

# 'PRESIDENT' DOES NOT EXCITE 'PRESS': THE LIMITS OF SPURIOUS LEXICAL ACTIVATION IN L2 LISTENING

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## ABSTRACT

Two Cross-Modal Priming experiments assessed lexical activation of unintended words for nonnative (Dutch) and English native listeners. Stimuli mismatched words in final voicing, which in earlier studies caused spurious lexical activation for Dutch listeners. The stimuli were embedded in or cut out of a carrier (*PRESident*). The presence of a longer lexical competitor in the signal or as a possible continuation of it prevented spurious lexical activation of mismatching words (*press*).

**Keywords:** spoken word recognition, nonnative listening, lexical activation, phonetic contrast.

## 1. INTRODUCTION

While listening to a second language, even proficient second language learners may find it difficult to distinguish between particular sounds of that language. Such perceptual difficulties complicate the recognition of words. Minimal pairs that only differ in a difficult to distinguish contrast [1; 2], like *write–light* for Japanese listeners, and words with partially overlapping onsets [1; 3; 4], like *rocket–locker*, are harder to recognize for nonnative listeners, as they experience more activation of the unintended word than native listeners do. Further, non-words, that are embedded in the speech signal, like *lemp* in *eviL EMPire*, cause more activation of word forms they resemble (*lamp*) for nonnative listeners than for native listeners [1; 5].

In all the cited studies, spurious activation of unintended word forms was due to the difficulty listeners had distinguishing a particular phoneme contrast. Broersma [1; 6], however, found that similar problems may arise for phonemes that are perceptually unambiguous. Dutch listeners are familiar with obstruent voicing contrasts in their native language, but not in word-final position, as the distinction is neutralized in that position in Dutch. Although they can categorize English word-final voicing contrasts accurately [7], even

Dutch listeners with a high level of proficiency in English as a second language showed an increase of lexical activation of unintended words compared to native listeners. Minimal pairs like *code–coat* activated each other more for them than for native listeners [1]. Further, non-words like *glope* perfectly activated the words they resembled (*globe*) in a Cross-Modal Priming (CMP) experiment and were indeed judged as words in a lexical decision experiment [6]. Minimal pairs and non-words differing in final consonant voicing caused as much spurious lexical activation for the Dutch listeners as items differing in the perceptually difficult L2 contrast /æ-ε/ [1].

Note that the spurious lexical activation could not be resolved through lexical competition. For the minimal pairs, lexical competition seemed to remain unresolved as both lexical representations were activated equally strongly. For the non-words, the auditory input activated only one lexical representation, and there was no lexical competitor active that could suppress its activation.

This paper investigates whether the presence of longer lexical competitors might diminish the spurious lexical activation for nonnative listeners in the case of the word-final voicing contrast. Two studies with the difficult to distinguish /æ-ε/ contrast showed that the activation of such lexical competitors did not prevent spurious lexical activation for nonnative listeners [1; 8]. This may be different for the final voicing contrasts, which are not perceptually confusable for the nonnative listeners.

Two questions are addressed: Is there still increased lexical activation for nonnative listeners compared to native listeners, first, when a longer and better matching lexical competitor is present in the speech signal, and second, when a possible continuation of the speech input yields a longer and better matching lexical competitor?

## 2. EXPERIMENT 1

A CMP experiment investigated the activation of words that were ‘almost embedded’ in a longer carrier word, except for a mismatch in final consonant voicing, like *cab* in *capital*.

### 2.1. Method

#### 2.1.1. Participants

Participants were 36 native speakers of Dutch, recruited at the Radboud University Nijmegen (The Netherlands), and 36 native speakers of British English, recruited at the University of Birmingham (UK). The Dutch participants had received on average 7 years of English instruction and had a high level of proficiency in English as a second language. None of the participants reported any hearing loss, visual loss or reading disability. They received a small fee for participation.

#### 2.1.2. Materials

As experimental items, 12 monosyllabic English words were selected for visual presentation, 6 of which ended with a voiced consonant (/b,d,v,z/) and 6 with a voiceless consonant (/t,s/). For each visual target word, three auditory primes were selected. First, for the Identity condition, a di- or trisyllabic carrier word was found in which the target word occurred as an initial embedding (e.g., *cabinet* for *cab*, *precedent* for *press*). Second, for the Mismatch condition, for each target word the voicing of the final consonant was reversed, so that voiced consonants became voiceless and vice versa. For some items, this resulted in an existing word (e.g., *cab* became *cap*); for others, it resulted in a non-word (e.g., *press* became *\*prez*). For those items, a carrier word was found as well (e.g., *capital* for *cap*, *president* for *\*prez*). Third, for the Control condition, a phonologically and semantically unrelated di- or trisyllabic word was selected (e.g., *balustrade* for *cab*).

