-training sentences (2), stalks is clearly a property of the corn. For each participant, two novel verbs were trained in ambiguous sentences containing with-phrases, while another two verbs were trained in sentences disambiguated by substituting using or that has in place of with. Each novel verb was presented in only one of the four training structures. Pictures of the direct object (corn) and the potential instrument (tractor) were presented before each trial, to allow specific predictions about upcoming words. The instrument noun (e.g., tractor) appeared in all sentences, but in later non-critical positions in modifier-training sentences. We predicted that instrument training would lead to a highly predicted PP-object noun, while modifier training would not generate such specific expectations. At the behavioral test afterwards, each participant read 24 sentences containing the 4 trained verbs and another 2 untrained verbs in globally ambiguous sentences including with-phrases, such as (3). The task was to choose which of 2 pictures was more consistent with the ambiguous sentence.

Behavioral data suggested participants tended to learn instrument bias only from structurally ambiguous sentences using with-phrases. This effect were mainly carried by right-handers without left-handed relatives (n=13), who made reliably more instrument attachment choices for instrument-trained than modifier-trained verbs and untrained control verbs. No such difference was observed for verbs trained in unambiguous structures. The higher learning efficacy of ambiguous training was also reflected in reduced P600 amplitude across training blocks for ambiguous-trained novel verbs only. At the disambiguating noun, mean N400 amplitude elicited by instrument nouns (e.g., tractor) was reduced compared to modifier nouns (e.g., stalks) during the first training block, suggesting confirmation of readers’ semantic predictions about an upcoming instrument. Starting from the second training block, the effect changed to a reduced P600 elicited by instrument nouns compared to modifier nouns. The N400-to-P600 transition was observed mainly in ambiguous conditions containing with-phrases, suggesting that resolving ambiguity might be crucial for verb bias learning.

The results suggest experience-dependent plasticity in the language system, which continuously collects statistical patterns from linguistic input, particularly when input is ambiguous. Participants quickly apply newly-learned distributional information to guide predictions about upcoming sentence structure. Future analyses will further address effects of individual differences in familial sinistrality on verb bias learning.

Sentence Examples
(1) Instrument Ambig. / Unambig.: The suntanned farmer dakked the corn with / using the big tractor…
(2) Modifier Ambig. / Unambig.: The suntanned farmer dakked the corn with / that has the high stalks…
(3) Globally Ambiguous test sentence: The angry teacher dakked the student with the low score.

References
1. MacDonald, MC, Pearlmutter, NJ, & Seidenberg, MS 1994
2. Garnsey, S, Pearlmutter, N, Myers, E, & Lotocky, M 1997