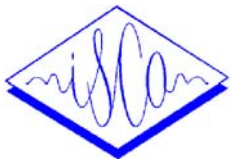

5th International Conference on Spoken Language Processing (ICSLP 98)
Sydney, Australia
November 30 - December 4, 1998

THE ROLE OF STRESS FOR LEXICAL SELECTION IN DUTCH

Jean Vroomen and Beatrice de Gelder

University of Tilburg, PObox 90153, 5000 LE TILBURG
The Netherlands

10.21437/ICSLP.1998-460

ABSTRACT

In the present study, we examined whether stress constrains the number of activated lexical candidates. In a phoneme monitoring task, we used Dutch carrier words that start in their citation form with a reduced vowel /ə/ (denoted as @), but which can also be produced with an unreduced vowel. For example, a word such as frequent (meaning frequent) can be pronounced as fr@QUENT (/frəˈkwɛnt/) or freQUENT (/freˈkwɛnt/). We examined whether mis-stressing these words had an effect on the activation of their lexical representation. Twenty subjects detected a target phoneme (e.g., the 't') in fr@QUENT, freQUENT, FR@quent, or FREquent; stress denoted in capitals. Results showed that target phonemes in words were reacted faster than in pseudowords, but neither stress, nor the nature of the vowel had an effect on the size of lexical effect. This confirms that stress is not part of the lexical input representation.

1. INTRODUCTION

A major issue in spoken word recognition is concerned with the role of prosodic information, in particular stress, in the activation and selection process of stored lexical representations. From the lexical statistics of English and Dutch, it is evident that there exist only very few minimal stress pairs such as SUBject and subJECT. Merely on the basis of this statistical fact, one might deduce that prosodic information does not enter the lexical selection process, simply because it will hardly ever be of use. However, at present only very few empirical data are available on this topic. Moreover, it is necessary to distinguish between the role that prosodic information has in *speech segmentation* versus *speech recognition*. The central question in speech segmentation is to understand how listeners segment the continuous speech signal into discrete words when there are no reliable acoustic cues that signal the beginning of words. In speech recognition, on the other hand, the focus is rather on how and when speech input activates word candidates so that a single lexical candidate is selected and recognized. Prosodic information may have different roles in speech segmentation and speech recognition.

Recently, we [1] have proposed that listeners in languages like Dutch assume that words start with a stressed syllable, but stress itself is not part of the lexical input representation in the sense that it reduces the cohort of activated lexical candidates. Evidence showing that prosodic information has indeed a role in speech segmentation has so far been obtained in Finnish [2] and Dutch [1]. Finnish is a language where each word has fixed stress on the initial syllable. In a word spotting task, we showed that words were recognized much faster when there was a stress cue on the word-initial syllable. The same pattern of results was found in a learning task were listeners had to segment new 'words' from an artificially created continuous speech string that listeners had never heard before. Finnish, but not French listeners were much better when words had stress on the initial syllable.

A similar observations was made in Dutch. This is important, because in Dutch the position of the stressed syllable is variable, and not fixed as in Finnish. Nevertheless, also in Dutch we found that words were recognized faster when the word-initial syllable was stressed, even when words were controlled for acoustic differences [1]. Taken together, these results show that stress has a role in speech segmentation because it signals a potential word boundary.

On the other hand, so far we and others have not been able to find reliable evidence for a role of stress in the lexical activation/selection process. In English, Cutler [3] observed with cross-modal priming that minimal stress pairs such as forBEAR and FORbear primed both their associates. This led her to conclude that stress does not constrain the number of lexical candidates. In Dutch, we came to the same conclusion on the basis of a phoneme monitoring task in which words with a correct versus an incorrect stress pattern were compared [1]. More specifically, the lexical contribution to phoneme monitoring remained the same whether carrier words were correctly stressed or mis-stressed. For example, there was no difference detecting the target phoneme 't' in the correctly stressed word BRUIloft (meaning wedding) or in its mis-stressed form bruiLOFT, if compared to non-words BRAAloft and braaLOFT. These finding led us to suggest that stress does not constrain the number of lexical candidates during word recognition.

In the present study, we continued these experiments and devised a more stringent test. In the previously mentioned study [1], all carrier words contained full unreduced vowels. However, a stronger test would be if words were mis-stressed which have in their citation form the reduced vowel schwa /ə/, because in phonology, a schwa can never be stressed. One may therefore expect that mis-stressing a word such as fr@QUENT as FR@quent /ˈfrəkwɛnt/ is a much bigger violation than mis-stressing BRUIloft as bruiLOFT. If on the other hand, there is no difference between fr@QUENT as FR@quent, one has firm evidence that stress is indeed not part of the lexical input

representation.

