

## PHONOLOGY

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### Summary

Phonology is a branch of linguistics dealing with the function and organization of speech sounds within particular languages and in human language in general. It is closely related to phonetics, another discipline dealing with speech sounds, but differs from it by focusing on the principles that govern the way sounds are organized in languages, rather than dealing with the physical aspect of speech production, transmission and perception. Phonology analyses language in terms of functional units of sound, including sound segments (in earlier approaches known as phonemes) and studies their organization into larger units, such as syllables, phonological words, phrases, and utterances. It expresses rules governing variation in pronunciation, thus searching for significant generalizations about the sound systems of particular languages and, ultimately, about sound systems in general. Phonology expresses rules of sound-patterning in terms of the so-called distinctive features. Apart from segmental features, such as voicing, or nasalization, phonology also deals with the function of the so-called suprasegmentals in languages, features pertaining to units larger than individual segments. These include properties such as rhythm, intonation, or stress, which are all used in language-specific ways in particular languages. Focusing on the abstract system of language, rather than its physical realization through speech, phonology is necessarily rather abstract. Patterns of sound organization in language are expressed by 'models', i.e., metaphorical representations of what the sound system looks like in human mind and how it functions. These models vary a lot, depending on the particular school of thought which the phonologist subscribes to. Roughly, three major types of analytical framework have been deeply influential in the history of modern phonology, i.e., since the full establishment of linguistics as an independent

scientific discipline at the beginning of the 20th century. These are: structuralism, generative (derivational) phonology, including linear and non-linear models, and optimality theory.

## **1. Introduction**

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## **2. The basic notions of phonology**

### **2.1. Segments of sound**

As opposed to phonetics (→ 6.91.1), phonology takes a functional view of speech sounds. What is meant by the function of speech sounds in this sense is commonly explained with reference to a fundamental notion of general linguistics, that of double articulation, also alternatively called duality of patterning. This notion was introduced by the French linguist André Martinet and it refers to one of the essential features of human language as opposed to other systems of communication, like the languages of various animal species, or systems such as the traffic code. In contrast to these other systems, human language is organized structurally in terms of two abstract levels. On the first, hierarchically higher level, language consists of meaningful units. As this observation holds for language in general, as well as any particular language, this point will be illustrated with reference to one possible sentence of English: *'John eats cakes.'*

One does not need any special linguistic training to identify units such as *'John'*, *'eats'*, and *'cakes'*, as well as to decompose two of them, *'eats'* and *'cakes'*, further into *eat+s* and *cake+s*, respectively, and identify the meaning conveyed by each of the component parts. In itself such combination of meaningful units is not specific to human language, but, rather, can be found in other communication systems as well. However, what makes human language so special is the existence of yet another, lower level of organization, on which these basic meaningful units can be further decomposed into smaller units. Intuitively, speakers of English, even if they are illiterate, or independently of the letters used in the spelling, would tend to decompose the word *'eats'* into smaller units of sound as follows: /i:/ + /t/ + /s/. What is essential to note is that these units by themselves do not have any meaning, but combined they create meaningful units and thus function, figuratively speaking, as building blocks in the creation of units on a higher level. Entities of this kind cannot be identified in any other kind of communication system. In analyzing any given language, the phonologist deals with issues such as the identity and distribution of these units of sound in a particular language and the patterns underlying the intuitive knowledge of this distribution making it possible for the speaker to pronounce and recognize acceptable utterances of his language. While native speakers know these patterns intuitively, phonologists are able to state phonological rules explicitly and account for the reasons why some rule operates exactly the way it does. So, to take another example from English, any native speaker would know that words like /\_veh/, or /b/esf/ do not sound English and are thus not possible words of English, while /sl\_fi/ or /se\_t/, albeit potentially, are possible, even though they do not actually exist in English. Another, somewhat less transparent example of this implicit phonological knowledge shared by native speakers of English concerns the pronunciation of the regular plural ending. Any native speaker of English, including illiterate ones, would agree that this ending is pronounced differently in *'cakes'*, *'bags'* and *'churches'*, i.e., as /s/, /z/, and /\_z/, respectively. However, very few of them, unless they have some linguistic training, are able to state the rule explicitly, let alone account for the reasons why the rule operates exactly the way it does. It is the job of the phonologist to identify patterns behind such surface variation in pronunciation. Generally, the phonologist is concerned with the way in which particular languages organize the physical substance of sound into phonological systems. Although certain universal principles are shared by all languages, every language organizes the physical reality of speech in its own way. An obvious proof of this is the adaptation of the pronunciation of foreign loanwords, taking place in all languages. In phonological analysis it is impossible to refer to any of the abstract units of phonology without reference to their physical reality. Phonology is thus inseparable from phonetics, and the two linguistic disciplines largely deal with the same subject-matter, i.e., speech sounds. They only look at them from different points of view, phonetics focusing on their physical reality, phonology looking at them as functional units of linguistic systems.

