

LEXICAL EFFECTS ON PHONEME IDENTIFICATION

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Abstract : The paper examines the effect of word familiarity on the identification of the English alveolar-interdental place of articulation contrast and the interdental voicing contrast. The results confirm those of previousstudies which showed that, while clear phoneme stimuli embedded in words are easily identified by native speakers, identification performance decreases with degraded stimuli. The study further confirms that in optimal conditions, native speakers are not sensitive to word familiarity in identification tasks: they identify both familiar and unfamiliar words with near-perfect accuracy. In adulterated conditions, however, the speech processing system is taxed and they tend to pick the more familiar word of the minimal pair.

Keywords: word familiarity ; identification tasks

In this paper I examine the potential effect of word familiarity on the identification of the English alveolar-interdental place of articulation contrast and the interdental voicing contrast.

The only comparable studies are two recent experiments on the influence of lexical familiarity on the identification of the English /r/-/l/-/w/-/d/ contrasts by Japanese speakers, with native English speakers serving as the control group (Yamada et al. 1996 and Flege et al. 1996). In both of these studies, the English speakers virtually always identified the words correctly, regardless of their "absolute" familiarity or their relative familiarity compared to the other members in the minimal pairs or triads.(Familiarity was assessed in these studies through self-estimation according to a rating scale ranging from " word" through "possible word" to non-word".) On the other hand, while the Japanese speakers had near ceiling

ISBN: 0 08 043 438X

identification scores for /w/ and /d/ which exist in their native language, those with less English experience responded more often with the familiar than with the unfamiliar words in the liquid pairs. The first team of authors concluded that it is only "when the listener has difficulty identifying phonemes from sensory input alone that higher-level knowledge contributes [is appealed to?- CL] to making a judgement" (p.113). The second goup of authors hypothesized that it might be tokens which are ambiguous between /l/ and /r/ for Japanese speakers that are subject to lexical effects; and that non-native speakers might choose the known word over the unknown in a familiar-unfamiliar pair when they are uncertain as to the phonetic identity of the test segment.

Further evidence for an effect of "token quality" on identification performance comes from studies showing that when subjects are asked to categorize members of phonemic contrasts on voicing (VOT) or place of articulation continua where one endpoint is a word and the other a non-word of English, it is the ambiguous stimuli around the middle of the continua that tend to be heard as words rather than nonwords. Identification of the clear stimuli at the endpoints, on the other hand, is not affected by word familiarity (see Pitt and Samuel 1993 for discussion and references). Similar results have been found for natural speech whose quality has been impaired through background noise or some sort of filtering (ibid.). Presumably, such stimuli stress the processing system and their identification is thus slow enough for lexical factors to influence phonemic processing.

The native English data reported here come from an experiment which basically replicates, as part of a bigger project, the Yamada et al. and Flege et al. studies, except for the contrasts tested (interdental and alveolar fricatives), the non-native speakers (French), and an external assessment of word familiarity. The native speaker data is reported here separately, because it was noticed that their identification performance with interdentals was not as good as the performance with alveolars, or with liquids and glides reported in the earlier studies. It was also noticed that the talker who recorded the test words put more emphasis on certain tokens of some of the unfamiliar words, which resulted in clipping off the amplitude peaks that go beyond the range of the recording equipment. While such tokens had to be discarded from the analysis of the French speakers' performance, they are interesting in their own right and have thus been analyzed separately and the results reported here. In particular, it was hypothesized that clipping might have impaired their quality enough to make subjects appeal to the lexical context, that is, the rest of the word, to identify the initial segment and thus tend to respond with the familiar member of the minimal pair.

1. METHODS

1.1. Materials.

A series of contrastive pairs of English words was constructed which contained a voiced and voiceless interdental (THigh-thy, teeTH-teethe) or an alveolar and an interdental matched in voicing (seam-THeme, breeze-breathe) in word initial, medial, or final position. One of the words in each pair was chosen as the test stimulus and recorded twice in a sound-proof booth by a native speaker in random order, with an average inter-stimulus interval of 2.7s (the talker had been asked to count to four between words). In order to increase the limited number of existing English words with interdentals that contrast with words containing an alveolar or

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other interdental, a number of rare and nonsense interdental words had to be included. It was among these words that some tokens with initial, mostly voiceless, interdentals were noticeably clipped on the recording (e.g., THem, THence, thine, thence), as well as one familiar word (THigh), due to over-emphasis on the inital (stressed) syllable.

