AN EXPERIMENTAL INVESTIGATION OF SPEECH PERCEPTION IN MOTOR APHASIA

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ABSTRACT

The perception of sentences with directional prepositions was studied in motor aphasia in two experimental conditions: 1) experiments in aphasia to identify prepositions in spoken sentences, while in Experiment 2 the sentence as a whole had to be understood and identified with a pictorial representation. The type of testing had a significant effect on the subjects' error number, suggesting that they chose different strategies. The types of perceptual confusion also depended on the testing procedure. The phonetic factor of primary importance in preposition identification, whereas the semantic meaning of prepositions plays a major role in sentence identification.

I. INTRODUCTION

This report reviews a series of experiments investigating speech production and perception deficits in motor aphasia. Our previous studies have shown that speech difficulties are caused by the inability or reduced ability to process and reproduce particular combinations of phonemes and morphemes in aphasia (e.g., voicelessness and softness in plosives) while at the same time retaining the correct use of other features (e.g., voicelessness and softness in fricatives). Motor aphasic seem to be quite sensitive to the phonetic realization rules, i.e., they process and perceive those phonemes successfully which are strongly emphasized at the point of production or perception and fail to pronounce and perceive weak phonemes that are not emphasized. This is a comparative complexity on either level.

Analysis of the data showed that individual phonemes are used to combine in speech utterances. As motor aphasic are unable to produce certain phonemes, they tend to simplify the sound chains of a sentence. The experiment tested the time of non-verbal reaction was measured automatically. There were 4 subjects with motor aphasia in the study. Two subjects with normal speech were also investigated. Two aphasics were tested twice in experiments 1 and 3, while the total number of responses was 50/3. In Experiment 2 two subjects were tested twice and one subject three times, giving 60 responses in total.

III. DISCUSSION OF THE EXPERIMENTAL DATA

First of all, it should be mentioned that the average error number was much higher in Experiment 1 (268) than that in Experiment 2 (188), indicating that it is much more difficult for aphasics to detect (in the spoken utterance) a particular segment (a proposition) in this experiment; and recognize it as a number of alternatives then to identify this utterance with one of the given visual stimuli (line drawings). Normal subjects made no mistakes in either experiment.

Figure 1 gives the matrices of preposition substitutions in Experiment 1 and 2 (in per cent).

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the distribution of prepositions (in per cent) the aphasic perceived in sen-
tences as indicated in the left margin. Cells forming the diagonal are cases of correct responses. Prepositions in the codes were 'ran' and 'is' were acted and 'in' and 'is' were transposed. The other concomitants in the prepositions con-
cides with the transcription.

For most prepositions (4 out of 6) the number of correct responses was higher in experiment 1 than in experiment 2. There are two exceptions, i.e., prepositions "at" (out of). Both preposit-
ions belong to the "away from the object" group. It seems to be worth mentioning that the preposition which was the easi-
est to identify ("is") is phonetically the longest, while the preposition which turned out to involve the largest number of errors was the case with shortest dur-
ation ("at"). It was quite natural to expect that the phonetic structure of a preposition was crucial for its correct identification. To test this hypothesis, we calculated the percentage of correct identifications of one-phoneme versus two-phoneme prepositions. The data ob-
tained confirmed this hypothesis. One-
phoneme prepositions were identified cor-
rectly in 67% of cases whereas two-phoneme (syllabic) prepositions were cor-
rectly identified in 70 per cent of cases.

At the same time, it seemed sensible to suppose that the phonetic structure of prepositions would affect the compre-
hen sion task in experiment 2 to a lesser degree than in experiment 1. This hypo-
thesis proved correct. The total number of correct responses in experiment 1 to one-phoneme prepositions was approx-
imately the same as to two-phoneme pre-
positions (63% and 60%, respectively).

In order to investigate further the role of the phonetic and semantic factors in speech perception and comprehension, we analyzed the types of most frequently
encountered mistakes from considering the length and semantic meaning of pre-
positions. The experimental data have shown that there is a "universal substitu-
tor", namely, the preposition "is" (out of), which replaces other prepositions in most cases in both experiments. As mentioned above, this preposition runs in unequivocal and is identified with accuracy in experiment 1.

It was rather tempting to look for a phonetic tendency in the perceptual con-
fusion pattern.

In experiment 1 one-phoneme prepositions revealed a slight tendency to be percet-

As two-phoneme prepositions. In the case of two-phoneme prepositions, the mistakes were determined by chance.

In experiment 1 the phoneme tended to perceive one-phoneme prepositions as two-
phoneme prepositions. The reverse was true (71% and 28%, respectively). The two-phoneme prepositions, however, were randomly confused with prepositions of either class.

Our next task was to test the semantic hypothesis of prepositional agnomy according to which the perceptual im-

cumstances in aphasia reflect the compli-
city of semantic features associated with a certain preposition.

Experiment 1 was designed to evaluate the ability of motor speech to process the speech flow and identify the segment. an expected, the semantic factor is not of primary importance for the aphasic listener and, consequently, the percentage of correct responses to prepositions denoting movement towards an object was roughly equal to that of prepositions having the opposite meaning (75% and 78%, respectively).

Conversely, in experiment 2 the role of the semantic factor increased: the pre-
positions that denote movement towards an object are 5.4 times more frequently perceived correctly than those which de-
scribe movement away from it. The total number of correct responses was 83% and
78%, respectively.

An analysis of the mistakes has shown that motor aphasia understand the direc-
tional meaning of a preposition and are able to describe it to one of the two be-
side groups but fail to recognize the ac-

we single feature. Thus, in experiment 1 the "towards an object prepositions" are confused with each other in 79% of the cases. The mistakes and to "away from the object" prepositions ur-
group in 70% of all cases. There was no uniform-
arity to be a function of the perceptual pattern in experiment 2.

The reaction time during the two percep-
tual experiments was found to be much-

ger in motor aphasia than in normal subjects and the lists of identification time.

In experiment 1 the data support the hypothesis that dis-
turbances in the perception of prepositions are often encountered in motor 
aphasia and is related to the phonetic structure of these function words.

The relative importance of the phonetic factor in the perception of prepositions 
depends on the type of the perceptual task. Thus, it seems to be of primary im-

portance in tasks involving the phonemic analysis of speech flow (as in experimen-
t 1) rather than by other factors, e.g., semantic, when experimental condi-
tions provide the subject to listen to an utterance not merely for its 
semantic content but for its comprehension as a whole (as in experiment 2).

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