The units of sound which in connection with double articulation were metaphorically referred to as 'building blocks' of human language are technically called phonemes in traditional phonology. The term was introduced in the early approaches, which saw phonemes as single atomic units of human language. More recent approaches no longer give phonemes the status of the indivisible and ultimate units of phonological analysis, but still occasionally operate with the term 'phoneme' to refer to discrete, i.e.

individually discernable, or clearly separate segments of sound, although the term 'segment' is nowadays largely preferred. In any case, the phonological description of any language necessarily includes the identification of the phonemic inventory, which is the set of distinctive sound units, or phonemes used by a given language. By contrast with speech sounds, whose number is theoretically unlimited, the number of phonemes in a language is limited, ranging from 11 to 141. That is, in purely physical terms any utterance is a continuous wave of sound, and the acoustic patterns corresponding to what in everyday speech we call 'speech sounds' are not individually distinct. If one analyzed acoustically the patterns of sound waves corresponding to any utterance of any human language, there would be no clear boundaries between sound segments. Still, phonologically speaking, there is evidence that human mind does analyze the amorphous continuum of sound in terms of discrete units. Most notably, this is borne out by the existence of phonemic alphabets, in which in principle one letter represents one such sound unit. Even the speakers of languages which do not use this type of alphabet are able to analyze language into segments. One does that unconsciously when applying various phonological rules, which very often are seen as operations which do something to segments of sound: they can delete, add, or re-arrange them.

The phoneme has been defined in several ways in the history of phonology, depending on the approach. When the notion was originally introduced into linguistics, attempts were made to define it psychologically, that is, in terms of some kind of a target sound which the speaker has in mind when uttering the real, concrete sound. However, despite the fact that the phoneme does have its psychological reality, modern linguistics is opposed to an extralinguistic, i.e., in this case psychological definition of fundamental linguistic notions. Thus the earliest attempts to define the phoneme psychologically were soon dismissed as 'mentalist' and a few alternative definitions have been offered instead since then. One of the alternatives was to define the phoneme as a family of phonetically similar sounds, referred to as allophones. To make this definition complete, another basic phonological notion must be introduced, *viz.* that of complementary distribution. To explain the notion it must be observed that the different realizations, or allophones of one phoneme as a rule occur in mutually exclusive contexts: one occurs where the others do not. To illustrate that with reference to English, /k/ is one of the members of the phonemic inventory of English functioning like a 'building block' in words like 'car', 'key' or 'task'. All three realizations of the phoneme under consideration are said to be the allophones of the phoneme /k/ and in phonetic notation are customarily enclosed within square, rather than slant brackets, to indicate their allophonic status. Despite being phonetically similar enough to be felt as members of the same family, each of these allophones of /k/ in English is phonetically slightly different from the other two. Thus the ones in 'car' and 'key', as opposed to the member of the same family occurring in 'task' are pronounced with some audible breath or aspiration (→ 6.91.1: 2.2. *Consonants*) as a result of the prevocalic context in which they occur. Among themselves they phonetically differ in that the one in 'car' is produced at slightly different points in the speech tract, the former being a true velar, as opposed to the latter, which is somewhat fronted towards the palatal region under the influence of the following front vowel. Although, strictly physically speaking, no two realizations of the same phoneme are exactly the same in speech, phonology abstracts away from differences which are below the threshold of human perception and focuses on those which are determined contextually, as in the above example. It is the contexts

