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Input effects on the acquisition of a novel phrasal construction in 5 year olds

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ABSTRACT

The present experiments demonstrate that children as young as five years old ($M = 5{:}2$) generalize beyond their input on the basis of minimal exposure to a novel argument structure construction. The novel construction that was used involved a non-English phrasal pattern: VN_1N_2, paired with a novel abstract meaning: N_2 approaches N_1. At the same time, we find that children are keenly sensitive to the input: they show knowledge of the construction after a single day of exposure but this grows stronger after 3 days; also, children generalize more readily to new verbs when the input contains more than one verb.

Introduction

A characteristic property of natural languages is the systematic correlation between structural patterns and abstract semantic or information structure functions (Fillmore, 1968; Grimshaw, 1990; Landau & Gleitman, 1985; Pinker, 1989). Such correspondences in the domain of argument structure—encapsulated by the notion of argument structure *constructions*—provide the basic clause types of a language (Goldberg, 1995). For example, the English sentences *Katie gave Jack the book* and *Poppy baked Henry a cake* are both instances of the ditransitive construction—a common phrasal pattern involving a subject and two objects. The two sentences contain distinct words but both convey actual or intended transfer. Our knowledge of this abstract linking is evident in the fact that we can use the construction productively—i.e., it can be used with new lexical items that may or may not lexically encode the transfer meaning. For example, if asked what *She mooped him something* means, speakers are quite likely to guess that she *gave* him something (Ahrens, 1995; Goldberg, 1995). In fact, adults generally interpret utterances with novel verbs by attending to the semantics of the argument structure constructions involved (Goldwater & Markman, 2009; Johnson & Goldberg, submitted for publication a; Kako, 2006; Kaschak & Glenberg, 2000).

At the same time, there is a question about whether young children are able to use argument structure constructions in the same way as adults. There is a great deal of evidence that children's early productions tend to avoid straying too far from their input. For example, when children younger than three hear a novel verb used intransitively, they are highly unlikely to productively transitivize it (Akhtar & Tomasello, 1997; Baker, 1979; Bates & MacWhinney, 1987; Braine, 1976; Pinker, 1989; Tomasello, 2000). Such experimental data, along with data from spontaneous production (Bowerman, 1982; Ingram & Thompson, 1996; Lieven, Pine, & Baldwin, 1997; Tomasello, 1992), have led to the proposal that early grammars lack abstract argument structure representations and that apparent uses of a construction actually rely on verb-specific representations (so called *verb-islands*; Tomasello, 2000).

Evidence from comprehension is somewhat more mixed. Experiments using the act out procedure, in which

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the child is required to demonstrate knowledge of a construction by acting it out with puppets, have again found that children younger than three have difficulty extending a new verb from an intransitive to a transitive construction (e.g., Akhtar & Tomasello, 1997). On the other hand, experiments using the preferential looking paradigm have demonstrated that young children can use knowledge of the semantics of a frame to make inferences about the meaning of a new verb (Fisher, 1996, 2002; Naigles, 1990; see Gleitman, Cassidy, Nappa, Papafragou, and Trueswell (2005) for a review). There is also evidence that children as young as 21-months have some knowledge of the link between specific word order and the abstract semantics of the English transitive construction (Gertner, Fisher, & Eisengart, 2006). Other work has found that young children require scaffolding in the form of initial exposure to familiar verbs used transitively in order to demonstrate any knowledge of the generalization (Dittmar, Abbot-Smith, Lieven, & Tomasello, 2008); this finding indicates that early generalizations may initially be tentative or "graded" (Abbot-Smith, Lieven, & Tomasello, 2008).

