



Learning novel phonological neighbors: Syntactic category matters



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ABSTRACT

Novel words (like *tog*) that sound like well-known words (*dog*) are hard for toddlers to learn, even though children can hear the difference between them (Swingley & Aslin, 2002, 2007). One possibility is that phonological competition alone is the problem. Another is that a broader set of probabilistic considerations is responsible: toddlers may resist considering *tog* as a novel object label because its neighbor *dog* is also an object. In three experiments, French 18-month-olds were taught novel words whose word forms were phonologically similar to familiar nouns (noun-neighbors), to familiar verbs (verb-neighbors) or to nothing (no-neighbors). Toddlers successfully learned the no-neighbors and verb-neighbors but failed to learn the noun-neighbors, although both novel neighbors had a familiar phonological neighbor in the toddlers' lexicon. We conclude that when creating a novel lexical entry, toddlers' evaluation of similarity in the lexicon is multidimensional, incorporating both phonological and semantic or syntactic features.

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1. Introduction

Many of the words young children hear are not yet in their vocabulary. As a result, in everyday conversation toddlers must often decide whether a given word-form corresponds to a word they already know, or to a word to be learned. In principle, children could accomplish this by checking to see if each utterance can be parsed entirely into a sequence of familiar words. If it cannot, perhaps the unidentified portions correspond to new words.

The problem, of course, is to define what counts as an instance of a familiar word and what does not. Different instances of a given word do not all sound the same. Talkers have different voices and varying accents (e.g., Labov, 1966); words sound different depending on the phonetic context they appear in (e.g., Holst & Nolan, 1995), and speakers routinely blend sounds together or omit completely entire sounds and even whole syllables of words (e.g., Ernestus & Warner, 2011; Johnson, 2004). Such phenomena are present in the speech parents direct to their children (e.g., Bard & Anderson, 1983). Drawing the boundary between the set of acceptable instances of a word, and the instances that cannot correspond to that word, is complex.

Traditionally, it is said to be the role of the language's phonology to define the set of phonetic differences that distinguish words,

to resolve these ambiguities. If words are represented as phonological descriptions adequate for maintaining contrast, and heard utterances are converted into phonological descriptions during speech comprehension, a simple comparison procedure should be adequate for identifying new words. If a word-form in the utterance fails to line up with any word-forms in the lexicon, this means that a new word has been heard.

This might not work for children, for several reasons. Children's skills of phonetic categorization are inferior to adults' and undergo substantial refinement well into the school years, despite the rapid progress toward language-specific perception made in infancy (e.g., Hazan & Barrett, 2000; Kuhl, 2004). In many cases children may not successfully characterize utterances in phonological terms. And even when they can, it is not clear that children understand that phonological distinctions are meant to signal lexical distinctions. Although children recognize words more easily when the words are spoken with their canonical pronunciations than when spoken with deviant pronunciations (e.g., Swingley, 2009), this does not imply that the mispronunciations are interpreted as novel words (e.g., White & Morgan, 2008). Toddlers do resist interpreting some discriminable, but not phonological, differences as contrastive (Dietrich, Swingley, & Werker, 2007; Quam & Swingley, 2010), which suggests some sophistication in relating speech and the lexicon. But being wary of interpreting a non-phonological distinction as if it could distinguish words does not imply the inverse skill of readily interpreting phonological distinctions as contrastive.

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One study tested whether toddlers could use a single-feature phonological distinction to assign a novel meaning to a word-form that sounded similar to a very familiar one (Swingley & Aslin, 2007). 19-month-olds were shown a novel object, which was repeatedly named using clear (hyperarticulated) speech. In some cases the novel name given was similar to a familiar word (e.g., *tog*, similar to *dog*), and in some cases it was not (e.g., *shang*, not similar to any words children knew). Children were tested using a fixation procedure in which pictures of two novel objects were presented on a screen, and one of the pictures was labeled using its novel name (e.g., “Look at the {*tog*, *shang*”). Fixation to the named picture was used to index learning of the word. In two experiments, children were able to learn words that sounded very different from the other words in their vocabularies (like *shang*), but children did not learn the phonologically similar words (like *tog*). For some of the items tested, children of the same age had previously shown discrimination of the nonce label and its familiar counterpart, so perceptual discrimination *per se* was apparently not at issue (e.g., Swingley & Aslin, 2002).

Why might this be? One possibility is that phonological competition *alone* is the problem. The lexical entry of *dog* might be activated by the phonologically neighboring form *tog*, interfering with children’s considering the possibility that a new word was being offered. This explanation of the experimental results is consistent with a view that children first adopt a phonological criterion of similarity, which apparently requires a greater difference than the single phonological feature tested in the experiment, and proceed accordingly.

