

Accents and their Differential Influence on the Perception by Normally Hearing and Hearing-impaired Subjects

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1. Introduction

Although the importance of prosodic cues in speech perception has been established beyond any doubt, relatively little can be found in the literature about the influence of prosodic factors on the perception of speech by persons afflicted with a hearing deficiency. The aim of the experiment to be reported on was to investigate whether prosodic cues are of comparable influence on the speech decoding process of normally hearing and hearing-impaired persons. The variables investigated are emphasized vs. non-emphasized words, position of sentence accent, position of word and speaker variation.

2. Method

In the assessment of the hearing level and its effect upon speech perception it is not enough to use tests which reflect mainly the functioning of the ear and the peripheral-neural parts of the system in response to simple stimuli such as pure tones or clicks for the following reasons: a patient's ability to hear and understand speech may not only be differentially affected by the specific nature of the deficiency, but it will also depend upon other variables, such as for example age at onset of the hearing loss, degree of linguistic attainment and amount of auditory training, all of which reflect the degree of exposure to normal language and are different in quality from those variables concerned simply with the acoustic input side of the system.

Bench and Bamford (1979) fervently plead for an advantage of sentences over words in speech audiometry tests. They mainly derive their arguments from the simple fact that 'because sentences are more than mere strings of words, perception of words in isolation is not necessarily a good predictor of the perception of sentences, which constitute the material of everyday speech' (1979: 17). An additional advantage of sentences over words is that they also allow investigation of the time domain, since they are of sufficient duration to permit alteration of the temporal characteristics of speech. The same holds of course for various other prosodic parameters.

On the strength of these arguments we decided that our test material should consist of sentences. For the construction of the test sentences the

following criteria were kept in mind: occurring words should be in common use and checked for frequency of occurrence in natural language, sentences should be syntactically simple and more or less equal in length so as not to be a burden on the memory and, of course, they should be semantically acceptable. As to the number of sentences we decided - on the basis of various trial runs - that 17 sentences would achieve an acceptable balance between reliability and test duration.

We selected our speakers - one male and one female - on the grounds of good intonation, clear articulation and good voice quality. Both were native speakers of Dutch. Sentences were read out in three versions, the difference consisting in sentence accent assignment. Recordings were made using high-quality recording equipment. For masking purposes speech noise was recorded on a parallel track. Based on a pilot study S/N ratio for normally hearing subjects was decided to be -2 dB and for hearing impaired subjects +5 dB so as to achieve an average score of approximately 50% correct for either group.

In all 106 subjects participated in the test; 53 were pupils of various secondary schools for hearing impaired children; their ages ranged from 12 to 17 years and they all had a congenital hearing loss. Hearing impaired subjects took the test individually. The 53 normally hearing subjects were either undergraduate students of the Department of English of Utrecht University or students of the Dutch Academy for Tourism, none of whom had any self-reported hearing deficiencies. They took the test in a language laboratory equipped with headphones. Subjects of each group were randomly assigned to an experimental condition (male or female speaker, early, middle or late sentence accent). They received oral and written instructions and were asked to write down whatever they heard after every test item, even if it were only a fragment of the whole sentence.

3. Analysis and Results

The first two sentences were considered practice items and were therefore not incorporated in the analysis of results. The remaining 15 sentences were analysed as to influence of accent (emphasized vs. non-emphasized words), position of accent in the sentence (early, middle or late) and position of the word in the sentence. Results were quantified in terms of number of correctly perceived words. Figure 1 shows the results.

Although S/N ratios for normally hearing and hearing impaired subjects had been based on pilot experiments, we have to accept the fact that hearing impaired subjects' scores were lower than the hoped for 50% limit and normally hearing listeners' results were lower still. We therefore did not consider it justified to carry out interpopulation comparisons as to absolute values of test results, but we want to make the following observations:

- in all conditions, i.e. both subject categories, both speakers and all accent positions, accented words are perceived better than unaccented words.
- hearing impaired listeners score highest on the early accent position