in which they occur within the word that give these allophones their identity, and it is the job of the phonologist to formulate rules about their distribution. So, to simplify it a somewhat, it can be observed that the aspirated allophone, properly indicated by the phonetic and phonological notational conventions as [k<sup>h</sup>], occurs before a stressed vowel, and the fully de-aspirated one occurs after [s]. Both phonemes and allophones are necessarily identified and referred to as language-specific entities, as individual languages employ the physical reality of sound in their own specific ways, and what is a phoneme in one language need not be a phoneme in others. Likewise, what is an allophone of some phoneme in one language may be a separate phoneme in another. Thus to refer back to the aspirated velar sound [k<sup>h</sup>], unlike in English, in Hindi, for example, it is a separate phoneme, rather than an allophone of /k/. Allophones are thus seen as realizational varieties of a given phoneme which are determined contextually and thus occur in mutually exclusive contexts, i.e. in complementary distribution.

Another example from English illustrating the complementary distribution, as well as the language-specific status of allophones is that of the possible realizations of the English phoneme /l/. Focusing on the phonetic difference between the initial consonant in 'love' and the final one in 'bell', one may observe that, to put it technically, the latter is velarized (→ 6.91.1: 2.2. *Consonants*), while the former lacks this property. Hence the popular and somewhat impressionistic distinction between the 'clear' and 'dark' /l/ in English, which the case of allophony at hand illustrates. Once again this difference in phonetic quality is contextually determined. Any linguist analyzing English pronunciation would notice that such difference is not random, but rather, there is a pattern behind the distribution of the two allophones, which in this case has to do with the position of the consonant under consideration within the syllable (→ 2.3.1). Once again, this generalization need not and most of the time does not hold true of other languages. In some languages, such as Polish, the 'dark l' is a separate phoneme, while in some others it does not even occur at all in healthy speech, either as a phoneme or as an allophone. Although being part of the definition of the phoneme, complementary distribution in itself is no proof that two sounds belong to the same phoneme. A case in point is the relationship between their English consonants /h/ and /ɥ/, which do happen to appear in mutually exclusive contexts, but having no phonetic similarity whatsoever, they are not considered to be allophones of the same phoneme. Rather, their complementary distribution is accounted for as a matter of historical coincidence.

Although allophones are defined as contextually determined varieties of one phoneme, there are cases where the variants of one phoneme for whatever social or idiosyncratic reasons may appear in the same context, yet without causing any difference in meaning of the given words. These are cases of free variation. So, for example, in Scottish English the place of articulation of /t/ and /d/ may be either alveolar or dental. Hence, [t] and ↙↔ ↘ or [d] and ↙○ ↘, respectively, are said to be in free variation in this variety of English pronunciation (→ 6.91.1:3. *IPA notation*). The notion of free variation is closely related to the notion of the range of performance (sometimes alternatively referred to as the area of tolerance). The range of performance of some phoneme in a language refers to the limits within which sounds are recognized as belonging to that phoneme. Like the notion of phoneme, that of range of performance is language-specific. So, for example if one compares the range of performance of the English phoneme /r/ to that of the Japanese /r/, it can be observed that the Japanese /r/

has a wider range of performance than the English one, as there is no phoneme /l/ in Japanese, so any [l]-like sounds are likely to be interpreted as belonging to the range of performance of the phonetically closest consonant /r/.

