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Research report

The representation of homophones: More evidence from the remediation of anomia

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ARTICLE INFO

Article history:
Received 5 January 2006
Reviewed 29 March 2006
Revised 29 May 2006
Accepted 11 July 2006
Action editor Stefano Cappa
Published online 19 November 2007

Keywords:
Homophone picture naming
Aphasia
Word form access
Phonological treatment
Anomia

ABSTRACT

This paper compares two theoretical positions regarding the mental representation of homophones: first, that homophones have one phonological word form but two grammatical representations (lemmas, e.g., Levelt et al., 1999; Dell, 1990), or second, that they have two separate phonological word forms (e.g., Caramazza et al., 2001). The adequacy of these two theoretical accounts for explaining the pattern of generalisation obtained in the treatment of homophone naming in aphasia is investigated.

Two single cases are presented, where phonological treatment techniques are used to improve word retrieval. Treatment comprised picture naming of one member of a homophone pair using a phonological cueing hierarchy.

A significant improvement in word retrieval was found for both the treated and the untreated homophones, while there was no improvement for phonologically and semantically related controls.

It is argued that the data support a shared representation for homophones at the word form level. However, current theories cannot explain the pattern of generalisation found without the addition of a mechanism for repetition priming (e.g., suggested by Wheeldon and Monsell, 1992) and feedback between word form and lemmas to explain the results.

1. Introduction

In the psycholinguistic literature, there are different theories regarding how the mental lexicon is organised for speech production. In this paper, we will focus on two approaches. The first approach is the discrete Two-Stage model (Levelt et al., 1999) in which lexicalisation occurs in two steps: (i) a syntactic representation (the lemma) has to be accessed before and (ii) the phonological word form can be activated and selected. The second approach is that of the Independent Network (IN) model (Caramazza, 1997) where there is only one lexical layer, and phonological information can be accessed before grammatical information is fully activated. In the following, the focus will be on ambiguous words: homophones are words which sound the same, but have two or more different meanings. They can be homographic, where the spelling is the same (e.g., 'ball' and 'ball') or heterographic, where spelling differs (e.g., 'knight' and 'night').

Levelt et al. (1999) assume a single representation for homophones at the word form level (e.g., 'ball' has two entries at lemma level but only one at homophone level), whereas Caramazza et al. (2001) postulate two separate word form entries (e.g., 'ball' has two separate entries at word form level). We address the issue of the representation of homophones by using data from the treatment of aphasia. If we train one

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0010-9452/$ – see front matter
doi:10.1016/j.cortex.2006.07.004

partner of a homophone pair but not the other and generalisation to the untrained homophone word form is detected after training, then this is support for models with a single, shared word form entry for homophones. If we find no generalisation to the untreated homophone, support for models with separate homophone word forms is found. We will first review the literature regarding homophone production and demonstrate the important role homophones can play in specifying theories of spoken word production.

2. Psycholinguistic debate regarding the representation of homophones

Dell (1990) analysed speech errors made by normal speakers and showed that the frequency of both content and function words determines how error-prone they are. However, unlike other words, low-frequency homophones are no more error-prone than high-frequency homophones. For homophones, the important determinant of error rate seemed to be the summed or cumulative frequency[1] of both homophones rather than the item-specific frequency of one homophone. Dell argued, therefore, that low-frequency homophones 'inherit' the frequency of their high-frequency twin.

> ''It appears to be the frequency of the form of the word rather than that of the word itself that influences its sound errors. A low-frequency word that is homophonous with a high-frequency word may inherit the relative invulnerability of the high-frequency homophone by sharing its form'' (Dell, 1990, p. 326).

This is implemented in Dell's (1990) interactive Two-Step-model (see Fig. 1) in which an activated lemma (semantic–syntactic) level results in a spread of activation to the adjacent phonological level (where the phonological word forms are represented as single nodes). The word form level in turn feeds back activation to the lemma level, and forwards its activation to the segment level. The homophonic word form can therefore activate its second lemma meaning via feedback.[2]

Converging evidence for the frequency inheritance effect was found by Jescheniak and Levelt (1994). They used an English–Dutch translation task, where the Dutch translation of the English word was a homophone.[3] In this task, Jescheniak and Levelt (1994) demonstrated that low-frequency homophones had almost identical translation times to their high-frequency twins. In contrast, a clear-cut effect of frequency on translation time was found for high and low-frequency non-homophones. Jescheniak et al. (2003) extended these findings by replicating the English–Dutch translation task and adding an English–German translation task. In both languages they found a significantly faster translation time for the homophone condition (regardless of whether the translation response was for the high- or low-frequency partner) compared with the low-frequency non-homophone condition[4]: the high-frequency non-homophone condition (matched on cumulative homophone frequency) showed a similar translation time to the homophone condition. Hence, they provided a cross-linguistic replication of the basic finding that low-frequency homophones are named significantly faster than low-frequency controls (see also Cutting and Ferreira, 1999). The authors explain their findings using a discrete Two-Stage model, where one homophone entry is activated from two lemma entries (see Fig. 2a): the frequency of the (single) phonological representation of a homophone represents the frequency of occurrence of both homophone meanings.

However, in a translation task with Spanish–English bilinguals, Caramazza et al. (2001) could not replicate the frequency inheritance effect for homophones. Instead, they found a clear-cut effect of frequency for homophones (low-frequency homophones were slower than high-frequency homophones), as for non-homophonic words. Moreover, they found significantly slower naming latencies in an English picture naming task[5] for English homophones than for English control words matched for cumulative frequency. The authors inferred that specific-word frequency (rather than cumulative frequency) must be the critical variable in homophone production. These results were also replicated in Mandarin (Caramazza et al., 2001, but see Jescheniak et al., 2003 for a critique of this paper).

Caramazza (1997), Caramazza et al. (2001) and Caramazza and Miozzo (1998) reject, therefore, the existence of a homophone processing advantage and argue against the need for an independent lemma representation. They propose direct access from semantics to the phonological word form level, where each homophone meaning has a separate word form node (see Fig. 2b). In their IN model, while it is possible

[1] The cumulative frequency consists of the sum of the frequency of both homophones.

[2] In later versions of the model (such as Dell et al., 1997 and Foygel and Dell, 2000) the lemma level is directly adjacent to a phoneme/segment level, a separate word form level no longer exists. This modification of the model has important implications for the explanation of homophone generalisation (see Section 7). As in these later papers homophones are not discussed, we primarily restrict ourselves to the instantiation of the theory described by Dell (1990).

[3] The authors used only homographic homophones like *Fest* (celebration) and *fest* (hard), which belonged to different word categories (noun versus adverb, verb or adjective).

[4] Although the homophone effect in the English–Dutch translation task was larger than in the English–German design, homophones still showed a significant advantage compared with low-frequency controls. The authors explain this difference by pointing out that in German, non-target responses occurred on a much larger proportion of trials for the homophones than for low-frequency controls. For example, there are two acceptable German translations for *party*: *Fest* (the target homophone) and *Feier* (a non-homophone). This suggests that more non-target lexical candidates could have been activated during the translation task for German homophones than for Dutch homophones. Obviously, in this case there are more competitors, which interfere with the processing of the target more strongly in the homophone condition than in the control condition.

[5] They replicated this word specific frequency effect in an Italian picture naming task and used a delayed naming task in English to exclude the possibility that homophone pictures were articulated slower and/or triggered the microphone later than other items.