



## Original Articles

## Linguistic generalization on the basis of function and constraints on the basis of statistical preemption

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## ABSTRACT

How do people learn to use language in creative but constrained ways? Experiment 1 investigates linguistic creativity by exposing adult participants to two novel word order constructions that differ in terms of their semantics: One construction exclusively describes actions that have a strong effect; the other construction describes actions with a weaker but otherwise similar effect. One group of participants witnessed novel verbs only appearing in one construction or the other, while another group witnessed a minority of verbs alternating between constructions. Subsequent production and judgment results demonstrate that participants in both conditions extended and accepted verbs in whichever construction best described the intended message. Unlike related previous work, this finding is not naturally attributable to prior knowledge of the likely division of labor between verbs and constructions or to a difference in cue validity. In order to investigate how speakers learn to constrain generalizations, Experiment 2 includes one verb (out of 6) that was witnessed in a single construction to describe both strong and weak effects, essentially statistically preempting the use of the other construction. In this case, participants were much more lexically conservative with this verb and other verbs, while they nonetheless displayed an appreciation of the distinct semantics of the constructions with new novel verbs. Results indicate that the need to better express an intended message encourages generalization, while statistical preemption constrains generalization by providing evidence that verbs are restricted in their distribution.

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## 1. Introduction

Learners sometimes generalize beyond their input and produce verbs in novel ways. For example, by the time children are in preschool, they readily extend nonsense verbs that have only been witnessed intransitively (*It meeked*) for use in the transitive construction (*She meeked it*) (e.g., Akhtar, 1999; Tomasello, 2000), and their comprehension of familiar and novel verbs used in constructions that are new for those verbs begins even earlier (e.g., Fisher, 2002; Gertner, Fisher, & Eisengart, 2006; Naigles, 2000).

And yet while speakers produce and comprehend language that goes beyond their input, there are certain generalizations that are only rarely made, and are judged to be less than fully acceptable, even though they are easily understood (Bowerman, 1988; Goldberg, 1995; Pinker, 1989). This type of *overgeneralization* is illustrated by the examples in (1)–(3):

- (1) ?? The child seems sleeping (Chomsky, 1957)
- (2) ?? Don't giggle me (Bowerman, 2000)
- (3) ?? an asleep boy (Boyd & Goldberg, 2011)

When and why do speakers generalize beyond their input? And when and why do they not? These questions have long puzzled researchers (Ambridge, Pine, Rowland, & Chang, 2012; Baker, 1970; Bowerman, 1988; Braine, 1990; Goldberg, 1995; Lakoff, 1970; Perék, 2015; Pinker, 1989), and artificial language learning experiments have been found useful in addressing them (e.g., Braine et al., 1990; Brooks et al., 1993; Amato & MacDonald, 2010; Culbertson, Smolensky, & Legendre, 2012; Fedzechkina, Jaeger, & Newport, 2012; Gómez & Gerken, 2000; Moeser & Bregman, 1972; Valian & Coulson, 1988). A typical paradigm involves exposing learners to a miniature language which includes a set of novel word order patterns that are paired with familiar transitive or intransitive interpretations. Another paradigm involves exposing learners to novel constructions that pair novel word order patterns with novel abstract meanings (Casenhiser & Goldberg, 2005); speakers need to learn constructions in order to produce and comprehend real natural languages; i.e., they need

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knowledge of how words can be combined formally *and* the particular range of interpretations that each type of combination evokes (Goldberg, 2006; Tomasello, 2003).

One factor that plays a role in determining whether speakers are willing to generalize the way a verb is used is whether other verbs have already been witnessed being generalized. For example, Wonnacott, Newport, and Tanenhaus (2008) exposed adult participants to an artificial language that included two synonymous transitive constructions. Results demonstrated that participants are sensitive to the overall statistics of an artificial language when determining whether predicates can be extended in new ways. In particular, participants tended to behave conservatively when exposed to a language in which all 12 verbs appeared in only one of two constructions, i.e., they avoided extending verbs for use in the other construction (see also Perek & Goldberg, 2015, Exp. 2; Thothathiri & Rattinger, 2016, Exp.1). However, when exposed to a language in which some of the verbs were witnessed in both constructions, they showed some degree of generalization, using verbs freely in either construction. Wonnacott (2011) is a similar study that replicated the basic findings with children.