Cases of free variation actually represent a weak point of the definition of the phoneme as a set of phonetically similar sounds occurring in complementary distribution. One way of getting around this difficulty is to adopt an alternative approach in defining the phoneme, that is, an approach in which the key notion is that of contrast or distinctiveness. Under this approach, the phoneme is seen as a minimal sound unit which is capable of contrasting word meaning. The proponents of this approach argue that phonemes are identified by their contrast, or, to use their original term, opposition to the other members of the sound system. The procedure to establish the phonemic identity of a sound involves the procedure of substitution, whereby word pairs differing in one sound only are compared to see if the difference changes the meaning. So, for example, if we want to establish whether the sound [ŋ] is a phoneme of English, we need to find out whether in the above sense it is in contrast with some other phonetically similar sound.

Indeed, in English there are pairs of words like 'sing' /sɪŋ/ - 'sin' /sɪn/, where the difference in this single segment carries the difference in meaning. Thus /ŋ/ is capable of contrasting word meaning and is a phoneme of English. In many other languages, such as Italian, for example, this is not the case. Although one can hear a nasal sound [ŋ], which matches the phonetic description of the corresponding English sound, in words like '*banco*' ('bank'), it is not possible to find a single pair of words where the difference between [ŋ] and [n] is contrastive. If we substituted the two sounds for each other in Italian, however strange such pronunciation may sound, the meaning of the words in question would never be affected. So, it turns out that the sound [ŋ] in Italian is an allophone of the phoneme /n/, that is, its contextually determined variety, occurring in certain contexts. Pairs of words like the one in the English example, *sing* - *sin*, differing in one phoneme only are called minimal pairs. The approach based on the notion of contrast is rather static in that the phonemic system of a language is conceived of as a closed system. Each element of the system is defined through the network of relations that hold between itself and the other elements. In other words, the identity of each phoneme of a phonemic system is defined as what the others are not. In terms of logic, this kind of definition can be said to be circular. However, this need not necessarily be seen as a weakness. An approach based on distinctiveness highlights the linguistic function of phonemes and offers some important insights into the nature of phonemic systems.

An interesting issue that arises with the approach based on distinctiveness concerns cases where in some positions the otherwise established phonemes fail to contrast phonetically. A case in point can be found in American English, where pairs of words like '*writer*' - '*rider*' may sound the same. In this particular case, the opposition between voiced and voiceless consonants is suspended. Such contexts are referred to as contexts for neutralization. Likewise, in many languages, the opposition between voiced and voiceless consonants is suspended at the end of the word. A case in point is the German pair of words '*Rat*' ('council') - '*Rad*' ('wheel'), both pronounced with a final [t].

## 2.2. Distinctive features

### 2.2.1. The nature of distinctive features

Two sounds may differ in one or more features. For example, [t] and [d] differ in voicing, the former being voiceless, as opposed to the latter, which is voiced (→ 6.91.1: 2.1. *Articulatory phonetics*). In addition to this, in English, [t] can be aspirated, i.e. pronounced with some audible breath. So, both voicing and aspiration are features of sounds. However, their phonological function is not the same in all languages. In English, voicing is phonologically relevant or distinctive, and aspiration is not and is said to be redundant. It is important to note that in this context the term 'redundant' does not mean anything like 'superfluous', because even those features which are not phonologically distinctive in language do have a linguistic function, which is to serve as additional cues in decoding the message. In fact, a large body of work in phonology, known as underspecification theory, has been devoted to the status of redundant features in phonological representation. In any case, distinctive features provide the basis for distinguishing phonemes, while redundant ones do not. In other words, while in English it matters for the identity of a phoneme whether it is voiced or not, with aspiration this is not the case. Any [t] sound of English is interpreted as an allophone of /t/, irrespective of whether it is aspirated or not. There is not a single pair of words in English differing in the aspiration of a segment only. By contrast, there are languages, like for example, Hindi, or Burmese, where aspiration is distinctive.