Another possibility is that a broader set of probabilistic considerations is responsible. Not only is *tog* phonologically similar to a well-entrenched word, but it is also syntactically and semantically similar: both *tog* and *dog* are *nouns* referring to *objects*. Considering that the 18-month-old lexicon is relatively sparse in both phonology and semantics (Swingley & Aslin, 2007; but see Coady & Aslin, 2003 for older children) the appearance of a novel word that is both phonologically similar to, and somewhat semantically close to, a familiar word, might seem implausible to children, leading them to suppose that the novel word might in fact be a rather dubious instance of the familiar word.

Adults too may, in some conditions, fail to interpret a one-feature phonological change as lexically meaningful (e.g., White, Yee, Blumstein, & Morgan, 2013). Under conditions in which the speech signal and the referential context are less clear (conditions which prevail quite generally in human communication), adults can interpret phonologically novel word forms as instances of known words (e.g., Cole, Jakimik, & Cooper, 1978). For example, upon hearing “this singer has a beautiful *foice*”, listeners are more likely to misperceive *foice* as an instance of *voice*. In such a case, adults find it plausible that the word *voice* has been uttered since both the syntactic and the semantic context constrained their lexical search toward singing-related nouns. Although /f/ and /v/ are lexically contrastive in English, the difference in voicing value may plausibly be interpreted as noise rather than indicating the presence of a new word in this particular context. In arriving at an analysis of spoken sentences, adults use a diverse array of sources of information: the physical context (e.g., Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995); the prior linguistic context (e.g., Altmann & Kamide, 1999); pragmatic expectations supported by the discourse (e.g., Nieuwland & Van Berkum, 2006); and idiosyncrasies of the speaker (e.g., Creel, Aslin, & Tanenhaus, 2008). In a sense, all of these are needed while interpreting speech because speakers are aware that listeners have this information at their disposal, and frequently provide only just enough phonetic information to allow the listener to resolve the intended meaning given the context (e.g., Hawkins, 2003).

These findings with adults highlight the importance of factors other than phonology in interpreting speech. Yet it is open to question whether toddlers identify words primarily using phonological criteria, or whether, like adults, they take into consideration a broader range of probabilities in judging the likelihood that a phonological distinction implies a novel word. In support of the latter, here we present evidence that toddlers evaluate other factors than phonological features, such as syntactic or semantic features, when evaluating the possibility that a novel sequence of sounds is a new word.

We started from Swingley and Aslin (2007)’s result that toddlers failed to learn new object labels that sounded similar to familiar object labels. In three experiments, French 18-month-olds were taught object labels that were phonological neighbors of a familiar *noun* (a noun-neighbor, as *tog* was, for *dog*), neighbors of a familiar *verb* (a verb-neighbor, like teaching *kiv*, a neighbor of *give*) or no-neighbors (such as *shang*). The noun-neighbor and the verb-neighbor were both phonologically similar to a familiar word in children’s lexicon. But only the noun-neighbor was also semantically and syntactically similar to its neighbor; the verb-neighbor was not. If children take into account semantic or syntactic likelihoods when interpreting novel neighbors, verb-neighbors should be perceived as sufficiently distinct from any word in the lexicon to be easily assigned a novel object meaning – just like no-neighbor words – whereas noun-neighbors are expected to suffer from the competition with the familiar noun and be hard to learn. In contrast, if children fail to learn both noun-neighbors and verb-neighbors, this would indicate that children stake everything on phonological similarity in deciding whether a word-form is a new word.

2. Experiment 1

Experiment 1 sought to replicate Swingley and Aslin (2007)’s results showing that phonological neighbors of a familiar noun (noun-neighbors) are hard for toddlers to learn. We taught French 18-month-olds two novel object labels: a noun-neighbor (e.g., “ganard,” a neighbor of “canard” *duck*) and a no-neighbor (e.g., “torba”). Word learning was then evaluated using a language-guided looking method (Fernald, Zangl, Portillo, & Marchman, 2008; Swingley, 2011). Children were presented with the two novel objects and heard sentences that named one of the pictures (e.g., “il est où le ganard?” *where is the ganard?*). An above-chance proportion of looks toward the target picture after word onset was taken as evidence that the word had been learned.

2.1. Method

2.1.1. Participants

Sixteen French 18-month-olds participated in the study, ranging in age from 17;19 (months; days) to 18;23, with a mean of 18;13 ($SD = 0;8$; 7 girls). An additional 8 children were not included in the sample because they refused to wear the sticker necessary for eye-tracking ($n = 3$), fussiness during the experiment resulting in more than 50% of trials with missing eye tracking data ($n = 3$), no increase in average proportion of looks toward the target during familiar-word trials ($n = 1$)¹ and hearing problems reported by the parents ($n = 1$). The attrition rate was somewhat higher than

¹ Following previous pilot experiments, before commencing testing here we decided on an exclusion criterion of rejecting children who looked at the target on average less than 55% of the time (from word onset until the end of the trial) over the 8 familiar-word trials. Individual time courses were inspected to be sure to not reject children who only quickly looked toward the target instead of having a sustained look; there were no such cases. This criterion was applied blind to condition performance.

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