HOW DO DUTCH LISTENERS PROCESS WORDS WITH EPENTHETIC SCHWA?

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ABSTRACT

Dutch words with certain final consonant clusters are subject to optional schwa epenthesis. The present research aimed at investigating how Dutch listeners deal with this type of phonological variation. By means of syllable monitoring experiments, it was investigated whether Dutch listeners process words with epenthetic schwa (e.g., 'balluk') as bisyllabic words or rather as monosyllabic words. Real words (e.g., 'balk', 'balluk') and pseudo-words (e.g., 'golk', 'golluk') were compared, to examine effects of lexical representation. No difference was found between monitoring times for BAL targets in 'balluk' carriers as compared to 'balk' carriers. This suggests that words with epenthetic schwa are not processed as bisyllabic words. The effects for the pseudo-words paralleled those for the real words, which suggests that they are not due to lexical representation but rather to the application of phonological rules.

1. INTRODUCTION

In Dutch, words like 'balk' (*beam*) and 'dorp' (*village*) are often realised with an inserted schwa, i.e. in this case as 'balluk' and 'dorrup'. This epenthesis of schwa is optional, but occurs frequently. It is restricted to the realisation of consonant clusters consisting of consecutive liquids and non-coronals (e.g., /lk/, /rp/). A word like 'geld' (*money*) will therefore not be realised as 'gellud'. The epenthetic schwa is supposed to create an extra syllable (Booij, 1995). Kuijpers, Donselaar and Cutler (1996) provide a more detailed phonological treatment of Dutch epenthetic schwa in their introduction.

The aim of the present study is to investigate how listeners deal with this type of phonological variation. Since epenthetic schwa occurs frequently but not consistently in Dutch, listeners need to realise that a village may be referred to as either a monosyllabic 'dorp' or a bisyllabic 'dorrup'. The main question here is whether listeners process words with epenthetic schwa (e.g., 'balluk') as bisyllabic words. A related question is whether this type of phonological variation is lexically represented.

In order to answer these questions, both real words and pseudo-words with or without epenthetic schwa were investigated in a syllable monitoring experiment. In syllable monitoring, subjects listen to targets followed by carrier words and decide as rapidly as they can whether the target was in the carrier. This paradigm was chosen since it was found to be sensitive to syllable structure in Dutch (Zwitserlood, Schriefers, Lahiri and Donselaar, 1993; Donselaar and Stoutjesdijk, 1994). In the experiment by Zwitserlood et al. faster response times were obtained for CVC targets like BUK (*bend*) in bisyllabic carriers with a matching first syllable like 'buksen' (*rifles*) or 'bukken' *(bend*) than in carriers like 'buks' (*rifle*) or 'bukt' (*bends*).

In the present monitoring experiment response times are predicted to be faster for BAL targets in carriers with matching first syllables due to epenthetic schwa (e.g., 'balluk') than in carriers without epenthetic schwa (e.g., 'balk'). Monitoring latencies for BALK targets were predicted to be shorter in 'balk' carriers than 'balluk' carriers.

2. METHOD

2.1 Material

Twelve monomorphemic CVCC real words (nouns) with a final consonant cluster of liquids and non-coronals were selected as stimulus materials, such that the initial CVCs were real words as well. Analogously, twelve CVCC pseudo-words were created, of which the initial CVCs were pseudo-words as well. Table 1 lists an overview of the words used.

Twelve real words and twelve pseudo-words with matching initial targets and 48 real words and pseudo-words with matching final targets (e.g., RAAT-referaat) were used as fillers. Ninety-six fillers with only a partial overlap between target and carrier, e.g. MES-melk (so-called catch-trials) were added as well.

All material was read by a female speaker with phonetic training in one session, and recorded on Digital Audio Tape. The stimulus targets (e.g., BAL/BALK) and carriers (e.g., 'balk/balluk') were read separately. There were therefore two different recordings of the 'balk'-like stimuli, one of which was used as a target and one as a carrier.

Table 1. Stimulus word materials.

real words		**pseudo-words**
vel-velg	(*skin-rim*)	kel-kelg
hel-helm	(*hell-helmet*)	mel-melm
vol-volk	(*full-people*)	gol-golk
ver-verf	(*far-paint*)	zer-zerf
nor-norm	(*nick-standard*)	bor-borm
pul-pulp	(*tankard-pulp*)	ful-fulp
bal-balk	(*ball-beam*)	ral-ralk
wal-walm	(*shore-smoke*)	nal-nalm
gal-galg	(*gall-gallows*)	jal-jalg
dor-dorp	(*dry-village*)	sor-sorp
per-perk	(*per-bed*)	ner-nerk
tol-tolk	(*toll-interpreter*)	zol-zolk

2.2 Subjects

Fifty-six subjects, all native speakers of Dutch, were recruited from the MPI subject pool. They were paid for their participation.

