THE USE OF PROSODIC INFORMATION IN WORD RECOGNITION IN MODERN STANDARD ARABIC

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ABSTRACT

A semantic priming experiment investigated the effect of lexical stress during auditory word recognition in Arabic. In minimal stress pairs, lexical decision was inhibited only through rightward stress movements. In common words, stress shifts were adverse in both directions. The results are explained in terms of stress pattern frequency and syllable weight.

INTRODUCTION

Stress, the relative prominence of one syllable within a word [1, 2] is said to be lexical when it is functionally distinctive. Attempts to detail its influence present a rather confusing picture.

It seems that in English prior information as to the number of syllables and lexical stress pattern of a target word does not improve lexical decision performances. Also, mis-stressing inhibits word recognition only if a canonically strong-weak (/SW/) stress pattern is realized in a /WS/ version [3]. More important still, minimal stress pairs such as "forbear/forbear" behave like homophones, suggesting that lexical stress information is not used to constrain lexical access [4]. Likewise, the mis-stressing of pairs like "contract-contract" does not impede word processing, eventhough it involves a vowel quality change [5].

However, positive evidence regarding the influence of lexical stress on word recognition also exists. For instance, English listeners' identification of an ambiguous initial segment is biased in the midrange of a speech voicing continuum by stress information [6]. Also, the detection of mispronounced targets is greater in stressed than in unstressed syllables[7], and mis-stressing results in slower shadowing responses, whether a vowel quality change is involved [8] or not [9]. Finally, gating evidence shows that the words suggested on the basis of gated information differ depending on whether the word is /SW/ or /WS/ [10].

Given the inconclusive results from earlier studies, it would be interesting to provide additional cross-language information from semantic priming regarding the potential effects of lexical stress on spoken word recognition.

In Modern Standard Arabic (MSA) stress pattern can have a lexically distinctive function in the sense that there are few minimal stress pairs [11, 12, 13]. Such pairs consist exclusively of three-syllable words and are either /SW/ or /WS/, final syllables being almost always extrametrical in this language unless superheavy [14]. For instance, the sequence /wæsʕafa/, with a /SW/ stress pattern means "he described", but with a /WS/ stress pattern, /wæsʕafa/ means "it cleared up". Being semantically different, members of such pairs are supposed to be related to different words on the representational level [4]. The /SW/ version is related to the word /ʃæræħæ/ (i.e., he explained), while the /WS/ one is related to /ræ:qæ/ (i.e., it became brighter). A contribution of lexical stress to the process of word recognition in MSA can be demonstrated, if a member of a minimal stress pair is found to facilitate only the recognition of the target related to it. On the other hand, if stress plays no role, then minimal stress pairs should behave like homophones [4, 5]. In order to further define the role of lexical stress in word recognition, it would be of interest to examine the perceptual effects of mis-stressing /SW/ and /WS/ MSA common words, that is words which are not members of a minimal stress pair (e.g., /kætæbæ/-/ʃæ:hædnæ:/ (i.e., "he wrote, they saw" respectively). Should mis-stressing have an adverse effect on lexical access, then the correctly stressed versions of common words should facilitate related targets, while the incorrectly stressed versions should not. It is worth noting

that stress manipulation in MSA has no consequence at the segmental level [15], thus allowing a better assessment of lexical stress effects than a language like English in which stress shifts usuallly alter vowel quality [4].

A PRIMING EXPERIMENT

The role of lexical stress during auditory word recognition in MSA has been tested in a semantic priming experiment in which subjects made a lexical decision for a target which was or was not related to a preceding prime word. Preliminary control studies were run to construct reliable material relative to the associative relations between primes and targets, and to determine an unprimed baseline lexical decision time.

METHOD

Subjects

Twenty four student volunteers aged between 23 and 34 took part in the experiment. They all were native Arabic speakers with no known history of hearing loss or speech disorder.

Materials

The materials consisted of two sets of three-syllable words controlled for frequency [16]. The first set comprised 18 quadruplets of which the first item was a /SW/ or /WS/ minimal stress pair member. Each member of minimal stress pairs served as a prime either to a target semantically related to it (R1), or a target related to the second member of the pair (R2) or to a control word (C), which was matched to the prime as closely as possible on syllable length, frequency of occurrence, word class and polysemy. The second set consisted of 18 triplets of which the first item was a /SW/ or a /WS/ common word token realized in a correctly stressed (CS) or a mis-stressed version (MS). Mis-stressing resulted when stress was shifted either to the right in the case of a /SW/ word, or to the left in the case of a /WS/ one. The CS and the MS versions of such words were used to prime semantically related and control targets (C). In addition, 126 words were selected to serve as primes to nonword targets formed by changing one to two phonemes across all possible positions in the original 126 words. Four lexical decision lists were prepared each containing 62 to 64 items half of which were non-word targets. The other half consisted in word targets primed either by a member of a minimal stress pair, a correctly stressed common word or a mis-stressed common word. Stimuli were recorded in a sound-treated room using a Sony double-deck cassette (TW320) and a microphone Vivanco (EM 238) to be digitized later at a sampling rate of 10 kHz and a 12 bit resolution.

Procedure

Subjects, tested individually in a quiet room heard, the stimuli over a pair of headphones. A practice set comprised 24 trials half of which were non-words. The interstimulus interval was 100 ms, while the inter-trial interval was 1s. Stimuli were presented in two blocks containing two experimental lists each. A five-minute pause separated the presentation of the two lists within a block which was presented to half of the subjects. The prime-target pairs were counterbalanced across the lists and their presentation was randomized for each block. The same test word never appeared twice in the same list. Subjects had to respond "word" or "nonword" as quickly and as accurately as possible by pressing one of the two appropriately labelled response keys which were counterbalanced across subjects. The presentation of stimuli and collection of data were controlled on-line by a Toshiba T 5200, using a da_tr program (Hallé 1991). Response times were measured from the acoustic offset of the target word.

