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Are Phonemes Really Realized?

By H. MOL, Oegstgeest

It has become increasingly clear since the 4th Congress that only in isolated words a speaker brings into full play the complete system of perceptual differences characteristic of his language.

For the correct identification of isolated words the listener is solely dependent on the acoustic information contained in the sound waves and on his knowledge of the words of the language in question and of the articulatory habits of the speaker.

As a matter of fact the well-known paradigmatic technique used in defining the phonemes is based on the often exaggerated precision with which isolated words can be identified. Hence, strictly speaking, the thus-defined phonemic system only pertains to the exceptional and rather abnormal situation of isolated words enunciated by one particular speaker. Application of the phonemic system to other situations, including the normal, is an as yet unproved extrapolation, notwithstanding the practical advantages of such an extrapolation for the art of writing.

In connected speech a speaker, as it were, eases the strain. He permits himself considerable overlap, especially in the vowels. No 'clustering' in his vowel-formants can be detected. Fortunately he gets away with his seemingly sloppy articulation because the listener has at his disposal other, extra-phonetic, cues derived from the context, the situation and his knowledge of the linguistic structures he may expect. In really alphabetic writing, connected speech is recorded visually with the aid of the complete set of phonemic symbols derived from the pronunciation of isolated words, a notation which suggests an articulatory precision that is decidedly not present.

The seeming ease with which connected speech is recorded alphabetically by adult writers is very deceiving and lures our

attention away from a very complicated brain mechanism that places the human writer well above the level of a teletype. The alphabetic way of recording some of the aspects of connected speech is uncannily ingenious but constitutes at the same time a great barrier to scientific progress. At the moment phonemics is completely under the spell of alphabetic spelling and pays lip-service to writing. This is frankly admitted by *K. L. Pike* who gave the following title to one of his books: "Phonemics, a technic for reducing spoken language to writing."

The current, but untenable, extrapolation in linguistics is to explain the aural identification of words as a running analysis into a familiar sequence of phonemes, thereby putting hearing into the same class as alphabetic reading. The next slippery step is to regard pronunciation as the production of a running series of phonemes. The main theme of this Congress: "The phoneme and its realization" openly shows this alphabetic bias.

Alphabetic writing is based on a conscious interpretation of the differences one thinks one hears between sound waves that are experienced as different words. These differences, however, are referred to in, often vague, articulatory terms, evidently because the articulatory data are the only data to which one has direct conscious access. Interviews with illiterates show that language users belonging to that category identify words in a subconscious manner. They cannot even answer simple questions that presuppose alphabetic training. They simply 'know' when different words are presented to them and state they 'hear' them as different.

The undeniable success of alphabetic writing and reading as practical methods based on conscious processes has, as it were, gone to the heads of those phonemicists who regard the phonemes as units that actually 'function' in a brain mechanism. They tacitly assume that, before the advent of phonemics, the phonemes did their work in the darkness of the subconscious. In their opinion the phonemes were, as it were, patiently waiting until they were brought into the light of publicity by a talent scout. Phonemes, however, have not been discovered, they have been invented, which makes all the difference.

Though the alphabetic system is the result of the combined efforts of many brain mechanisms, we may not, without further preface, infer that the brain also uses alphabetic units for its own purposes. We must reckon with the possibility that a manufacturer of

lemonade drinks champagne himself. It is necessary to investigate whether the physiological properties of the brain mechanism makes such a thing as a high-speed running alphabetic analysis possible at all. Psychologists have established that the capacity of the nervous system is too low for handling the separate phonemes as they are defined by means of the paradigmatic technique. Moreover, phoneticians have shown by measurement that there is no one-to-one correlation between actual articulation and intention for the vowel phonemes in connected speech. Even in isolated words there are no such things as absolute acoustic cues that unambiguously label the speaker's intention.