2.3 Procedure

Subjects were tested in pairs in separate, sound-treated booths. Stimuli were presented via headphones. The subjects received written instructions to listen carefully, to decide as quickly as possible whether the carrier contained the target, and press the corresponding ('yes/no') button. The experimental system used was NESU on a Hermac AT computer. If the subjects did not press a button within 1500 ms after the onset of the carrier word, the response was treated as missing. Each session took approximately 40 minutes (including instructions, practice trials and a 5 minute break halfway).

2.4 Design

Fixed factors were structure of the Target (BAL/BALK), structure of the Carrier ('balk/balluk') and type of Word (real word/pseudo-word). All items appeared in the crossed combinations of Target and Carrier. To avoid an effect of repetition of the same items, four different experimental versions were used. The conditions were divided over the versions according to a Latin Square. The dependent variables were: reaction time (in ms) and the hit ('yes') rate. The reaction results were subjected to separate analyses of variance, with subjects (F_1) and items (F_2) as random factors, respectively. Any effect reported as significant here had a p value below .05.

3. RESULTS AND DISCUSSION

Figure 1 gives the 'yes' rates for real words, which were on average quite high (74%), although comparatively low for the condition in which BALK targets had to be detected in 'balluk' carriers (38%). Hit rates were significantly higher for BAL targets than for BALK targets (F_1[1,55]=35.6; F_2[1,11]=32.2) and for 'balk' carriers as compared to 'balluk' carriers (F_1[1,55]=66.2; F_2[1,11]=53.2). The interaction between Target structure (BAL vs. BALK) and Carrier structure ('balk' vs. 'balluk') was significant as well (F_1[1,55]=38.0; F_2[1,11]=31.1). Figure 2 shows that the pattern of results for the pseudo-words was highly similar to those for the real words. The effect of Target structure was only significant in the analysis by subjects (F1[1,55]=7.2), but the main effect of Carrier and the interaction between Target and Carrier were significant in both analyses (resp. F_1[1,55]=85.9; F_2[1,11]=24.5, and F_1[1,55]=33.7; F_2[1,11]=9.8).

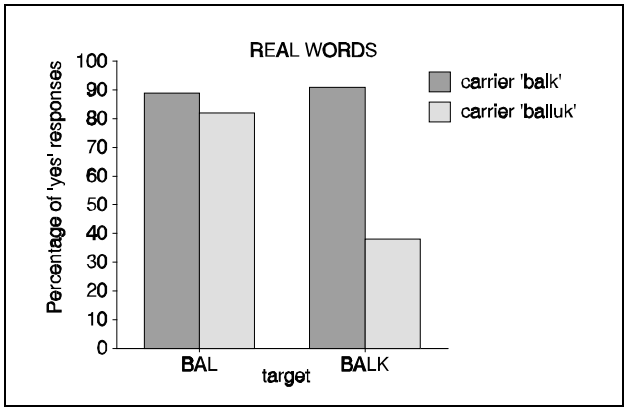

Figure 1. Average hit rates as a function of Target and Carrier, for real words.

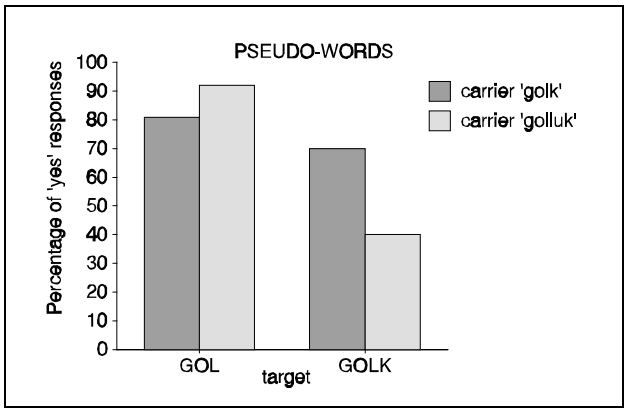

Figure 2. Average hit rates as a function of Target and Carrier, for pseudo-words.

The effect of Word type (real word vs. pseudo-word) was not significant in the analyses of the hit rates. Figures 3 and 4 show the average reaction times for real words and pseudo-words. As can be seen in these figures, word type did have an effect on the reaction times, since faster reactions were obtained for real words than for pseudo-words in all conditions. This effect was significant (F_1[1,55]=16.0; F_2[1,11]=26.5).