Note that when distinct formal patterns are assigned the exact same function, using a verb in one construction conveys exactly the same message as using a verb in the other construction. But in natural languages, it is hard to find verbs that occur in two constructions that serve exactly the same function; instead the choice between two constructions is typically conditioned by differences in information structure or semantics (e.g., Bolinger, 1968; Bresnan, 2011; Goldberg, 1995; Scott-Phillips, Kirby, & Ritchie, 2009). With this in mind, Perek and Goldberg (2015, Exp. 1) aimed to investigate whether communicative pressures would encourage learners to generalize the constructions for use with verbs that had not been witnessed in those constructions during exposure. Adult participants were exposed to six nonce verbs that were used in two constructions that differed in terms of information structure properties as well as word order. In particular, one construction always contained a pronominal patient argument (Pronoun<sub>Patient</sub> NP<sub>Agent</sub> V), while the other occurred exclusively with lexical noun phrase arguments in a distinct order (NP<sub>Agent</sub> NP<sub>Patient</sub> V). Results demonstrated that learners used verbs in ways that went beyond the verb-specific regularities in the input in order to take advantage of the information structure properties of the newly learned constructions. More specifically, when even a minority of the verbs in the input alternated, participants freely used all of the verbs in whichever construction was more appropriate in the given discourse context, ignoring the fact that most of the verbs had been witnessed only in one construction or the other. Even in a fully lexicalist condition, in which each of the six verbs in the input appeared only in one construction or the other, participants still showed a tendency to generalize beyond their input, although they were also lexically conservative to a lesser extent.

Similarly, Thothathiri and Rattinger (2016, Exp. 2) exposed adult participants to a mini-artificial language in order to determine whether learners tended to generalize on the basis of verb-specific information or on the basis of the functions of the constructions. One construction had Verb-Agent-Patient order and included an additional, final nominal that was interpreted as an instrument, and the other construction had Verb-Patient-Agent order and included a final nominal that was interpreted as a modifier (something the patient was holding). Ten out of 12 verbs consistently appeared in one or the other construction, while two verbs alternated between the two constructions. As found in Perek and Goldberg (2015), speakers demonstrated a strong tendency to generalize on the basis of the functions of the constructions, using verbs in whichever construction better captured the intended message.

The striking tendency in these studies for participants to generalize beyond the verb-specific input when the constructions' functions were distinct is, however, subject to a potentially potent criticism. The tendency to ignore verb-specific distribution may have resulted from prior knowledge about the sorts of information that individual verbs normally convey. The constructions used by Perek and Goldberg (2015) differed in terms of information structure, and adult participants can be expected to be aware that individual verbs are not generally associated with differences in information structure. In particular, whether a pronoun or a lexical noun phrase is appropriate in a given context is not something that usually depends on individual verbs. Relatedly, the two constructions used by Thothathiri and Rattinger (2016) differed in terms of what are normally considered adjuncts, i.e., constituents that are not dependent on, or conditioned by, particular verbs. Therefore, in both cases, the remarkable tendency to generalize beyond verb-specific information in the input could have resulted from adults' understanding that the difference between the two constructions was not likely conditioned by individual verbs.

Additionally, previous experiments offered distinct interpretations of *why* participants are likely to generalize beyond their input when two constructions are assigned distinct functions. As described above, while Perek and Goldberg (2015) suggested that participants' productive use of verbs in an unwitnessed construction results from the communicative pressure to express an intended message with whichever construction is better suited, Thothathiri and Rattinger (2016) interpreted their parallel findings in terms of an advantage of *cue validity* of verbs vs. scenes in predicting which construction was expressed during exposure (Bates & MacWhinney, 1989; Chan, Lieven, & Tomasello, 2009; Goldberg, Casenhiser, & Sethuraman, 2005; MacWhinney, 2012). In the latter experiment, the type of scene predicted which construction was used with a probability of 1. On the other hand, while 10 out of 12 verbs also uniquely predicted which construction was witnessed during exposure, offering a cue validity of 1, another two verbs appeared in either construction with equal probability, giving them a cue validity of 0.50. Thus, the cue validity across all verbs for predicting the construction was 0.92 ( $= 1 \times 5/6 + 0.5 \times 1/6$ ). The authors conclude that learners used the scene rather than the verbs to determine which construction to use because the scenes were more reliable predictors of constructions than verbs.

Two experiments presented here aim to investigate how learners generalize beyond their exposure and how those generalizations are constrained. The experiments are also designed to address issues raised by previous work, namely: (a) the possible confound that prior knowledge of the division of labor between verbs and constructions led to an increase in generalization and (b) the question of whether cue validity or expressive power (or both) encourages the productive use of constructions. In both experiments, participants are exposed to two novel word order constructions that differ in terms of core clausal semantics. In particular, one construction exclusively describes actions that have a strong effect on a "patient" (or undergoer) argument; the other construction describes actions with a weaker but otherwise similar effect. This is just the sort of contrast that can readily be conveyed by distinct verbs (*tease* vs. *harass*; *charm* vs. *enchant*; *tap* vs. *smack*), and there is no English phrasal construction that designates this difference. Therefore, if participants extend (in a production task) and accept (in a judgment task) verbs for use in the alternative construction depending on whether the effect on the patient is strong or weak, it is not likely due to any prior knowledge that word order constructions should be more likely responsible for conveying the degree of affectedness than verbs.

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