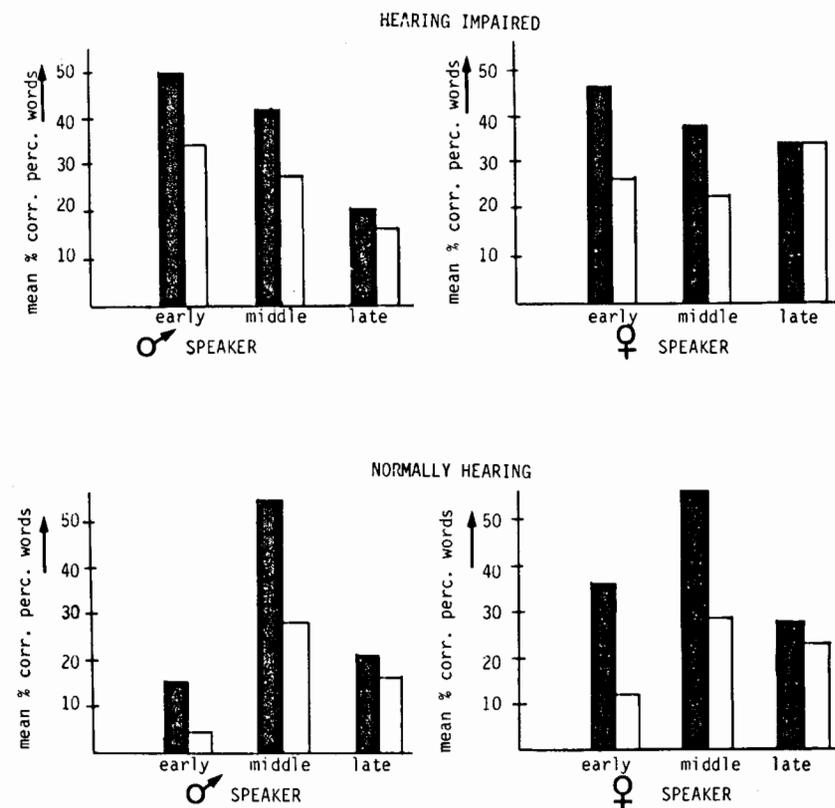


Fig. 1. Mean percentage of correctly perceived words per condition. ■, accented words; □, unaccented words.

condition and lowest on the late accent position condition. Normally hearing subjects score highest on the middle accent position; this again holds for the male and the female speaker condition.

- SDs are in all conditions smaller for unaccented words than for accented words.
- SDs are on the whole smaller for normally hearing subjects than for hearing impaired subjects; this holds for both the male and the female speaker condition.

Since early, middle and late accent positions are defined in terms of *accented* words only, it seemed necessary to investigate the influence of word position in the sentence in general on the percentage of correctly perceived words by hearing impaired and normally hearing subjects in both the male and female speaker condition. Results of this analysis can be seen in figure 2.

Results of a breakdown of means for all *unaccented* words made us observe the following:

- both listener groups show relatively high scores for word positions early in the sentence.

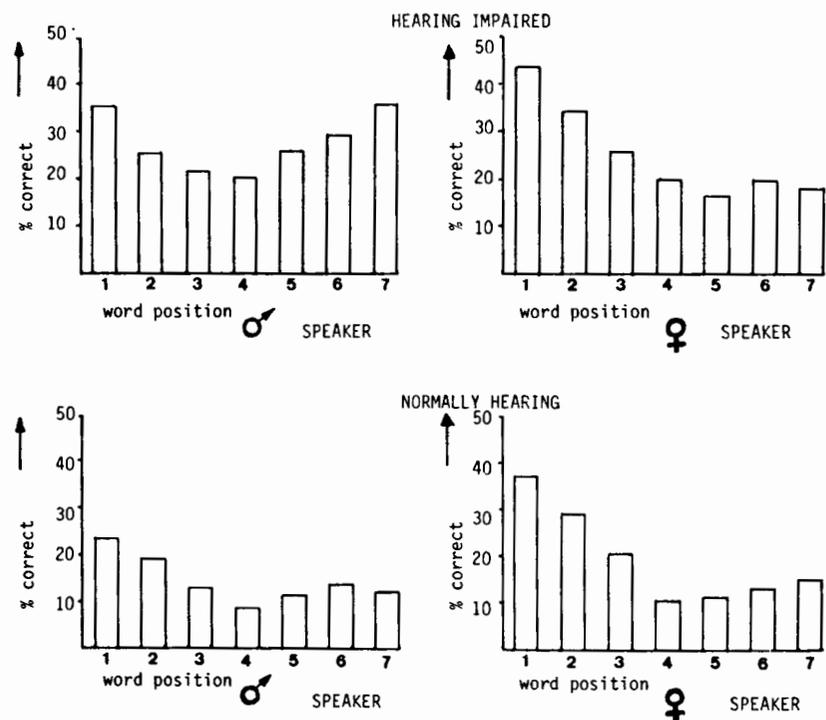


Fig. 2. Mean correctly perceived words per word position for either male or female speaker condition.

- SDs are smaller for normally hearing listeners than for hearing impaired listeners; this difference is more marked in the male speaker condition than in the female speaker condition.
- (corollary): the degree of variability of responses is related to the absolute number of correct responses; thus we must assume that a high percentage of correct scores is caused by a small number of extremely good responses.

4. Conclusions

As to test scores of unaccented words we see a declining discrimination line for *both* groups of subjects indicating a higher percentage of correctly perceived words at the beginning of the sentences. This can most probably be explained by the fact that the amount of information is highest at the beginning of an utterance, or sentence and that the listener has trained himself to focus his attention on that part of the sentence. However when looking at the influence of *position of accent* we see different results for the two populations: hearing impaired listeners show - as was also the case for unaccented words - the highest scores on the early accent position, whereas normally hearing listeners score highest on the middle accent position. In other words: the general structure of test results remains the same for hearing

impaired listeners whether looking at accented or unaccented words, whereas this is clearly not the case for the normally hearing population.

It is also known from the literature that hearing impaired persons generally have great difficulties in detecting which of a limited number of words in an utterance is emphasized, whereas normally hearing people are accurate and highly consistent in making decisions as to what parts in a sentence are stressed (Risberg and Agelfors, 1978; Lea, Medress and Skinner, 1972). These observations corroborate our findings and our main conclusion is then that accent has a less differentiating function in the decoding process of speech by hearing impaired listeners than by normally hearing persons.

Overall percentage correct responses is somewhat higher in the female speaker condition than in the male speaker condition (31% vs. 27%). An attempt at generalizing these findings would not be warranted in this particular case because of the lower speech rate of our female speaker as compared with the male speaker. The influence of speech rate on the perception of normally hearing and hearing impaired listeners will be discussed in the related paper by Vingerling.

References

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