

Perceptual discrimination across contexts and contrasts in preschool-aged children



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Abstract

This paper investigates a proposed phonetically-based account of developmental phonological patterns that lack counterparts in adult typology. Adult listeners perceive some phonemic contrasts more accurately than others, and these differences in perceptual recoverability are posited to represent one influence on phonological typology. One hypothesis suggests that children and adults could differ in their patterns of relative perceptual sensitivity, and these differences could form the basis for some child-specific phonological patterns in production. However, there has been a lack of empirical evidence to support this claim. This study used a nonword discrimination task to investigate differences in perceptual recoverability across contrasts and contexts in typically-developing preschool children. Participants heard nonwords that were identical or differed by a single segment in initial or final position. Results revealed general agreement between child and adult listeners in the relative discriminability of different featural contrasts. For certain contrasts, discrimination accuracy was significantly greater in initial than final position, mirroring an asymmetry seen in adults. Overall, these results suggest that perceptual discrimination in preschool-aged children is broadly congruent with patterns of relative sensitivity observed in adult listeners. These findings suggest that factors other than perceptual recoverability should be explored to account for child-specific phonological patterns.

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1. Introduction

1.1. Phonetic pressures as an influence on phonological typology

A common assumption in the study of language acquisition is that of *continuity* between child and adult grammars: that is, the rules or principles governing a child's linguistic behavior should not pose an exception to generalizations that are universal across adult languages (e.g., Macnamara, 1982; Pinker, 1984). In the context of developmental phonology, the continuity hypothesis is challenged by the existence of *child-specific phonological patterns*, which are attested or even common in child speech but find no counterpart in adult typology. For example, many children acquiring English exhibit a pattern of consonant harmony in which a coronal consonant assimilates to a labial or velar consonant across an

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intervening vowel (e.g. [gɔg] for “dog,” [kɪk] for “cup”), whereas no adult grammar permits long-distance assimilation for major place of articulation (e.g., Pater, 1997; Becker and Tessier, 2011). These areas of divergence between child and adult phonology have drawn interest as a potential source of insight into broader questions about the nature of phonological knowledge. Various factors have been posited to play a role in determining which sound patterns recur in cross-linguistic typology: universal markedness (e.g., Hale and Reiss, 2008), phonetic pressures (e.g. Hayes et al., 2004), or biases in the diachronic transmission of language (e.g. Blevins, 2004). It is probable that all of these factors interact to shape phonological typology. However, following previous work on child-specific speech patterns (e.g. Inkelas and Rose, 2007; Dinnsen and Farris-Trimble, 2008; McAllister Byun, 2011), the present work will focus on the hypothesis that phonetic factors play an important role in shaping child phonology. It is well-established that the physical experience of producing and perceiving speech differs across child and adult speakers (e.g., Kent, 1992; Nittrouer, 2002). If phonological patterns can arise from phonetic pressures (e.g., Hayes et al., 2004), these phonetic differences are naturally predicted to give rise to some degree of divergence in the systematic phonological patterns exhibited by child and adult speakers. Despite the present emphasis on phonetic (especially perceptual) influences on phonology, it should be kept in mind that these factors exist in a potentially broader context of universal markedness and diachronic pressures.

1.2. Perceptual recoverability in adult speech patterns

Previous research has clearly established that phoneme contrasts within a language can differ in acoustic-perceptual salience. That is, certain sound pairs are more readily discriminated than others across a variety of listening conditions, as in the contrast between the highly confusable fricatives /f-/θ/ and the highly distinctive fricatives /s-/ʃ/ (e.g., Cutler et al., 2004). These differences in discriminability are largely rooted in physical properties of the acoustic signal, such as loudness and duration. For example, the frication noise generated in the production of the sibilants /s/ and /ʃ/ is considerably louder than the frication noise for non-sibilants such as /f/ and /θ/, offering a straightforward explanation for the lower discriminability of the latter contrast (e.g., Wright, 2004). Similarly, Wright (2004) found that perception of stop place contrasts was more negatively affected by increasing levels of background noise than perception of intensity-matched fricative place contrasts. The greater perceptual recoverability of fricative contrasts was attributed to their longer duration, which provides the listener with an extended window in which to detect the target contrast. This paper will use the term *cue* to refer to any acoustic information that contributes to the perceptual recoverability of a phoneme contrast, and *cue robustness* to refer to the acoustic salience of those elements.¹ Some phonemes carry strong *internal cues* (i.e., they can be perceived while standing alone), while others are perceived primarily through *transitional cues* created by coarticulation with an adjacent vowel or sonorant consonant.

Many of the results of studies of perceptual cue robustness are highly intuitive, such as the finding that phonemes associated with a loud or long acoustic signal are perceived more reliably than phonemes with short or low-intensity acoustic cues. The most interesting contribution of this body of experimentation has emerged from a line of research proposing that differences in perceptual salience can contribute to a deeper understanding of the cross-linguistic typology of phonological systems. Differences in perceptual recoverability have been argued to account for implicational generalizations regarding the environments in which a given sound or contrast can appear in a language: that is, the occurrence of a given contrast in a context of low perceptual salience implies that it can also occur in a context of greater perceptual salience (e.g., Steriade, 2001; Henke et al., 2012). For example, many languages allow sibilant fricatives to occur in a wider range of consonant cluster contexts than other obstruents. English permits a variety of onset clusters with rising sonority (e.g., /bl-, fr-, tw-, sn-/), but only sibilants can appear in onset clusters of flat or falling sonority (e.g., /st-, sp-, sk-/; cf. */pt-, fp-, rt-/). The broader distribution of sibilants is attributed to their robust internal perceptual cues, which allow the listener to recover the identity of a sibilant even when it does not occur adjacent to a high-sonority segment that can act as a carrier of transitional cues (Henke et al., 2012).

Another factor frequently studied in connection with the influence of perceptual recoverability on phonological typology, which will play a key role in the study reported below, relates to asymmetries in the distribution of consonants in syllable-initial versus syllable-final position. Cross-linguistically, CV syllables are more common than VC syllables, and within a language, phoneme contrasts that occur in final position tend to represent a subset of the contrasts that can occur in initial position (e.g., Bell and Hooper, 1978; Redford and Diehl, 1999; Beckman, 1997). For example, European Portuguese contrasts labial, alveolar, and postalveolar fricatives in onset position, but only postalveolar fricatives can appear in coda position (Mateus and d’Andrade, 2000). These phenomena have been attributed to the fact that perceptual cues to contrasts among non-sonorant consonants are carried primarily in the transition to or from an adjacent sonorant

¹ Discussion in this paper will focus on acoustic intensity and duration as the major predictors of cue robustness. However, other influences on robustness have been proposed, such as the degree of modulation or acoustic change between sounds, and relative sequencing of sounds with differing acoustic properties (see discussion in Henke et al., 2012).

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