Debra Titone • Cynthia M. Connine

Syllabification strategies in spoken word processing: Evidence from phonological priming

Abstract Two experiments were conducted to examine which of two linguistic syllabification strategies, the maximal onset principle and the stress principle, is operative in auditory word recognition. Test stimuli consisted of bisyllabic words and nonwords containing two medial consonants, the second of which had a potential attachment to either the coda of the first syllable or the onset of the second syllable (e.g., MARKET). A phonological priming paradigm was used in which prime stimuli were artificially syllabified by inserting silence. In the critical conditions, the prime was consistent with the maximal onset principle (e.g., MAR-KET) or with the stress principle (e.g., MARK-ET). The results suggested that listeners prefer to attach a medial consonant to the onset of a syllable in a way that is characterized by the maximal onset principle. The results also indicate some use of the stress principle.

Introduction

English is a language in which there is considerable ambiguity with respect to syllabification of multisyllabic words. Based simply on phonological well-formedness considerations, syllabification of the word MARKET could be MAR-KET as well as MARK-ET. Despite the fact that there may occasionally be acoustic cues to syllable and lexical segmentation, it is not at all clear that such cues are systematically available and, if available, are used for segmentation at any level (i.e., words and/or syllables): Precisely because of this apparent lack of signal-based cues for segmentation, research has focused on the types of strategies listeners might use for segmentation.

Recent investigations have focused on two major aspects of syllables and their role in language processing. Cutler, Mehler, and colleagues (Cutler, Mehler, Norris, & Segui, 1983; Cutler, Mehler, Norris, & Segui, 1986; Cutler & Foss, 1977; Cutler, Norris, & Williams, 1987) have investigated the role of syllables in segmenting speech; does the syllable function as the basic unit for speech segmentation? The general conclusion to emerge from this work is that the use of syllables as segmentation units is language-dependent. Syllables are useful units for languages that use syllables as timing units in production (e.g., French), but syllables are not useful as units for languages such as English that are stress-timed (see also Cutler & Norris, 1988, and Cutler & Butterfield, 1992). A second approach for investigating syllabification is exemplified by Treiman and her colleagues. Treiman has focused her efforts on determining whether linguistic theories of syllable structure correspond to representations constructed by language users. This research has provided detailed information about the mental representation of syllables and their internal structure (Treiman, 1983, 1986, 1990; Treiman & Danis, 1988; Treiman & Zukowski, 1990).

The research presented here follows the latter approach in investigating the role of syllables. Specifically, the experiments were designed to determine whether speakers of English use syllabification principles specified in linguistic theory to process bisyllabic words. The particular syllabification principles investigated were the maximal onset principle (e.g., Pulgram, 1970) and the stress principle (Bailey, 1978; Hoard, 1971). The maximal onset principle states that the maximum number of consonants possible attach to a syllabic onset. In contrast, the stress principle states that consonants preferentially attach to stressed syllables. In a previous study comparing these two strategies, Treiman and Zukowski...
(1990) asked subjects to select between syllabifications of bisyllabic stimuli whose medial consonants were legal in syllable final position (e.g., PONTIFF) and were segmented according to the maximal onset (e.g., PONTIFF) or the stress (e.g., PONTIFF) principle. Consistent with the maximal onset principle, subjects were significantly more likely to select segmentations assigning the second medial consonant to the onset of the second syllable than to select segmentations assigning the second consonant to the offset of the first syllable. However, a small difference in response percentages between words with first and second syllable stress suggested an influence of the stress principle. Similar results were found using an oral syllabification task in which subjects repeated a spoken word by uttering the first or last syllable twice (e.g., QUAR-QUARTER or QUARTER-TER) Treiman & Zukowski, 1990). Subjects were more likely to say QUAR-QUARTER than QUART-QUARTER, and QUARTER-TER than QUARTER-TER, consistent with the maximal onset principle.