Modern theory of brain mechanisms as, for instance, developed by *Frank Rosenblatt* who was greatly inspired by *D. O. Hebb*, shows how a brain mechanism can learn to recognize stimuli via a process of conditioning involving feed-back. Analysis into discrete units, so characteristic of conscious processes, is unnecessary and even undesirable in this automatic process. In the systems proposed by *Rosenblatt* in his "Neuro-dynamics" recognition of a pattern of nervous activity, be this recognition correct or not, is the result of the joint activity of, in this case, acoustic as well as situational stimuli acting on the same field of the brain.

Sound waves are, by their very nature, time functions that describe how the barometric pressure varies with time. Only a limited number of portions of a sound curve can make themselves felt in the nervous system as patterns of nervous activity. These portions follow each other in time because there is no other possibility.

Likening these portions to the alphabetic units that are also supposed to follow each other in time is tempting but nevertheless false. These portions are time intervals of possible nervous activity but the activity itself is not quantized in discrete possible units: a practically continuous scale of patterns of nervous activity is possible in every portion. The net result is that the active length of a sound curve is shorter than the total duration of that curve.

A parrot can echo speech waves as well as barking and laughing. It cannot be expected to handle phonemes in speech and to use another system in barking or laughing. Its brain mechanism does not even recognize. It just stores the patterns of nervous activity corresponding to sound waves in a non-alphabetic manner and there is no reason to suppose that the human brain uses a fundamentally different system for storing and processing. Therefore, in my opinion, it

would have been wiser to speak of: "Phonetic reality and the phoneme" than of "The phoneme and its realisation".

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Discussion

Westring Christensen (Copenhagen): Je suis d'accord avec *M. Mol* qu'il n'y a pas de relations très simples entre les phonèmes et les «faits» articulatoires et acoustiques, que les phonèmes n'existent pas dans le cerveau et que les phonèmes sont, dans une certaine mesure, inventés par les linguistes. Seulement je n'aime pas que *M. Mol* préfère parler de la *réalité phonétique et du phonème* au lieu de parler du *phonème et sa réalisation*, parce que la *réalité phonétique* en soi n'existe pas; elle est toujours interprétée par un observateur, que cela soit directement par un informateur ou par un linguiste, soit indirectement à l'aide d'instruments.

Je trouve que la «réalité» phonétique formée par une transcription phonématique est aussi «réelle» que la «réalité» phonétique observée par des instruments. Evidemment je ne nie nullement l'utilité d'examiner les aspects physiques, physiologiques ou psychologiques que propose *M. Mol*. Mais je pense que la description de la «réalité» phonétique par une transcription phonématique est beaucoup plus intéressante d'un point de vue linguistique que celle par ondes acoustiques ou mécanismes nerveux, non seulement pour le plan de l'expression dans le sens *hjelmslévien*, mais aussi pour le plan du contenu et pour les rapports entre les deux plans; s'il est par exemple, très compliqué de décrire les expressions de signes dans le sens *hjelmslévien* ou les morphèmes dans le sens américain par des traits distinctifs au lieu de phonèmes, il serait encore plus difficile de les décrire par des formants ou par des symboles de mécanismes cérébraux. Je ne crois pas qu'on puisse déduire une description de l'autre ou inversement, il faut faire les deux. Et j'aimerais qu'on arrive aussi à une description qui rend compte des deux groupes de facteurs pour le comportement des individus parlants, parce que l'interprétation humaine du discours n'est pas la même que l'interprétation animale. Il ne faut pas se faire d'illusions à ce qu'une description soit plus réelle ou plus scientifique que l'autre.

Je pense que la formule que propose *M. Mol*: «Phonetic reality and the phoneme» est aussi fautive que l'autre formule «the phoneme and its realisation», car d'une part les phonèmes n'existent que dans une notation ou transcription, et d'autre part la «réalité» phonétique en soi n'existe pas. J'aimerais qu'on trouve un autre terme que *réalité phonétique*.