In addition, the Dutch language allows one to test directly the combined role of vowel identity and mis-stressing. Many words that start in their citation form with a reduced vowel, can be pronounced with an unreduced vowel as well (except those words that start with the prefixes b@, v@r, or g@). For example, fr@QUENT can also be pronounced as freQUENT /freˈkwɛnt/. If stress interacts with the reduced/unreduced nature of the vowel, one may expect that mis-stressing freQUENT as FREquent is less harmful than mis-stressing fr@QUENT as FR@quent. If on the other hand, stress is not part of the lexical input representation, one expects once again no difference between these word forms.

2. METHOD

Participants. Twenty students from Tilburg University took part in the experiment. They were all native Dutch with normal hearing. They received course credits for their participation.

Materials. Twenty-four disyllabic carrier words were selected. All had in their citation form a schwa in the initial syllable and thus stress on the second syllable. The to-be-detected target phoneme was always a 't' or 's' at the end of the carrier word (The complete list of word targets can be found at the end). The other word forms were derived from the citation form. In the miss-stressed condition, the stress pattern was changed, but the phonemes were not. For example fr@QUENT became FR@quent. In the unreduced condition, the reduced vowel became unreduced (in most cases, /ə/ became /e/), but the stress pattern remained the same (fr@QUENT became freQUENT). Finally, in the mis-stressed/unreduced condition, fr@QUENT became FREquent.

In order to measure the lexical contribution of these words, nonwords were created by changing the initial phoneme. For example, the control conditions for fr@QUENT, FR@quent, freQUENT, and FREquent were br@QUENT, BR@quent, breQUENT, and BREquent, respectively. As fillers, another 24 disyllabic words (all with reduced vowel in citation form, half of them miss-stressed) and 24 nonwords (half with stress on the first syllable, the other half with stress on the second syllable) were selected that did not contain a target phoneme.

Procedure. Four lists were constructed, one for each version of an item. Stress and vowel reduction was counterbalanced across word quadruples and lists, so that a subject received all conditions, but never heard the same word more than once. A short list of 16 practice trials was also recorded.

All participants were tested individually. They were instructed to press a button as fast as possible whenever they heard a previously specified target phoneme. Targets were shown for 1500 ms on a computer screen. The carrier word was then played back 500 ms after presentation of the target.

3. RESULTS

Reaction times (RT) were measured from the onset of the target phoneme (see Table 1). One item was discarded because of an experimenter error. The 2 (Word/Pseudoword) x 2 (Correctly Stressed/Mis-stressed) x 2 (Reduced/Unreduced Vowel) ANOVA on the RTs showed that, as expected, words were reacted faster than pseudowords (a lexical effect of 36 ms, on average, $F_1(1,19) = 14.69$, $p < .001$; $F_2(1,22) = 9.11$, $p < .006$). There was no difference between the various word forms: Neither stress, nor the nature of the vowel had an effect on the size of lexical effect, and all interactions were non-significant (all F's < 1). The error rate was very low (0.7%) and equally distributed across the four conditions.

Table 1
Mean Phoneme Monitoring Time (in ms) for the Final Phoneme

Word Form	*Word*	*Pseudoword*	*Lexical Contribution*
Citation form	fr@QUENT 509	br@QUENT 544	fr@QUENT 35
Mis-stressed	FR@quent 519	BR@quent 546	FR@quent 27
Unreduced	freQUENT 504	breQUENT 546	freQUENT 42
Unreduced/Mis-stressed	FREquent 507	BREquent 547	FREquent 40

4. CONCLUSION

The present experiment investigated whether prosodic information enters the lexical selection process. Words were used that have in their citation form a reduced vowel in syllable-initial position, but an unreduced vowel is also permissible. The words were either mis-stressed or not, and the initial vowel was either reduced or not. If compared to appropriate nonwords, there was substantial lexical facilitation in all words, but no difference between the word forms. Thus even the form that is phonologically illegal, (FR@quent with stress on the reduced vowel), produced a facilitatory lexical effect indistinguishable from that of the citation form. This result is in line with [1,3] and confirms that stress, unlike segmental information, does not constrain the number of lexical candidates.

5. REFERENCES

1. Vroomen, J., and de Gelder, B. “Stress is a cue to word onset: Stress Based Speech Segmentation,” Submitted.
2. Vroomen, J., Tuomainen, J., & de Gelder, B. “The roles of word stress and vowel harmony in speech segmentation” *J. Mem. Lang*., Vol. 38, 133-149, 1998.
3. Cutler, A. “Forbear is a homophone: Lexical prosody does not constrain lexical access,” *Lang. and Speech*, Vol. 29, 201-220, 1986.

6. APPENDIX

Word targets: br@vet, d@bat, d@creet, d@fect, d@vies, fr@gat, fr@quent, cl@ment, kr@diet, m@ljard, p@dant, p@rcent, r@kruut, r@bels, r@cept, r@cent, r@laas, r@pliek, r@spect, s@creet, sk@let, g@nant, v@rnis