Although these experiments provide valuable evidence of syllabification preferences, strong statements concerning the use of syllabification strategies during ongoing language comprehension are potentially precluded by the meta-linguistic nature of these tasks (cf. Treiman, 1990). For example, Pierrehumbert and Nair (1995) have argued that these types of tasks teach subjects new processes of word formation based on both previously existing processes and possibilities of language in general. Additionally, they argue that tasks requiring the alignment of two input words simultaneously provide less information about intrinsic phonological structure than tasks requiring output on the basis of a single word input. Finally, because the items in these experiments were presented words in their written form, the influence of orthography on syllabification was not ruled out.

Given these potential drawbacks of meta-linguistic tasks requiring explicit segmentation of stimuli, claims concerning syllabification preferences would be bolstered by parallel lines of evidence from other methodologies. In the present case, we focus on developing a methodology that may demonstrate processing consequences for non-preferred syllabifications in the auditory domain. The method we used in the experiments is a variant of the phonological priming paradigm. In the phonological priming paradigm, listeners are presented pairs of stimuli and are asked to make a decision (e.g., lexical decision) on the second stimulus. Typically, the relationship between the first stimulus (the prime) and the second stimulus (the target) is manipulated in order to determine whether a specific dimension shared by the two influences the decision (e.g., reaction time) on the target. For example, Slowiaczek and Pisoni (1986) used phonological priming to determine whether phoneme overlap between a prime and target facilitated a lexical decision on the target (see also Slowiaczek, Nusbaum, & Pisoni, 1987). More recently, Goldinger, Luce, and Pisoni (1989) have used phonological priming in a perceptual identification task to investigate the relationship between lexical neighborhood density and word frequency.

The present experiments used the phonological priming paradigm to determine whether the particular syllabic segmentation in a prime stimulus influenced lexical decision latency of a word or nonword target. Experiment 1 tested whether subjects prefer the maximal onset principle or the stress principle in syllabification. Although the maximal onset and stress principles make similar predictions for bisyllabic words with second syllable stress (e.g., PONTOON), their predictions diverge for bisyllabic words with first syllable stress (e.g., MARKET). For words with first syllable stress, the maximal onset principle predicts attachment of the ambiguous consonant K in MARKET to the onset of the second syllable (e.g., MARK-KET). Alternatively, the stress principle predicts attachment of the K in MARKET to the stressed offset (coda) of the first syllable (e.g., MARK-ET).

In order to create primes consistent with the maximal onset and stress principles, the experiments used a manipulation from work in the visual domain where divided stimuli have been used to investigate units of lexical access (Taft, 1979; Lima & Pollatsek, 1983). The present study used bisyllabic words having two medial consonants and canonical first syllable lexical stress. To assess the generality of the results, targets consisted of either a base word (e.g., MARKET) or a nonword derived from the base word by changing the initial phoneme (e.g., FARKET). Three of the four prime conditions used a nonword derived from the base word where the initial phoneme differed from that of the nonword target (e.g., LARKET). Nonwords were segmented into syllable units consistent with the maximal onset and stress principles (e.g., LAR-KET and LARK-ET, maximal onset and stress conditions, respectively) or were unsegmented (e.g., LARKET, intact condition).

A fourth condition consisted of a nonword prime stimulus that has no phoneme overlap with the target (e.g., BESTION, control condition). The intact and control conditions were included in order to replicate previous research showing faster lexical decision responses in an intact condition compared with a control condition (Slowiaczek et al., 1987; Slowiaczek & Pisoni, 1986). Experiment 2 extended the results of Exp. 1 by using a variant of the phonological priming paradigm.

Similar to the assumptions underlying the phonological priming paradigm, the segmentation manipulation assumes that the syllabification set up by a prime stimulus will be useful (i.e., facilitatory) to the extent that it matches the preferred syllabification of the target. If the maximal onset strategy is used by listeners to segment stimuli into syllables, then lexical decision responses should be faster following primes segmented according to the maximal onset principle. Conversely, if the stress principle is used by listeners, then responses should be faster following primes segmented according to the stress principle.