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# Analogical Processes in Language Learning

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## Introduction

Language acquisition is a complex task, encompassing (at least) perception and categorization of phonemes, segmentation of speech, learning word meanings, and extracting morphological and syntactic regularities. The daunting nature of this task might suggest that a specialized module is required for language acquisition. Yet there is increasing evidence that general learning processes play a major role (e.g., Marcus et al, 1999; Saffran, Aslin & Newport, 1996). In this symposium we present the case for analogical comparison processes in language learning.

Analogical comparison recruits a structure-mapping process between two instances that highlights their common relational structure—a critical feature in abstracting regular patterns across utterances. A further outcome of structure-mapping is that alignable differences (differences that play the same role in the matching structure) become salient, and this can help learners notice key contrasts.

The goal of this symposium is to show how individuals spontaneously use analogical reasoning in language learning. We bring together empirical work addressing language acquisition in young children and second language learners, across three different levels of linguistic structure: phonology, lexical semantics, and syntax.

B. Pajak will present work showing that learners infer commonalities between observed phonetic contrasts in their native language, and that this leads them to expect analogous contrasts along the same dimensions when learning a new language. D. Gentner and R. Shao will show how analogical processes help children learn new word meanings with limited exposure. They revisit the classic Carey and Bartlett (1978) fast-mapping study and show that structural alignment processes are critical for success. M. Goldwater and C. Echols address the role of analogical processes in learning constructions, using a structural priming paradigm. They show that structural priming in young children

depends heavily on overall similarity between primes and target; further, they show that priming with high-similarity ‘easy’ primes renders children more likely to show priming from purely syntactic matches. Both these findings are directly parallel to work on analogical learning on nonlinguistic tasks.

Adele Goldberg will be a discussant.

## Structural Priming as Analogical Mapping

Micah Goldwater

We examined the development of syntactic knowledge in children using a structural priming paradigm. Structural priming refers to speakers’ tendency to match their syntax to that of a recent input sentence (Bock, 1986). It facilitates dialog in adults (Pickering & Garrod, 1998) and can also serve as a gauge of syntactic development in children. Goldwater and Echols provide evidence that children show structural priming when they are able to construct sentences via semantic and syntactic analogies from the utterances of others.

Constructing analogies entails recognizing commonalities in the relational structure of two situations (or two sentences). Early in learning, such recognition typically requires concrete similarity as well as relational similarity. To test whether children’s priming results from analogically mapping a previous sentence’s structure, we engaged 4- and 5-year-old children in a turn-taking scene-description task using the typical measure of structural priming. That is, we asked whether children would describe a new picture with a sentence matching the structure of a previous sentence, rather than using an equally correct sentence with a different structure. For example, given the previous sentence “Grandma handed Sally the cake,” when describing a new picture the speaker would say “The teacher gave the boy a pencil” rather than “The teacher gave a pencil to the boy.” We found, first, that young children showed syntactic priming only when there were correlated concrete commonalities in the characters and events. This is consistent with numerous findings showing that young

children typically recognize overall similarity before they can recognize purely relational similarity. However, after processing overall matches, in which structural alignment is supported by concrete similarities, children are often able to process relational commonalities without the “training wheels” of superficial similarity (Gentner, 2010). Consistent with this pattern, young children showed structural priming for semantically dissimilar sentences only they had first processed pairs of semantically similar sentences.

## **Analogy in Learning Second-Language Phonetic Categories**

Bozena Pajak

Phonetic category acquisition is a complex problem of learning a mapping from variable phonetic tokens onto discrete categories. How is this achieved? Prior experimental and computational work has identified two main sources of information available to and used by learners, both infants and adults: statistical distributions of sounds and lexical context. I will argue that, in addition to those two sources of information, phonetic category learning is supported by analogy-based abstraction: learners infer commonalities between observed phonetic contrasts (e.g., /b/-/p/, /d/-/t/), which leads them to expect analogous contrasts defined along the same phonetic dimensions (e.g., /g/-/k/). I will present a computational model of how such analogical reuse of categories might be achieved during acquisition (Pajak, Bicknell, & Levy, 2013), and I will support it with experimental evidence. In particular, I will show that (1) the adult perceptual system is sensitive to non-native phonetic contrasts that are analogous to their native-language contrasts (Pajak & Levy, 2014; Pajak, Piccinini, & Levy, in progress), and that (2) a brief exposure to novel second-language phonetic categories leads adults to form expectations about analogous categories in that language (Pajak & Levy, 2011). I will argue that analogical abstraction can effectively bootstrap the acquisition of a language's entire phonetic system given the typological evidence that languages tend to reuse the same phonetic dimensions for multiple contrasts (Clements, 2003).

## **Interactions between Structural Alignment and Language in Word Learning**

Dedre Gentner & Ruxue Shao

We propose that analogical processes are important in allowing children to infer word meanings from indirect speech. Here, we revisit Carey & Bartlett's (1978) classic ‘fast mapping’ study, in which 3-year-olds learned the meaning of a new color term (chromium) in a single exposure, without direct reference. Children simply responded to the request “Give me the chromium one, not the red one.” We suggest that a key component of the children's success was the high alignability of the materials

used. The children chose between two trays that were identical except for color. According to structure-mapping theory, this should have promoted structural alignment, thereby highlighting color as an alignable difference. To test this, we gave 3- and 4-year-olds the classic fast mapping task, but varied the alignability of the materials. Children saw two objects and were asked to “point to the chromium one, not the blue one.” The High Alignability group saw two highly alignable alternatives, differing only in color (as in Carey & Bartlett's study). The Low Alignability group saw a pair that varied in both color and shape, making them harder to align. Both groups accurately pointed to the chromium object initially, but there was a large difference in what they learned from this. When asked to identify new chromium objects later, the high-alignability group far outperformed the low-alignability group. A second study ruled out a purely informational account. These findings suggest that structural alignment processes help children learn the word meanings from indirect linguistic information.

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