Given the evidence that lexically specific constructions are characteristic of young children's early productions and, at least to some extent, their early comprehension as well, it is important to ask what sorts of input ultimately encourage generalization. Novel construction learning studies allow us to manipulate the input systematically, so that we can explore how the structure of that input affects the nature of the abstractions acquired. Wonnacott, Newport, and Tanenhaus (2008) explored the effect of input structure on the generalization of two novel constructions to unattested verbs, using an artificial language learning paradigm (cf. also e.g., Braine, 1963; Gomez, 2002; Hudson Kam & Newport, 2005, 2009). In the context of learning a novel artificial language, over five learning sessions, adult learners were exposed to a set of sentences exemplifying two novel phrasal patterns (VN_1N_2 and VN_2N_1 *particle*) which each mapped to a semantic pattern where the entity denoted by N_1 was the *agent* of an action which affected the entity denoted by N_2 (the *patient*). Note that this is the same basic semantics denoted by common examples of the familiar English transitive construction. Using a variety of methods, learners were tested on their usage and acceptance of the two constructions with attested and unattested verbs. The results demonstrated strong learning of both constructions, and a clear ability to extend the constructions to unfamiliar verbs (i.e., novel verbs not used in the exposure sentences). However, the statistical structure of the input affected the extension of familiar verbs (used in the exposure sentences) from one construction to the alternative construction. For example, learners were less likely to extend verbs that had frequently appeared in the alternative construction, and were also less likely to extend constructions given a language in which there was strong evidence that the usage of constructions was lexically conditioned. Wonnacott et al. argued that the generalization of constructions to new verbs depended upon the input in a rational, evidence-based manner, and Perfors, Tenenbaum, and Wonnacott (2010) demonstrated that human performance is in line with the predictions of a hierarchical Bayesian model. This pattern of learning has also been demonstrated in children, though in a different linguistic domain not involving verb argument structures (Wonnacott, 2011), suggesting that this type of learning may be relevant for language acquisition.

The results of Wonnacott et al. (2008) suggest that generalization is a function of the statistical structure of the input. However one limitation of the study from the perspective of exploring novel construction learning per se, is that it does not consider the situation in which a novel phrasal form is associated with a novel abstract meaning (i.e., one not encoded by any existing English construction). Certain previous studies that have used a familiar meaning encoded by a novel word order have found that older children tend to "correct" the novel word order to make it consistent with the language that they know (Abbot-Smith, Lieven, & Tomasello, 2001; Akhtar, 1999; Matthews, Lieven, Theakston, & Tomasello, 2005). One explanation is that learners implicitly assume that a different form should indicate a different meaning, since true synonymy is rare in language, both in morphology and in phrasal constructional patterns (e.g., Bolinger, 1977; Clark, 1987; Goldberg, 1995). While adults in the Wonnacott et al. (2008) study were willing to treat the artificial language learning context as providing pragmatic motivation for assigning a familiar meaning to one or more novel forms (cf. also Chang, Kobayashi, & Amano, 2009), in the current work we avoided potential complications posed by synonymous constructions by assigning a novel *function* to our novel form. In this case, it is clear that the target "correct" response is one that makes use of the novel word order.

Another benefit to studies that involve novel functions as well as novel forms is that, arguably, this is exactly the learning task that children face. They are not learning forms (or functions) in isolation but rather which formal patterns correspond to which abstract functions. There are a few studies that have taught children novel form-function pairings. Casenhiser and Goldberg (2005) exposed 6-year-old children to examples of a construction involving the novel form NP_1NP_2V and a novel abstract event semantics: the entity denoted by NP_1 (the *theme*) appeared in/on the location denoted by NP_2. The construction was presented in the context of English with novel verbs. For example, the sentence *The rabbit the hat moopos* referred to a scene in which a rabbit appeared on a hat. Children were exposed to the semantics by watching a set of 16 animated scenes accompanied by audio. The scenes were presented in a block with total exposure lasting approximately 3 min. The results demonstrated that there was better generalization of the abstract construction to novel vocabulary when the input was skewed such that half of the exemplars of the construction occurred with one particular nonsense verb, as opposed to equal numbers of exemplars with each novel verb (in each case the construction was presented the same number of times in total, and seen with the same total number of nonsense verbs – i.e. token and type frequency were held constant). Equivalent results were found with adult learners in related experiments (Goldberg, Casenhiser, & Sethuraman, 2004; cf. Boyd & Goldberg, 2009; Johnson & Goldberg, submitted for publication a; Year & Gordon, 2009, for limits on the advantage of skewed input). This result indicates that the extent to which learners generalize a construction is a function of the structure of the input and