

This Week's Citation Classic

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Liberman A M, Cooper F S, Shankweiler D P & Studdert-Kennedy M. Perception of the speech code. *Psychol. Rev.* 74:431-61, 1967. [Haskins Laboratories, New York, NY]

The phonemic segments (consonants and vowels) of speech are encoded in such a way that a single acoustic cue carries information in parallel about successive phonemes. This reduces the rate at which discrete sound segments must be perceived, but at the price of a peculiar relation between acoustic cue and phoneme: cues vary with context, and there are, in these cases, no commutable acoustic segments of phonemic size. Phoneme perception therefore requires a special decoder. [The *Science Citation Index*[®] (*SCI*[®]) and the *Social Sciences Citation Index*[™] (*SSCI*[™]) indicate that this paper has been cited over 415 times since 1967.]

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"The paper's publication coincided with the rising influence of modern linguistics on psychology and with a revived interest among psychologists in the biological foundations of human cognitive capacities, thus accounting for its frequent citation.

"Our work began with our inability, just after World War II, to solve a practical problem: how to convert print to sound in a reading machine for the blind. Initially, we assumed that, just as consonants and vowels are represented in writing by discrete letters of an optical alphabet, so are they represented in speech by an alphabet of sounds. We therefore created devices to transform each letter into an arbitrary but distinctive pattern of sound, expecting that our blind subjects would learn this acoustic alphabet much as they had, in our view, learned the equally alphabetic sounds of natural speech. In the event, they did not. We were slow to

appreciate the significance of this failure, but we finally saw that it might be impossible for a human being ever to learn to make efficient use of an arbitrary alphabet of sounds, however distinctive each sound might be. That led us, naturally enough, to ask: what is special about speech that makes it work so well?

"The answer we offered in our 1967 paper was that speech is not an acoustic alphabet (or cipher) but a peculiar, and peculiarly efficient, code. From a functional point of view, the speech code matches the special requirements of linguistic communication to properties of the vocal and auditory systems that evolved long before language. The chief formal characteristic of the code is that successive consonant and vowel segments are restructured (i.e., encoded) for overlapping and near simultaneous transmission. Since that characteristic of speech follows from the way it is articulated—or, more properly, co-articulated—we came to appreciate that the key to the code is in its manner of production: in speech the processes of perception and production are somehow intimately linked.

"The greatest change in our thinking since the 1967 paper is in our recognition that research on speech opens broad and inviting vistas. We are ever more persuaded that speech is a grammatical code, exhibiting close formal and functional resemblances to the codes of phonology and syntax. In that sense—and, we think, in every other—speech is an integral part of language. It is also the part most accessible to scientific investigation. We hope, therefore, to use it increasingly as a window on language, believing that for many purposes it will afford a better view than we can get at other levels.

"Having been invited to say here what could hardly be said in a formal scientific publication, we would point out that a full six years elapsed between the beginning of the work and the first publication of results. There are, we suppose, few institutions that would have given young investigators so much time. We are therefore grateful to the very small and very independent laboratory that did."