As fillers for visual presentation, three sets of 24 words and 32 non-words were selected, each set with a different type of auditory prime. For the Identity condition, a carrier word was selected that contained the item as an initial embedding. For the Mismatch condition, for half of the items the vowel and for the other half the final consonant was replaced with another phoneme, and a carrier word was selected that contained the result. For the Control condition, a phonologically and

semantically unrelated word was selected. Again, all the auditory materials were di- or trisyllabic words. Finally, there were 12 words with the same three types of auditory primes, which are discussed in [8]. For these items, for the Mismatch condition, the /æ/ was replaced with /ɛ/ and vice versa.

Items selected for visual presentation were not spelled like existing Dutch words, and items selected for auditory presentation did not sound like existing Dutch words. All auditory materials were recorded by a male native speaker of British English. The speaker read the items one by one, separated by a pause, in a clear citation style. The recording was made in a soundproof booth using a high quality microphone onto digital audiotape and downsampled to 16 kHz during transfer to a computer.

#### 2.1.3. Design and Procedure

Each participant was presented with each of the visual targets only once, with four of the experimental targets in each of the three conditions: Identity condition (e.g., *cabinet* - *CAB*), Mismatch condition (e.g., *capital* - *CAB*), and Control condition (e.g., *balustrade* - *CAB*). Each participant was presented with all of the filler words and filler non-words, and with the 12 /æ-ɛ/ items discussed in [8], such that each participant saw a total of 96 words and 96 non-words, with 64 presentations in each of the three conditions. Items were presented in a semi-random order, such that maximally five words or five non-words were shown in succession, and two experimental targets were separated by at least one other item.

On each trial, an auditory stimulus was presented binaurally over closed headphones and at offset of that, a visual stimulus appeared on a computer screen. Participants were asked to indicate with a button press, as fast and as accurately as possible, whether the visual stimulus was an English word or not. No time limit was imposed for the responses. After each button press, the next trial started.

### 2.2. Results

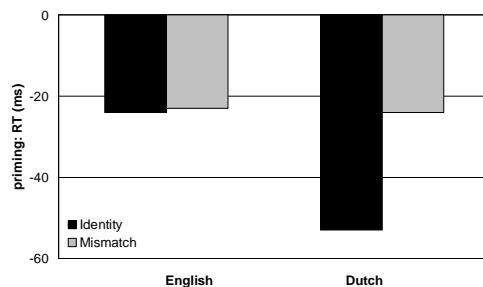
For the experimental items, visual targets were always real words. In the following ANOVAs, the dependent variable was the mean reaction time (RT) of the correct (“yes”) responses.

The results are shown in Figure 1. Although the figure suggests a hint of inhibition, there was no effect of Condition ( $F_1(2, 136) = 3.76, p < .05$ ;  $F_2$

(2, 22) = 1.76,  $p > .1$ ). There was no interaction between Condition and Group ( $F_1(2, 136) = 1.24$ ,  $p > .1$ ;  $F_2(2, 22) < 1$ ). Thus, the recognition of the visual target word was not facilitated if it was preceded by a prime word that fully or almost contained the target word (compared to an unrelated prime), for Dutch and English listeners alike. These results differ significantly from those for the /æ-ε/ items described in [8], as reflected in an interaction between Manipulation (/æ-/-ε/ versus consonant voicing) and Condition ( $F_1(2, 136) = 7.63$ ,  $p < .001$ ;  $F_2(2, 44) = 4.62$ ,  $p < .05$ ).

Finally, the English listeners' RTs were shorter than those of the Dutch listeners ( $F_1(1, 68) = 14.67$ ,  $p < .001$ ;  $F_2(1, 11) = 50.39$ ,  $p < .001$ ), and the proportion of correct responses was higher for the English listeners than for the Dutch listeners ( $F_1(1, 70) = 40.72$ ,  $p < .001$ ;  $F_2(1, 11) = 13.02$ ,  $p < .01$ ).

**Figure 1:** Experiment 1, priming results, computed as the reaction times of correct responses in Identity or Mismatch condition minus those in Control condition, with negative values indicating inhibition.



No activation was found for 'almost embedded' words mismatching in word-final voicing. For Dutch listeners, hearing a word like *capital* or *president* did not facilitate recognition of *cab* or *press*. Further, hearing a word like *cabinet* or *precedent* did not facilitate recognition of the really embedded words *cab* or *press* either. Presumably, as the lexical representation of the carrier word matched the speech input better than the 'almost embedded' word (lacking the consonant voicing mismatch, as well as matching a larger part of the input), the carrier word deactivated the 'almost embedded' word. These results differed from those for the /æ-ε/ contrast [8], where after presentation of the full word form, the 'almost embedded' word form was still activated for Dutch (but not for English) listeners.

Experiment 2 investigates whether there is increased lexical activation for nonnative listeners when a longer and better matching lexical

competitor is not actually present in the input, but only forms a possible continuation of the speech signal.

### 3. EXPERIMENT 2

In this CMP experiment, the stimuli from Experiment 1 were truncated and listeners were presented with fragments either fully (*press*) or almost (*\*prez*) forming a word.