One of the approaches to the definition of the phoneme is based on the notion of distinctive features. Phonemes can be conceived of as bundles of distinctive features. Metaphorically speaking, distinctive features can be seen as basic ingredients of phonemes. The very notion of distinctive features actually requires a revision of Martinet's idea of double articulation. By decomposing phonemes into distinctive features, phonologists have gone one step further in analyzing human language and thus abandoned the idea of the phoneme as an atomic unit. Although for many practical purposes it is convenient to treat successive segments of speech sounds as single atomic units, there are good reasons why phonologists operate with distinctive features as the basic units of phonological analysis. In the first place, although a case can be made for the psychological reality of the phoneme, phonemic analysis is at odds with the physical reality of speech. Physiologically speaking, the utterance of any single speech sound is not a unitary action on the part of any single organ in the speech tract. Rather, it involves several simultaneous or overlapping gestures. What is even more important to the phonologist, it is in terms of these 'ingredients' that segments pattern together in phonological processes. So, for example, there would be little point in noticing the distinction between voiced and voiceless segments in phonology, if it did not turn out that each of the two categories of sounds 'behave' in the same way in languages. In other words, natural categories of sounds, sharing some physical properties, also turn out to constitute phonological categories in terms of which generalizations are made, i.e., rules are expressed in phonology. Thus it is of interest to phonologists to be able to refer to some universal system of phonological description based on properties that could be defined independently of particular languages. Since the introduction of the notion of distinctive features in phonological theory, irrespective of the school of thought they belong to, phonologists have searched for a universal framework of the features that are

exploited for phonological purposes in the world's languages.

An important notion associated with that of distinctive features is that of binarity. It turns out that sounds can be classified in terms of two mutually exclusive possibilities. This refers to the presence or absence of a certain feature. In distinctive feature theory, contrasts between phonemes are commonly marked using +/- specification. For example, /t/ is specified as '-voice', while /d/ is '+voice'. It is argued that the principle of binarity is fundamental to human language and that it reflects the nature of human mental processes, in particular, the functioning of the nerve cells. Thus, binarity in phonology can also be related to the principles of binary coding in information theory. However, in phonology the status of binary contrasts is somewhat controversial. That is, there are aspects of phonological description arguably requiring, or at least favoring another type of features, univalent (also referred to by a number of alternative terms: single-valued, monovalent, unary, privative features). Such features constitute the key notion of some more recent models of phonological analysis (→ 3.2.1.2. *Post-SPE Phonology*). It is important to note that segments may be unspecified for certain features, either because a feature is univalent and a given segment does not have it (→ place features), or because some binary feature is irrelevant for a given class of segments (e.g. → ±strident, ± distributed). Generally, in recent phonological theory, distinctive features are not only widely seen as the basic units of phonological analysis, but, moreover, have become a focus of attention in their own right and within such frameworks, several models of feature theory have been rather influential.

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### Biographical Sketch

**Višnja Josipović Smojver** is an associate professor of phonetics and phonology in the Department of



English, University of Zagreb. She graduated in *English language and literature* (1st major) and *Italian language and literature* (2nd major) from the University of Zagreb. Since graduation she has been employed at the same university. She started her academic career as a teaching assistant. In 1987 she completed her post-graduate course and received her Master's degree. Her Master's thesis was a comparative work on the differences between the consonantal systems of English and Croatian. Phonetic and phonological features of foreign accent have since then remained the focus of her interest. Her doctoral thesis with which she received her Ph.D. in 1994 was on the suprasegmental aspects of foreign accent. On several occasions she spent extensive periods of time studying abroad. In 1988 she received a British Fund scholarship and spent a semester studying at University College, London. She spent the academic year 1989/1990 at the University of Massachusetts at Amherst, on a Fulbright scholarship. In the academic year 1992/1993 she taught Croatian in the Department of Slavonic Studies at Nottingham University, Great Britain. The most recent field of her interest is the speech of twins. She has published a number of works in her area, including a university textbook, *Phonetics and Phonology for Students of English* and presented papers at international linguistic and phonetic conferences.

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