Name dominance in spoken word recognition is (not) modulated by expectations: evidence from synonyms

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<https://doi.org/10.36505/ExLing-2008/02/0057/000116>

Abstract

Two German eye-tracking experiments tested whether top-down expectations interact with acoustically-driven word-recognition processes. Competitor objects with two synonymous names were paired with target objects whose names shared word onsets with either the dominant or the non-dominant name of the competitor. Non-dominant names of competitor objects were either introduced before the test session or not. Eye-movements were monitored while participants heard instructions to click on target objects. Results demonstrate dominant and non-dominant competitor names were considered for recognition, regardless of top-down expectations, though dominant names were always activated more strongly.

Key words: spoken-word recognition, synonyms, pre-exposure, eye tracking

Introduction

Eye movements to displayed objects are one of the most informative methods for studying spoken-word recognition as it happens. Eye-movement studies have, for example, confirmed phonological cohort activation (e.g., Allopenna et al., 1998): when hearing the name of an object, for instance *candle*, listeners fixate phonologically similar objects like *candy* more than phonologically dissimilar objects. Cohort activation is furthermore modulated by lexical frequency (e.g., Dahan et al., 2001, Weber and Crocker, 2006): high-frequency cohort competitors are fixated more than low-frequency ones. Semantic information from preceding contexts also constrains cohort activation (e.g., Dahan and Tanenhaus, 2004): listeners no longer fixate competitor pictures when a preceding verb constrains upcoming material. Thus, upon hearing *the woman lights the...*, only suitable objects like candles but not candy will be fixated. The present eye-movement studies investigated the interaction of bottom-up frequency effects with top-down context effects in German.

Two important changes were incorporated compared with previous studies. Rather than varying lexical frequency between different conceptual objects (e.g., comparing high-frequency competitor *bed* with low-frequency competitor *bell*), and thereby introducing the possibility that items vary along dimensions other than frequency, we investigated name dominance effects for single conceptual and pictorial representations. To this end, we

selected competitor objects with two synonymous names that varied in dominance (e.g., ‘accordion’, dominant *Akkordeon* and non-dominant *Ziehharmonika* in German). Some pictorial displays of synonyms can potentially bias towards a particular word form, thereby surpassing lexical frequency effects (e.g., the picture of a magician and a wizard can look differently). We avoided such items, and rather established via a naming pre-test that synonym pictures evoked two names with varying frequency. Secondly, testing the influence of word expectation within a sentence context usually complicates effect localization; we therefore modulated listeners’ expectations with pre-exposure to a particular word form in isolation. In particular, listeners were introduced to the non-dominant names of competitor pictures prior to the eye-tracking session.

If lexical frequency effects operate for synonyms as they do for other words, more looks to the same competitor picture should be observed when its dominant name is phonologically related to the target picture (*Akkordeon* for target *Akrobat*, ‘acrobat’) than when its non-dominant name is (*Ziehharmonika* for target *Zielscheibe*, ‘target disc’). If pre-exposure further modulates listeners’ expectations for non-dominant competitor names, either by inhibiting high-frequency names or by priming low-frequency names, the magnitude of the competitor activation should vary with pre-exposure.

Experiment

Method

Participants

Sixty-four native speakers of German, all students at Saarland University, took part in the experiment for monetary compensation. Half of them participated in Experiment 1a (target similar to non-dominant competitor name), the other half in Experiment 1b (target similar to dominant competitor name).

Materials

Twenty competitor pictures with two synonymous names varying in dominance (‘accordion’, *Akkordeon* and *Ziehharmonika* in German) were displayed together with target pictures that were phonologically related to either the non-dominant competitor name (‘target disc’, *Zielscheibe*, Experiment 1a) or the dominant competitor name (‘acrobat’, *Akrobat*, Experiment 1b). Two unrelated distractor pictures were added to each display (e.g., ‘pear’, *Birne*, and ‘church’, *Kirche*, see Figure 1). Forty filler trials similar in setup but with no phonemic overlap between object names were prepared in addition.

Figure 1. Example display from Experiment 1a.

Procedure

Instructions to click on objects (e.g., ‘Click on the target disc’) were presented auditorily. Trials were divided into two blocks. For one test block, the complete set of pictures was shown to the participants before the experiment; for the other block, participants were additionally familiarized with the picture names (non-dominant names for competitor objects).

Listeners' eye movements were monitored while they were listening to the instructions. A camera on the participants' dominant eye provided the input to the eye tracker (SMI Eyelink head-mounted). Onset and offset times and spatial coordinates of eye fixations were recorded.

Figure 2. Average fixation proportions for competitor and distractor pictures between 250 and 700 ms after target onset in Experiments 1a and 1b.

Results

Figure 2 presents the averaged fixation proportions for cohort competitors and distractors between 250 and 700 ms after target word onset in Experiments 1a and b. In this time window competitor activation is commonly observed in eye-tracking studies.

When no name expectation was induced in the picture pre-view, listeners looked at the competitor more often when the target was phonologically similar to the dominant name (Exp. 1b) than the non-dominant name (Exp. 1a; $t(62) = -2.13$, $p < .04$), thus replicating previous frequency effects. However, when we biased listeners to expect the non-dominant name, this

difference disappeared ($t(62) = -.731, p > .4$), suggesting that pre-exposure increased the availability of the non-dominant name. However, the size of the cohort effect was not significantly modulated by expectation. While there was a numerical decrease in the looks to competitors when targets were phonological neighbours of the dominant name, this difference was not statistically reliable, suggesting that pre-exposure does not restrict the candidate set considered by the word recognition system.

Discussion

Eye movements showed that, indeed, dominant synonym names were activated more strongly than non-dominant synonym names. This finding is in line with previous results for nouns varying in lexical frequency, and generally supports the claim that long-term accrued experience with a word influences the recognition process (e.g., Goldinger, 1998). However, while we did find evidence that pre-exposure increases the availability of the primed name, we did not find evidence that it inhibited the accessibility of the alternative name. This result contrasts recent eye-tracking studies who found an early effect of sentential context on spoken-word recognition. Rather it suggest that lexical access is initially form-based and context-independent (e.g., Norris et al., 2000).

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