THREEFOLD PROPERTIES OF SPEECH SOUNDS

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Annotation: This article examines the threefold properties of speech sounds articulatory, acoustic, and auditory and explains how these dimensions interact in the production, transmission, and perception of spoken language. The study clarifies each property with examples from English and outlines the relevance of the threefold model for phonetic and phonological analysis. Special attention is paid to how articulatory gestures shape acoustic output and how the listener's auditory system interprets these signals. The article aims to give a concise but rigorous account of the phenomenon for students and researchers in linguistics.

Keywords: speech sounds; phonetics; articulatory properties; acoustic properties; auditory properties; segmental analysis; phonological interpretation.

Speech sounds are not simple mechanical events; they are multidimensional phenomena shaped by the speaker's physiology, the physical nature of sound waves, and the perceptual mechanisms of the listener. In phonetics, this complexity is traditionally described through a threefold classification:

a. articulatory,
b. acoustic, and
c. auditory properties.

Understanding speech sounds through this tripartite framework allows linguists to connect what speakers *do*, what the sound *is* as a physical signal, and what listeners *hear*. Because each dimension highlights different aspects of the same event, the threefold model remains foundational in modern linguistic research. Articulatory phonetics describes how speech organs produce sounds. It focuses on the actions of the tongue, lips, vocal folds, velum, and airflow mechanism. These properties answer the question: *How is a particular sound formed?*
The location where the active articulator approaches or contacts a passive articulator defines the place of articulation. For example:

- /p, b/ are bilabial, produced by the two lips.
- /t, d/ are alveolar, produced by the tongue tip at the alveolar ridge.
- /k, g/ are velar, produced at the soft palate.

The second one is manner of articulation. It describes how airflow is manipulated. For example:

- Stops (e.g., /t/, /k/) involve complete closure.
- Fricatives (e.g., /f/, /s/) create turbulence.
- Nasals (e.g., /m/, /n/) redirect airflow through the nasal cavity.

The next one is voicing. Voicing depends on whether the vocal folds vibrate.

a. Voiced: /z/, /v/, /g/.
b. Voiceless: /s/, /f/, /k/.

Articulatory characteristics form the basis of phonetic classification and are essential for understanding how physical gestures correspond to phonological contrasts. While articulatory phonetics deals with gestures, acoustic phonetics analyzes the sound waves produced as a result. Every speech sound generates measurable acoustic patterns, typically examined through spectrograms. Key acoustic properties include:

Frequency: this refers to the number of vibrations per second, perceived as pitch. Vowel quality depends heavily on the relative frequencies of formants (F1, F2, etc.). For example, /iː/ has a high F2, while /uː/ has a low F2.

Amplitude: amplitude determines loudness, reflecting the energy of the sound wave. Stressed syllables generally have higher amplitude than unstressed ones.

Duration: duration corresponds to the time a sound lasts. Length differences play a phonological role in some languages, though in English they primarily support rhythm and stress.

Formant structure: formants resonant frequencies shaped by the vocal tract are central to vowel identity. The acoustic profile of consonants, though more complex, also contains identifiable spectral patterns such as bursts and frication noise.

Acoustic analysis links the physical signal to patterns that listener rely on to differentiate sounds.

Auditory phonetics deals with how speech sounds are perceived, focusing on the physiology of the ear and the cognitive processes that interpret acoustic input. This dimension answers the question: *What does the listener hear, and how is the signal processed?* Listeners interpret frequency as pitch, amplitude as loudness, and spectral shape as timbre. These perceptual categories guide differentiation between phonemes.

Humans often perceive sounds not as continuous acoustic variations but as discrete categories. For example, English speakers hear a sharp boundary between /b/ and /p/ based on voice onset time, even though the acoustic signal varies gradually. The ear and brain selectively amplify or suppress certain frequencies. This enables listeners to detect speech in noisy environments and to focus on meaningful contrasts. Auditory properties illustrate why the same acoustic signal may be interpreted differently depending on the listener's linguistic experience.

Although each property can be analyzed independently, speech is best understood through their interaction. A simple example illustrates this:

1. When producing /s/, articulatory settings create a narrow groove in the tongue.
2. This generates a high-frequency acoustic noise characteristic of fricatives.
3. The listener recognizes this spectral pattern as /s/ because of auditory categorization.

Similarly, vowels demonstrate the tight relationship between articulation, acoustics, and perception: tongue height and advancement shape formant frequencies, which then map onto perceptual categories such as *high*, *mid*, or *low* vowels. The threefold model thus provides a comprehensive view of speech as a coordinated physical and perceptual process.

The threefold properties of speech sound articulatory, acoustic, and auditory offer a coherent framework for understanding how speech is produced, transmitted, and perceived. Articulatory properties describe the physiological mechanisms, acoustic properties explain the physical signal, and auditory properties show how the listener interprets these signals. Together, they allow linguists to bridge the gap between physical action and linguistic meaning.

Because speech functions as both a biological and cognitive system, describing it through only one perspective is insufficient. The threefold model remains essential for phonetic research, language teaching, speech technology, and clinical phonetics, providing a balanced understanding of how humans communicate through sound.

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