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Phonological priming and cohort effects in toddlers

Nivedita Mani [a,*], Kim Plunkett [b]

[a] Free-Floater Research Group in Language Acquisition, University of Göttingen, Germany
[b] Department of Experimental Psychology, University of Oxford, United Kingdom

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ABSTRACT

Adult word recognition is influenced by prior exposure to phonologically or semantically related words (*cup* primes *cat* or *plate*) compared to unrelated words (*door*), suggesting that words are organised in the adult lexicon based on their phonological and semantic properties and that word recognition implicates not just the heard word, but also related words. We investigate the phonological organisation of the toddler lexicon with two experiments using a picture priming technique. Twenty-four month olds showed inhibition of target recognition in related primed trials compared to unrelated primed trials (Experiment 1) and also in related primed trials compared to unprimed trials (Experiment 2). Further analysis of children's responding found that this inhibition effect was modulated by the cohort and neighbourhood size of the words tested. Overall, the results indicate a lexical basis for the reported effects and suggest that the phonological properties provide an organisational basis for words in the toddler lexicon.

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1. Introduction

The current study investigates the cognitive processes involved in toddler word recognition. We examine how words are represented in the toddler's mind, focussing on whether the phonological properties of words are important for their organisation in the toddler lexicon. The organisation of the adult lexicon has been rigorously studied by using priming techniques. For instance, adult word recognition studies report that hearing a word (e.g., 'cup') influences subsequent recognition of phonologically and semantically related words like 'cat' and 'plate' (Goldinger, Luce, & Pisoni, 1989; Marslen-Wilson & Zwitserlood, 1989; Slowiaczek & Hamburger, 1992): word recognition is primed by prior exposure to phonologically and semantically related words. These findings have been taken to suggest that hearing a word leads to the activation of phonologically and semantically related words, and that the phonological and semantic properties of words provide an organising principle for words in the adult lexicon.[1] We follow a similar rationale to that used in adult studies of the mental lexicon by testing phonological priming in toddlers to examine whether infant word recognition involves the activation of other phonologically related words.

A recent study shows that 18-month-old word recognition is influenced by prior activation of phonologically related words (Mani & Plunkett, 2010 – henceforth MP). MP (2010) presented infants with an image of a name-known object (the prime image) followed by two simultaneously presented images, one of which was labelled, i.e., the target image. In half of the trials, the label for the prime image began with the same onset consonant as the label for the target image, e.g., cake (prime image) – car (target image). In the other half of the trials, the label for the prime image was unrelated to the label for either the target or distracter image. MP (2010) reported that infants looked

* Corresponding author. Address: Goßlerstraße 14, 37073 Göttingen, Germany. Tel.: +49 551 3910889.
E-mail addresses: nmani@gwdg.de (N. Mani), kim.plunkett@psy.ox.ac.uk (K. Plunkett).

[1] We define "organisational basis" as similarity relations between sound-patterns or semantic properties of words (Luce & Pisoni, 1998), where such structural organisation impacts the speed and accuracy of spoken word recognition.

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longer at the target in related compared to unrelated primed trials and reasoned that facilitation of target recognition in phonologically related primed trials shows that infants internally generate the label for the prime image.

In adult word priming studies (Goldinger, Luce, Pisoni, & Marcario, 1992; Norris, McQueen, & Cutler, 2002; Radeau, Morais, & Dewier, 1989; Slowiaczek et al., 1987), a facilitation effect is considered inadequate evidence for the claim that hearing a word leads to the partial activation of other phonologically related words (Marslen-Wilson & Zwitserlood, 1989) for two reasons: First, the prime word may only activate its constituent sounds (e.g., *dread* activates /d/), making it easier for adults to achieve recognition of other words beginning with /d/ because the initial phoneme has already been activated. According to this explanation, facilitation can be understood as a pre-lexical level effect, tapping into the phonological realms of the priming process (Slowiaczek & Hamburger, 1992). Second, researchers have suggested that facilitation effects can arise from response biases developed during the experiment, and may provide little or no information regarding the organisation of the mental lexicon or the relationships between words (Goldinger et al., 1992; Hamburger & Slowiaczek, 1996; Norris et al., 2002). For example, participants may become aware of the sound similarities during the experiment and begin to predict that the target label will share some phonemes with the prime. This expectation can cause delayed responses to unrelated primed trials (where there are no similarities), and faster responses when participants' expectations are met.