Krámský (Praha): In *Mr. Mol's* lecture there were some good observations concerning the discrepancy between writing and speech as to the realization of phonemes of which words are composed. I should like to add some remarks to this interesting theme. I remember Prof. *Jakobson* saying in his lecture several years ago in Prague that some phonemes may be dropped from the word, but not any. And this is the problem: *which* phonemes may be dropped, and if they can be dropped without functional change of the meaning of the word in question, are they still phonemes? Let me give an example from Persian. There are two words in Persian meaning "four": /tʃæha:r/ and /tʃa:r/; *h* is dropped, the two *a*'s are contracted into one. Why was it possible that /tʃæha:r/ could be contracted into /tʃa:r/? Perhaps because the *h* in /tʃæha:r/ has a very weak functional relevance or perhaps a non-distinctive function, so that by dropping it the word is changed but not its meaning, only its form. And the second condition is that the contracted word /tʃa:r/ does not exist in the language in a meaning different from that of the word /tʃæha:r/. If there were such words with another meaning, the reduction of sounds in the word /tʃæha:r/ could hardly take place. However, even

this is not impossible in a language with a tendency to homonymy. Our observations lead us to the following conclusions:

1. We must differentiate between *systemic relevance* (that is the fact that a certain opposition exists in the system of the language) and *lexical relevance* (which depends upon the exploitation of phonemes).

2. In speech we must differentiate between *phonemes with full relevance* (that is such phonemes as are capable of changing the meaning of the word when replacing another phoneme) and *phonemes with non-full relevance* (that is such phonemes whose dropping from the word or replacing by another phoneme does not change the meaning of the word).

3. In connected speech the degree of phonemic relevance depends on the mutual relation of words in the context. If a word has a key position in a context, its distortion must not be great, its components are not redundant. On the other hand, an extreme case is the dropping of one or even more words in a sentence without changing its meaning or making it unintelligible.

The problem of the acoustic identity of the word deserves greater attention than it has been given so far; besides, it is also a problem of redundancy, and, consequently, it is of importance for the theory of communication.

Fischer-Jørgensen (Copenhagen): It is evident that in current quick speech many sound features or whole sounds are slurred or omitted. As far as I have understood Mr. Mol's paper, he seems to conclude from this fact that we do not perceive speech in terms of phonemes. But I am not sure that this conclusion is tenable; it depends on what is meant by perception. It is probably useful to distinguish several levels of perception. We do not hear (with our ears) sounds that are not there, but we may nevertheless at a higher level interpret what we hear as a sequence of phonemes.

Hammarström (Uppsala): According to your definition "phonetic reality" can be obtained through instruments giving "articulatory" and acoustic data. I would rather suggest a definition that includes auditory data. There is no essential difference between the different ways of obtaining data. The phonetician can measure with an acoustic instrument, let us say, the length of two sounds *a* and *b*, but he can also in a very comparable way let a hearer react to the two sounds and ask him to say for instance which of them is longer.

Vachek (Praha): Mr. Mol seems to overlook the fact of different functions of the spoken and written norms. The latter is detached from the extralingual reality with which the former is very closely tied; this is the reason why the former may have so much redundant elements dropped. But in case of misunderstanding we always refer to the basic, "ideal" form. Notice also Sapir's reference to "réalité psychologique de phonèmes": the native informants, quite ignorant of alphabetic (or any writing) give information to the linguist not in terms of sounds but in terms of phonemes.

Pohl (Bruxelles): On pourrait comparer la chaîne parlée à un accordéon. Quand la situation est suffisamment explicite, on peut impunément serrer l'«accordéon», quand la situation fait défaut, il est, au contraire, nécessaire de l'étendre.

J'ai annoncé des expériences sur le degré de compréhension des chiens, mais j'ai dû assez vite m'arrêter, pour de nombreuses raisons et particulièrement à cause de la quantité considérable de «matériel animal» qui aurait été nécessaire. De toute façon, en essayant le plus possible d'éviter les deux écueils du *conditionnement* et de l'*expressivité*, j'ai cherché dans quelle mesure on pouvait déformer le nom du chien sans qu'il cesse de le connaître. A première vue, et sans préjudice de ce que permettraient de conclure des recherches approfondies, il m'a semblé que l'on pouvait soumettre le «cynonyme» à des déformations et à des amputations assez importantes sans qu'il perde sa vertu communicative. Bien entendu, on ne saurait parler ici d'influence de la langue écrite.