#### 3.1. Method

Participants (36 Dutch and 36 English listeners) met the description given for Experiment 1. Embedded words and non-words were excised from the carrier words (e.g., Identity: *press* from *precedent*, Mismatch: *\*prez* from *president*). For the Control condition, the initial part (the first syllable and sometimes the onset of the second syllable) was excised from the unrelated word (e.g., *\*bal* from *balustrade*). Primes were words in Identity condition, and words or non-words in Mismatch and Control condition and for the fillers.

#### 3.2. Results

The results are shown in Figure 2. For the experimental items, there was a main effect of Condition ( $F_1(2, 140) = 16.96$ ,  $p < .001$ ;  $F_2(2, 22) = 8.75$ ,  $p < .01$ ), and no interaction between Condition and Group ( $F_1(2, 140) = 1.55$ ,  $p > .1$ ;  $F_2(2, 22) < 1$ ). As Figure 2 shows, there was facilitation in Identity condition ( $F_1(1, 70) = 39.93$ ,  $p < .001$ ;  $F_2(1, 11) = 21.08$ ,  $p < .001$ ), but not in Mismatch condition ( $F_1(1, 70) < 1$ ;  $F_2(1, 11) < 1$ ). Consequently, RTs were shorter in Identity condition than in Mismatch condition ( $F_1(1, 70) = 22.62$ ,  $p < .001$ ;  $F_2(1, 11) = 13.26$ ,  $p < .01$ ).

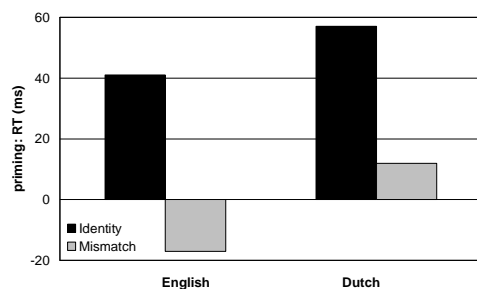
Finally, for the English listeners, RTs were shorter ( $F_1(1, 70) = 21.48$ ,  $p < .001$ ;  $F_2(1, 11) = 25.74$ ,  $p < .001$ ) and the proportion of correct responses was higher ( $F_1(1, 70) = 19.85$ ,  $p < .001$ ;  $F_2(1, 11) = 6.10$ ,  $p < .05$ ) than for the Dutch listeners.

Both for Dutch and for English listeners, embedded words cut out of a longer carrier word activated the lexical representations of these embedded words: *cab* cut out of *cabinet* activated the word form *cab*. However, fragments that mismatched a word in final voicing did not activate those word forms: *cap* from *capital* did not activate *cab*, and *\*prez* from *president* did not activate *press*. For the Dutch listeners, this pattern differs

from that for the difficult to distinguish /æ-ɛ/ contrast, where both *chess* from *chestnut* and \**chas* from *chastity* activated the word *chess* [1; 8].

Thus, even when a better matching lexical competitor was not actually present in the input, but only formed a possible continuation of the speech signal, there was no increased lexical activation for the nonnative listeners for the consonant voicing contrasts.

**Figure 2:** Experiment 2, priming results (see caption Fig. 1).



#### 4. DISCUSSION

In earlier experiments, non-words differing from words in a final voicing contrast caused more lexical activation for nonnative listeners than for native listeners [6]. In the present study, there was no increased lexical activation for the nonnative listeners. The crucial difference between the current and the earlier experiments is the presence of longer lexical competitors. In the earlier study, only very few of the non-words matched the beginning of a real word. In a study with minimal pairs, lexical competitors were equal in length [1]. In the present study, on the other hand, all the stimuli were either presented within a carrier word, or were cut out of a carrier word. In Experiment 1, the presence of a competitor that matched the speech signal better than the ‘almost embedded’ word annihilated any spurious lexical activation for the Dutch listeners. But even the mere possibility of a better matching competitor in the continuation of the stimulus prevented the occurrence of spurious lexical activation in Experiment 2.

These results show an important difference with the activation of words after an /æ-ɛ/ mismatch. Stimuli mismatching in the difficult to distinguish /æ-ɛ/ contrast always caused increased lexical activation for nonnative as compared to native listeners. Thus, after presentation of the entire word *chastity*, *chess* was still active, even though the carrier word itself provided a better match with

the input [8]. Clearly, the activation of a longer lexical competitor was not enough to undo the activation of the unintended word. For the consonant voicing contrasts, on the other hand, the activation of a longer and better matching lexical competitor does seem to be enough to suppress the spurious lexical activation.

It seems that for the final voicing contrasts (which are perceptually unambiguous but linguistically irrelevant in the native language), the nonnative listeners do ‘notice’ the mismatch between the speech signal and the lexical representation. In the absence of a lexical competitor, this does not lead to the bottom-up deactivation of the word form, but if a longer and better matching lexical competitor is activated, it receives more activation than the unintended word, so that it can deactivate that word through lateral inhibition. For the difficult to distinguish /æ-ɛ/ contrast, the better matching lexical competitor may not be favored over the unintended word enough to be able to deactivate it.

Thus, although the easy to distinguish final obstruent voicing contrasts can complicate English word recognition for Dutch listeners, this may only happen when no better matching and longer lexical competitors play a role.

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