## **Statistical Preemption**

Preemption is one of two hypotheses (the other being entrenchment, described below) that claim that children learn grammatical constraints via pragmatic inference from observed distributional patterns of word use in adult speech. Grammatical constraints are restrictions on productive morphological and syntactic patterns—for instance, knowledge that *mouse* cannot participate in the *-s* pattern of plural inflection (*\*mouses*), or that adjectives like *asleep* disprefer being used before the nouns they modify (e.g., *\*the asleep duck...*; cf. *the duck that's asleep...*). Adults obey constraints of this sort, whereas children go through a stage in which they do not. An explanation of how grammatical constraints are acquired is thus a necessary component of any complete theory of child language development.

Both preemption and entrenchment posit that children notice consistent gaps in adult usage, and are able to infer from these gaps that unattested word uses are disallowed. For example, when children observe that adults never inflect the verb *go* for the past tense using *-ed*, they settle on a very practical explanation: English must not allow *go* to participate in the *-ed* pattern (\**goed*). This type of inference is common in non-linguistic cognition: for example, it underlies the conclusion that a drug does not cause certain side effects if those effects are never attested in clinical trials.

The two hypotheses differ in that they highlight different characteristics of the input. Entrenchment emphasizes *frequency effects*—that exposure to more data leads to stronger constraints. For example, a child who has observed thousands of uses of word W—none of which are in pattern P—is in a stronger position to infer that the gap is due to a grammatical constraint and not some sampling accident than a child who has only witnessed W used a few dozen times. In contrast, preemption emphasizes *informativeness effects*—that exposure to some data types is more informative regarding the presence of grammatical constraints than others. Here the idea is that children can be more sure that a constraint against the use of W in P exists if they consistently fail to observe W used in P in discourse contexts in which P is otherwise highly expected. For example, failing to witness go inflected with -ed when adults are talking about past events constitutes an especially powerful cue that English does not allow go to occur with -ed, since this is exactly the context in which the *-ed* pattern normally appears. A related way of thinking about constraint learning in this situation is that adults' consistent use of *went* eventually blocks child productions like goed. Rather than accept two forms that appear to be synonymous, children infer that the attested form (went) is conventional, while the unattested form (goed) is not allowed.

Informativeness and frequency effects are not mutually exclusive, so it should be possible to demonstrate independent contributions of preemption and entrenchment to grammatical constraint learning. In practice however, this has been difficult to prove. For instance, research on the acquisition of constraints against the transitive use of intransitive-only verbs like *laugh* has shown that, by age three, children are less likely to produce transitive overgeneralizations (e.g., *\*The joke laughed me*) for high versus low frequency verbs (e.g., *laugh* vs. *giggle*). And by age five they judge transitive overgeneralizations with high frequency verbs to be less acceptable than the same overgeneralizations with low frequency verbs (see Figure 1). While these results and others like them show that children are responding to the amount of data, it is not clear

whether they might also be sensitive to the informativeness of the data. Are frequency effects magnified in the presence of highly informative data? Is constraint learning even possible from less informative data?

These questions have been addressed across several novel verb learning studies that allow for independent manipulations of frequency and informativeness. Learners in these studies view causative events (e.g., animals bouncing objects), hear an experimenter describe the events using a novel verb (e.g., *yad*), and are given opportunities to describe the events themselves. The number of uses of the verb in the input is held constant across two groups (a *more informative* and a *less informative* group), but only the more informative group witnesses the verb in the periphrastic causative construction (e.g., *The hamster made the ball yad*), which is a much less common way of talking about causation in English. Preemption hypothesizes that periphrastic causative uses should be especially informative regarding the presence of a constraint against transitive use, since they indicate that the experimenter is conceptualizing the event as being causative, yet is nonetheless consistently avoiding the expected transitive formulation. In agreement with preemption, the results show stronger constraint learning from more informative input: adults and six and seven-year-olds were more likely to avoid using the verb transitively in the more informative group.

A variant of this method also established that constraint learning is possible given exposure only to less informative data (see Figure 2). A control group viewed the same events as the more and less informative groups, but was given no exposure to the novel verb, and was instead asked to describe the events using the English verb *bounce*. This established a baseline preference for transitive descriptions that performance in the less informative group was compared to. Adult learners showed significant transitive avoidance relative to control, which suggests that grammatical constraint learning occurs even in the presence of less informative input.

Jeremy K. Boyd University of California, San Diego

See Also: Argument structure (acquisition of); Distributional knowledge and language learning; Language learning from overheard speech; Over-generalization of grammatical constructions; Over-generalization in morphological development; Recasts, clarifications, and other indirect negative evidence; Statistical learning in infancy.

## Further Readings

Ambridge, Ben, et al. "Avoiding Dative Overgeneralisation Errors: Semantics, Statistics, or Both?" *Language and Cognitive Processes* (in press).

Boyd, Jeremy, et al. "Adult Learners Use Both Entrenchment and Preemption to Infer Grammatical Constraints." 2012 IEEE International Conference on Development and Learning and Epigenetic Robots. Red Hook, NY: Curran Associates, 2012.

- Boyd, Jeremy and Adele Goldberg. "Learning What *Not* to Say: The Role of Statistical Preemption and Categorization in *A*-adjective Production." *Language*, v.87/1 (2011).
- Brooks, Patricia and Michael Tomasello. "How Children Constrain their Argument Structure Constructions." *Language*, 75/4 (1999).
- Hahn, Ulrike and Mike Oaksford. "Inference from Absence in Language and Thought." *The Probabilistic Mind: Prospects for Bayesian Cognitive Science*. Oxford: Oxford University Press, 2008.
- Goldberg, Adele. Constructions at Work: The Nature of Generalization in Language. Oxford: Oxford University Press, 2006.

## FIGURES



Figure 1. Frequency effects in grammatical constraint learning, as predicted by entrenchment. Each point represents an English intransitive-only verb (e.g., *giggle* and *laugh*, labeled above). As a verb's frequency in the input goes up, children are less and less likely to accept unattested transitive uses (e.g., *The joke laughed me* receives lower ratings than *The joke giggled me*).



Figure 2. Informativeness effects in grammatical constraint learning, as predicted by preemption. Learners are less likely to produce unattested transitive uses involving novel intransitive-only verbs (e.g., *yad*) when their input includes more informative rather than less informative uses (i.e., periphrastic causatives uses like *The hamster made the ball yad*). Less informative input can drive constraint learning though, as evidenced by a decrement in transitive productions relative to control.