Clearer evidence for a lexical level priming effect, at least in adult studies, comes from studies reporting interference effects in phonological priming tasks: adults are sometimes slower at recognising words given previous exposure to phonologically similar words compared to unrelated words (Goldinger et al., 1992; Radeau, Morais, & Segui, 1995; Radeau et al., 1989; Slowiaczek & Hamburger, 1992). The interference effect is explained by suggesting that priming activates a neighbourhood of words that are related to the target, creating a competitive environment, which slows down its recognition. The interference effect cannot be attributed to a phonological level effect, since the activation of shared phonemes between prime and target words should only facilitate recognition at the phonological level. Further evidence that the interference effect implies activation of phonologically related words in word recognition comes from studies showing a correlation between the level of interference with target recognition and the number of competitor words that can be simultaneously active (i.e., neighbourhood size: Dufour, Frauenfelder, & Peereman, 2007; Dufour & Peereman, 2003). Interference with target recognition (i.e., better recognition of the target following unrelated than related primes), therefore, provides more convincing evidence that hearing a word leads to the activation of phonologically related words, and, by extension, that the phonological properties of words form an organisational basis for words in the mental lexicon.

In keeping with the adult literature, the facilitation effect in MP's (2010) results cannot be taken as evidence for lexical neighbourhood activation at 18-months of age: Improved recognition of *car* when primed by *cake* does not show that infants activate the word *car* upon activating the word *cake*, since improved recognition could be driven purely by overlap at the phonological level or by strategic responding.

In this paper, we examine whether the phonological properties of words provide a basis for the organisation of words in the 24-month-old lexicon, such that word recognition involves the automatic activation of phonologically related words. In particular, we exploit the same picture priming technique used by MP (2010) to investigate whether phonological priming leads to interference effects in the 24-month-old lexicon and whether any such effects are modulated by the cohort size (number of other words beginning with the same sound) or the neighbourhood size (number of similar sounding words in the lexicon, based on a one phoneme difference between two words) of the words tested. In a lexicon organised on the basis of phonological properties of words, larger cohorts or neighbourhoods should produce greater inhibitory effects than smaller cohorts or neighbourhoods. We focus especially on children at 24-months of age because of the reported neighbourhood size effects on word learning at this age (Newman, Samuelson, & Gupta, 2008) and the large vocabulary size of these infants. Furthermore, both Mani (2010) and Huang, Khan, Wang, Geojo, and Snedeker (2011) report similar attenuation of target preferences in a related prime condition in a picture priming task with 24-month-olds.

Experiment 1 involves a direct replication of the study conducted by MP (2010) but with 24-month-olds instead of 18-month-olds. This experiment yielded very different findings to those obtained in MP (2010) but in line with Mani (2010) and Huang et al. (2011), which are also compatible with adult studies of work recognition in which lexical neighbourhood size can have an attenuating impact on target recognition. Experiment 2 attempts to identify the locus of this contrasting pattern of results obtained in Experiment 1 by systematically manipulating the cohort size of the target words and by comparing 24-month-olds' performance in a primed and an unprimed, baseline condition.

2. Experiment 1

2.1. Method

2.1.1. Participants

The participants were 32 toddlers at 24-months (M = 23.96 m; Range = 23.18–24.28). Five additional children were tested but were excluded due to fussiness, experimenter error or not completing all conditions. Participants had no known hearing or visual problems and were recruited via the maternity ward at the local hospital. Participants came from homes where British English was the primary language in use.

2.1.2. Procedure

During the experiment, children sat on their caregiver's lap about 80 cm away from a screen (88 × 24 cm). Two

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