For the real words (see Figure 3), the reaction times only partially confirmed the predictions: the BALK targets were detected faster indeed in 'balk' carriers than in 'balluk' carriers, but the BAL targets were detected equally fast in 'balk' and 'balluk' carriers. The interaction was just significant in the analysis by items (F_2[1,11]=4.2). For the pseudo-words (see Figure 4), a cross-over interaction was visible: GOLK targets were detected faster in 'golk' carriers than in 'golluk' carriers, whereas GOL targets were detected faster in 'golluk' carriers than in 'golk' carriers. The interaction was

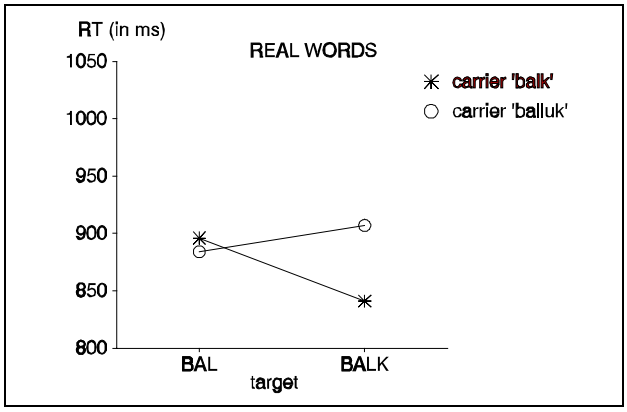

Figure 3. Average reaction times as a function of Target and Carrier, for real words.

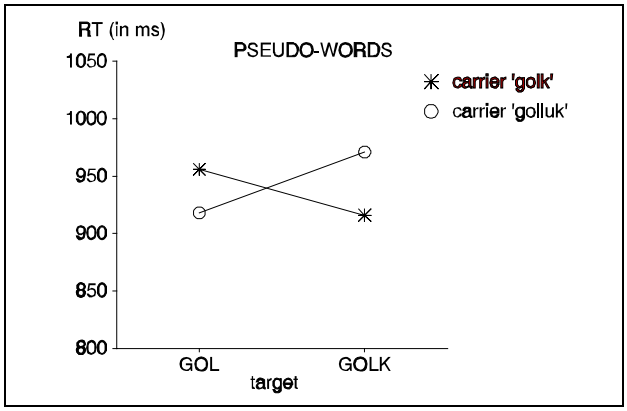

Figure 4. Average reaction times as a function of Target and Carrier, for pseudo-words.

significant in the analysis by subjects (F_1[1,55]=9.5). Although, at first glance, Figures 3 and 4 show slightly different patterns of results for real words and pseudo-words, the analyses showed no significant interaction between Word type and the structure of Target and Carrier. The difference in response times between GOL targets in 'golk' and 'golluk' carriers was not significant in a t-test. Since there is no advantage of 'balluk' carriers over 'balk' carriers in the detection of BAL targets, it was concluded that 'balluk' carriers are not processed as bisyllables. However, in both real words and pseudo-words, BALK-like targets were detected faster in 'balk'-like carriers than in 'balluk'-like carriers. This might indicate that listeners resyllabify words with epenthetic schwa: the match between monosyllabic BALK targets and monosyllabic 'balk' carriers is closer than the match between monosyllabic targets and bisyllabic 'balluk' carriers. An other possibility is that subjects in this experiment made an acoustic match, although a distractor ('klaar', meaning *ready*) had been inserted between targets and carriers to keep them from doing this. BALK targets and 'balk' carriers were of course different acoustic realisations but acoustically more similar than BALK targets and 'balluk' carriers. If listeners followed an 'acoustic-match' strategy, these results do not tell us very much about the way words with epenthetic schwa are processed or represented. As Figures 3 and 4 show, the reaction times in this experiment were quite long and therefore they possibly reflect strategic decision making. The low 'yes' rates in the condition where BALK targets had to be detected in 'balluk' carriers seem to point in the same direction. All in all, the results of the present experiment are difficult to interpret. Therefore the experiment was replicated: to avoid strategic processing the set-up was changed in an attempt to reduce the response latencies and increase the hit rates.

4. REPLICATION

4.1 Method

The stimulus materials to be tested remained the same, but three major changes were made to the experimental set-up. In the original experiment, items with initial targets and final targets appeared in random order. In the replication, the items were blocked into two groups: one block of items and fillers with initial targets (e.g., BAL-balk) and one block of items and fillers with final targets (e.g., ROOL-tieferool). It was expected that subjects would be able to respond faster if they knew where the target would occur. Subjects received no feedback on their reaction times in the original experiment. To speed up reaction times in the replication, subjects received feedback on their average reaction times, every ten trials. A third difference between the original experiment and the replication was that the first experiment was a 'yes-no'

decision task, whereas the replication was a 'go-no go' task. Subjects only had to press the button when they detected the target word in the carrier word.