RESULTS

Minimal stress pair analysis

Subjects' reponses included a low error rate -3%- both for minimal stress pairs and common words, so the analyses to be presented below concern RT's only. /WS/ words were longer in duration and yielded longer RTs than /SW/ words. fig.1. displays subjects' mean RTs. A two-way ANOVA -by subject F1 and by items F2- showed that the main effect of Stress was not significant [F1(1,23) = 0,49, p = ,5., F2(1,48) = 0,69,p =,5], reflecting the absence of difference in the processing of targets presented after /SW/ and /WS/ primes.There was, however a significant

main effect of Relation [F1(2,23) = 28, p = ,05., F2(2,48) = 96, p = ,05]. The interaction between the two factors was also significant in both analyses [F1(2,48) = 21, p < ,05., F2(2,48) = 18, p < ,05], with R2 responded to as quickly as R1 when the prime was /SW/. When the prime was a /WS/ item however, R1 was responded to significantly more quickly than R2 whose response time did not excel that of the control word C.

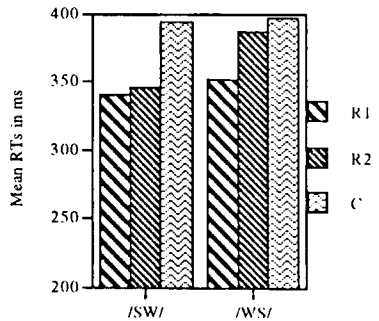

Fig.1. Mean lexical decision times in ms. R1= prime and target are semantically related, R2 = the target is primed by the member of the stress partner to which it is not related, C = control word.

In other words, while the target /ræ:qæ/, which is related to the /WS/ /wæsʕafa/ can be facilitated both by the /WS/ and the /SW/ versions of the sequence /wæsʕafa/, the target /ʃæræhæ/ which is semantically related to the /SW/ member of the minimal stress pair was facilitated only when preceded by the relevant priming stress partner.

Accordingly, our data do not concur entirely with those of Cutler [4], who argues that there is little premium in computing lexical stress on-line on the basis of her finding that English minimal stress pairs behave like homophones. Indeed, it would be counterintuive to sustain such an idea in MSA for the following reason: Lexical stress conveys morphological information in the sense that a stressed syllable always contains at least one segment belonging to the root morpheme, and root morphemes have a special status in MSA as they are associated with a semantic load the knowledge of which is crucial to the understanding of all the morphologically complex words. So, the failure to observe any leftward stress movement effects in minimal stress pairs may be due to the fact that the movement is between two syllables of equal weight. Furthermore, the /SW/ stress pattern is of higher frequecy because in MSA lexical stress assignment proceeds from right to left and the syllable on the right is more often than not an unstressable syllable [17].

Common Word Analysis

Mean lexical decision times in ms are displayed in Fig. 2. A two-way ANOVA revealed significant main effects of Stress [F1(1,23) = 133, p< ,05., F2(1,48) = 2,3, p<,05] and Relation [F1(2,23) = 7,5, p= ,05., F2(2,48) = 12, p= ,05]. The interaction was not significant, however [F1(1,23) = 0,49, p = ,5., F2(1,48) = 0,8, p = ,5].

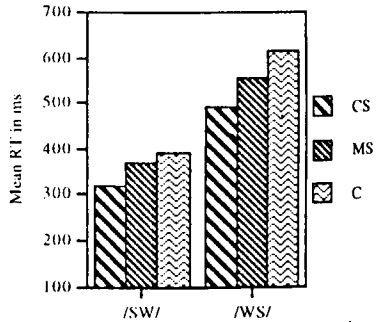

Fig. 2. Mean lexical decision times in ms. CS = a correctly stressed prime followed by a related target. MS = a mis-stressed prime followed by a related target. C = a control word.

The common word data show that lexical decision is seriously impeded both when stress is moved leftwards and rightwards. A /SW/ common word like /kætæbæ/ fails to prime a related target when it is realized in an unorthodox /WS/ stress pattern /kætæbæ/. Similarly, a canonically /WS/ common word like /ʃæ:hadna/ is of little facilitatory affect when mis-stressed as /ʃæ:hadna/.

This result shows that stress movements in both directions have an adverse effect on word processing. This may be explained as follows: Mis-stressing a /SW/ common word amounts to replacing a frequent stress pattern by a less frequent one, while mis-strsessing a /WS/ common word involves a stress shift from a heavy syllable to a light syllable, that is from a CVC to a CV. So in both cases word processing is impeded. We are tempted to say that the effects of syllable weight and stress pattern frequency are additive, although our data do not address this question directly.

CONCLUSION

Two key outcomes emerge from the experiment: First, priming is unaffected by *leftward stress movements* in minimal stress pairs. Second, both *leftward and rightward stress movements affect priming in common words*. It is suggested that when stress movements involve a shift between syllables of equal weight and when it results in a more frequent stress pattern, it is without effect. But when it is from a heavy syllable to a light one, or when it substitutes a less frequent stress pattern for a dominant one, a significantly less priming effect results.

Overall lexical stress is important in MSA as it conveys morphological information that is crucial to the meaning of the word [18]. Moreover, the *reduced variability of syllable structure*, the *ease with which syllable boundaries can be located and the interaction between syllable structure and lexical stress* all make the drawing on lexical stress in MSA a real premium.

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