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Acquiring and processing verb argument structure: Distributional learning in a miniature language ☆

Elizabeth Wonnacott [a,*], Elissa L. Newport [b], Michael K. Tanenhaus [b]

[a] *Department of Experimental Psychology, University of Oxford, South Parks Road, Oxford OX1 3UD, UK*
[b] *Department of Brain & Cognitive Sciences, University of Rochester, Rochester, NY 14627, USA*

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Abstract

Adult knowledge of a language involves correctly balancing lexically-based and more language-general patterns. For example, verb argument structures may sometimes readily generalize to new verbs, yet with particular verbs may resist generalization. From the perspective of acquisition, this creates significant learnability problems, with some researchers claiming a crucial role for verb semantics in the determination of when generalization may and may not occur. Similarly, there has been debate regarding how verb-specific and more generalized constraints interact in sentence processing and on the role of semantics in this process. The current work explores these issues using artificial language learning. In three experiments using languages without semantic cues to verb distribution, we demonstrate that learners can acquire both verb-specific and verb-general patterns, based on distributional information in the linguistic input regarding each of the verbs as well as across the language as a whole. As with natural languages, these factors are shown to affect production, judgments and real-time processing. We demonstrate that learners apply a *rational* procedure in determining their usage of these different input statistics

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* Corresponding author. Fax: +44 (0) 1865 310447.
E-mail address: elizabeth.wonnacott@psy.ox.ac.uk (E. Wonnacott).

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and conclude by suggesting that a Bayesian perspective on statistical learning may be an appropriate framework for capturing our findings.

Keywords: Language acquisition; Sentence processing; Verb argument structures; Eye-tracking; Artificial language learning

1. Introduction

Adult language incorporates both regular, abstract operations and patterns that are idiosyncratic or specific to particular lexical items. The complex interplay between these two types of process is particularly clear in the relationship between verbs and the argument structure constructions in which they may occur. For example, consider the use of the ditransitive structure in English. For many verbs this construction provides an alternative to the use of a prepositional form, as in (1):

(1) Jack gave/brought/threw the ball to Henry.
Jack gave/brought/threw Henry the ball.

In addition, the construction may be spontaneously applied to new verbs. For example, Gropen, Pinker, Hollander, Goldberg, and Wilson (1989) demonstrated that children who were taught the new verb *pilk* with the meaning 'transfer by car' would produce such sentences as *''he is pilking him the horse''*. Yet despite this apparent productivity, certain verbs are unexpectedly ungrammatical in the ditransitive, as in * Jack donated/carried/pushed Henry the ball. This illustrates a phenomenon known as *subcategorization*: particular verbs are constrained (or 'subcategorized') as to the set of constructions with which they may occur (Chomsky, 1957). This combination of generalization and lexical restriction turns out to be common across many constructions in different languages (see Pinker, 1989, for a review of the dative, causative, active–passive and locative alternations in English), yet poses a puzzle from the perspective of acquisition. If learners are able to extend verbs to new constructions, how do they learn that some new verb-construction combinations are ungrammatical, rather than simply absent from the particular sample of speech they have heard thus far? This constitutes a significant learning problem, sometimes known as ''Baker's Paradox,'' which has received a great deal of attention in the language acquisition literature (e.g. Baker, 1979; Bowerman, 1988; Braine, 1971; Braine & Brooks, 1995; Brooks & Tomasello, 1999; Pinker, 1989; Theakston, 2004). Although it has been proposed that very young children may avoid the issue by adhering to extreme lexical conservatism (see Fisher, 2002a; Gertner, Fisher, & Eisengart, 2006; Tomasello, 2000; Tomasello & Abbot-Smith, 2002 for review and discussion of the evidence), all researchers agree that, at least from around 3 years of age, children do generalize. When this occurs we also see over-generalization, where children use constructions with verbs for which they are ungrammatical (e.g. * *Jay said me no*, Gropen et al., 1989). In this article, our focus is on how the retreat from over-generalization can be achieved, i.e. how learners who are able to generalize balance this ability with their knowledge of verb-specific constraints. One obvious