1.2. Procedure.

Perception was assessed in a forced-choice two-alternative identification test. In individual booths equipped with headphones in the language laboratory, subjects consisting in 15 voluntary native English speakers recruited among undergraduate students and personnel at The Ohio State University, heard the 140-word recording. On a sheet of paper containing 140 minimal pairs, they were asked, for each word they heard, to circle the word on the sheet which corresponded to the word they had just heard. They were told that the corpus would include words known to them as well as words unknown to them, and that the "hard" (voiceless) interdental would be spelled TH and the "soft" (voiced), th, in order to facilitate their task.

1.3. Analysis.

Two phonetically trained listeners auditorily identified the clipped tokens which amounted to 21. Word familiarity was assessed by a native speaker who did not participate in the study. He was given the list of minimal pairs and asked to mark the words that he thought did not exist in English and the ones that exist but are hardly used. He thus marked sithe, but not teethe; sooth, but not soothe, for example. The marked words were labeled unfamiliar and the umarked ones familiar.

2. RESULTS

2.1. Overall identification accuracy.

Subjects correctly identified only 95.7% of the interdentals, but virtually all alveolars (99.6%) which were mostly in familiar words that were not unduly stressed and thus not clipped. More specifically, they at times misidentified one interdental for the other, but virtually never an interdental for an alveolar or an alveolar for an interdental. The interdental voicing contrast thus caused greater difficulty (only 91.7% correct identifications) than the interdental-alveolar place contrast (99.7%). It will be shown that the factor responsible is the impairment of some tokens with initial interdentals. This did not influence the identification of "degraded" interdentals paired with ("non-degraded") alveolars (e.g., *THence* vs *sense*) which were acoustically different enough for correct identification. It did, however, influence the identification of "degraded" interdentals paired with other interdentals (e.g., THem vs them). Only the results for the interdental voicing contrast will therefore be examined further. (Due to space-limitations, no figures can be included). As expected, the subjects had significantly lower scores in word-initial (93.6% correct) than in word-final position (97.6%), as it was initial interdentals that were susceptible to clipping. The less than perfect scores finally were due to a couple of speakers who were unsure of the English spelling rule of adding an 'e' to words ending in a voiced interdental (e.g., *mouth* vs *mouthe*). The subjects also had

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significantly lower scores for the initial voiceless (90.4%) than for the voiced interdentals (96.5%), presumably because the stronger airflow in the former makes them more prone to clipping. Finally, subjects had significantly lower scores with clipped initial interdentals (82%) than with unclipped ones (98.7%), thus confirming the hypothesis that clipping impaired the identification performance of native subjects on the interdental voicing contrast.

2.2. Effect of word familiarity.

The speakers correctly identified interdentals significantly more frequently in familiar words (98.3%) than in unfamiliar words (92.7%), whereas no such difference emerged with alveolars, whose identification scores were at ceiling level. The lower scores for unfamiliar words are due to the fact that in such words a number of tokens were clipped, in particular tokens beginning in a voiceless interdental. The latter were identified correctly 97.7% of the time in familiar and 89.7% in unfamiliar words, the voiced interdental 98.9% and 95.2%, respectively. The lower scores for the voiceless than the voiced in familiar words are due to the word THigh whose second token was clipped. Identification of unimpaired unfamiliar words was significantly better (98.2%) than that of impaired ones (81.2%), due to the fact that when identifying a clipped word, subjects responde with the familiar word more often than with the unfamiliar word. In other words, with impaired stimuli they chose the known word more often than the unknown word. No such tendency to respond with the familiar member of the pair emerged in the identification of unclipped unfamiliar words.

CONCLUSION

The results confirm those of previous studies which showed that, while clear phoneme stimuli embedded in words are easily identified by native speakers, identification performance decreases with degraded stimuli. The study further confirms that in optimal speech conditions, native speakers are not sensitive to word familiarity in identification tasks: they identify both familiar and unfamiliar words with near-perfect accuracy. In adulterated conditions, however, the speech processing system is taxed and speakers' phoneme categorization ability is impaired. As a consequence, they tend to pick the more familiar word of the minimal pair. In such conditions, native speakers' performance resembles that of inexperienced non-native speakers whose uncertainty, even in optimal conditions, as to which of two L2 sounds they heard leads them to respond with the more familiar word in identification tasks.

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ISBN: 0 08 043 438X

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ISBN: 0 08 043 438X