4.2 Results and discussion

Fifty-six new subjects from the same population participated in the experiment. The replication results showed higher average hit rates than in the previous experiment (85% vs. 74%) and lower reaction time averages (736 ms vs. 905 ms). The hit rates for the condition in which BALK targets had to be monitored in 'balluk' carriers increased considerably from 39% to 67%. The hit rates did not show differences between real words and pseudo-words. The reaction times again reflected this difference, since real words led to much faster responses (by 80ms on average) than pseudo-words (F_1[1,55]=45.7; F_2[1,11]=35.5). There were no significant interactions between Word type and the structure of Target and Carrier.

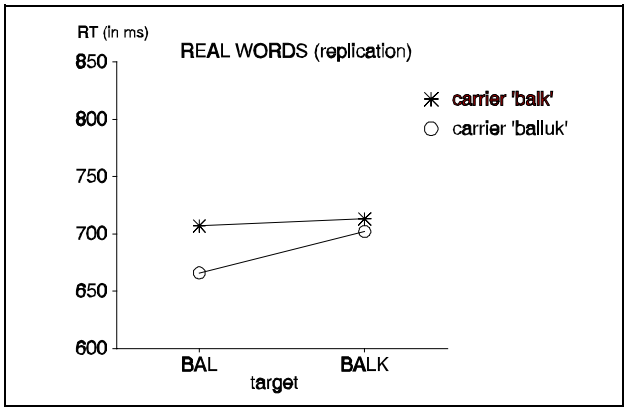

Figure 5. Replication. Average reaction times as a function of Target and Carrier, for real words.

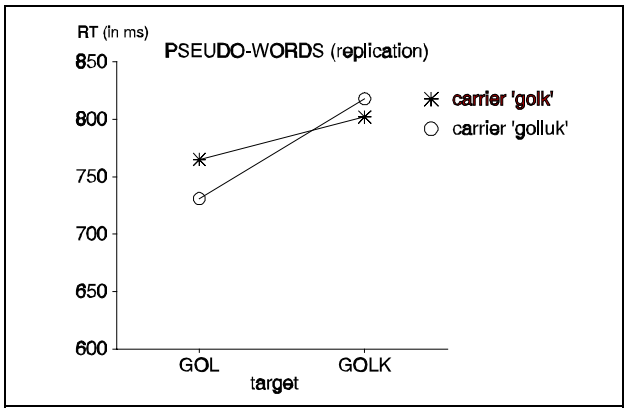

Figure 6. Replication. Average reaction times as a function of Target and Carrier, for pseudo-words.

Separate analyses of both real words and pseudo-words showed no interactions, and the reaction time differences between BAL targets in 'balk' and 'balluk' carriers was not significant in t-tests. The earlier differences between BALK targets in 'balk' and 'balluk' carriers were not replicated in this experiment. The present results therefore do not show any significant difference between carrier words with and without epenthetic schwa.

5. CONCLUSIONS

The aim of the present study was to investigate how Dutch listeners deal with optional but frequent epenthetic schwa in the realisation of words with certain final consonant clusters. One question was whether listeners process these words as bisyllables. The present results do not indicate that words with epenthetic schwa are processed as bisyllabic since no difference was found between target monitoring in monosyllabic realisations (e.g., 'balk') and realisations with epenthetic schwa (e.g., 'balluk'). The results also indicate that real words and pseudo-words were processed in very similar ways, which suggests the application of phonological rules to the occurrence of epenthetic schwa rather than a lexical storage of epenthetic variation.

Furthermore, the number of word pairs with and without schwa in a final cluster of liquids and non-coronals (e.g., toorn-toren; meaning *rage-tower*) is very limited in Dutch and many pair members are highly infrequent. The presence of epenthetic schwa in a word will therefore seldom lead to confusion as to its lexical identity.

REFERENCES

1. Booij, G. (1995). *The phonology of Dutch*. Oxford: Clarendon Press.

2. Donselaar, W. van and Stoutjesdijk, O. (1994). The acoustic/phonetic factors behind the 'syllable effect', in: M. Everaert, B. Schouten & W. Zonneveld (eds.) *OTS Yearbook 1993* (pp. 25-43). Utrecht: LED.

3. Kuijpers, C., Donselaar,W. van and Cutler, A (1996). Phonological variation: epenthesis and deletion of schwa in Dutch. In: *Proceedings of the Fourth International Conference on Spoken Language Processing*, Philadelphia.

4. Zwitserlood, P., Schriefers, H., Lahiri, A. and Donselaar, W. van (1993). The role of the syllable in the perception of spoken Dutch. *Journal of Experimental Psychology: Learning, Memory and Cognition*, vol. 19, 2:260-271.