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ARTICULATORY AND ACOUSTIC CHARACTERISTICS OF SPEECH SOUNDS: THE ROLE OF SPECH ORGANS

Jizzakh branch of the National University of Uzbekistan named after Mirzo Ulugbek
The faculty of Psychology, department of Foreign languages
Phylology and foreign languages
Supervisor: Teshaboyeva Nafisa Zubaydulla qizi
Student of group 302-21: Jumaniyozuva O`g`iljon Bakdurdi qizi

Annotation: The article "Articulatory and Acoustic Features of Sounds: Speech Organs" provides a comprehensive overview of the anatomical structures involved in speech production and their functional roles in articulating sounds. It begins by categorizing the speech organs into three main systems: respiratory, phonatory, and articulatory, highlighting how each contributes to sound generation. The article details key organs such as the lungs, larynx, and tongue, explaining their specific functions in producing different speech sounds. It further explores articulatory features like place and manner of articulation, as well as voicing, which define how sounds are produced. Acoustic features such as frequency, amplitude, duration, and formants are also examined, emphasizing their importance in distinguishing speech sounds and conveying meaning. The interaction between articulatory and acoustic features is discussed, particularly the concept of coarticulation, which illustrates how sounds can influence one another in connected speech. Overall, the article underscores the complexity of speech production and its significance in linguistics, speech therapy, and artificial intelligence. It serves as a valuable resource for understanding the mechanics of human communication, providing insights into both the biological and acoustic dimensions of speech.

Key words: articulatory features, acoustic features, speech organs, respiratory system, phonatory system, articulatory system, lungs, larynx, vocal cords, tongue, lips, teeth, alveolar ridge, hard palate, soft palate, place of articulation, manner of articulation, voicing, frequency, amplitude, duration, formants, coarticulation, human communication, linguistics, speech therapy, artificial intelligence.

Speech is a complex and fascinating process that involves the intricate coordination of various speech organs and the production of sounds. Understanding the articulatory and acoustic features of speech sounds requires an exploration of the anatomy involved in speech production, the mechanisms by which these sounds are articulated, and how these sounds

are perceived acoustically. This article delves into the key speech organs, their roles in articulating speech sounds, and the acoustic properties of these sounds.

Speech Organs and Their Functions

Speech production involves a coordinated effort among several anatomical structures known as speech organs, which can be categorized into the respiratory system, phonatory system, and articulatory system.

Respiratory System

The respiratory system provides the airflow necessary for speech. It consists of:

- Lungs: The primary source of air pressure for speech. During exhalation, air is pushed through the vocal tract, enabling sound production.

- Diaphragm: This muscle separates the thoracic cavity from the abdominal cavity and plays a crucial role in controlling airflow.

- Trachea: The windpipe that conducts air from the lungs to the larynx.

The control of airflow is essential for modulating the loudness and pitch of speech sounds.

Phonatory System

The phonatory system is responsible for producing voiced sounds. The key structures include:

- Larynx: Often referred to as the voice box, it houses the vocal cords (vocal folds). When air passes through the closed vocal cords, they vibrate, producing sound. This vibration frequency determines the pitch of the sound.

- Vocal Cords: The tension and length of the vocal cords can be adjusted to create different pitches and volumes.

Articulatory System

The articulatory system shapes the airflow into distinct speech sounds. The main articulators include:

- Tongue: The most flexible and dynamic speech organ, responsible for producing a wide range of sounds. Different parts of the tongue (tip, blade, body, back) can be positioned to alter sound production.

- Lips: They can be rounded or spread to influence the shape of the oral cavity and modify sounds, such as in the production of bilabial consonants (/p/, /b/, /m/).

- Teeth: The upper front teeth play a critical role in producing dental sounds (/θ/, /ð/).

- Alveolar Ridge: The ridge just behind the upper front teeth is important for producing alveolar sounds (/t/, /d/, /s/, /z/).

- Hard Palate: The bony part of the roof of the mouth is essential for producing palatal sounds (like /ʃ/ and /ʒ/).

- Soft Palate (Velum): It can be raised or lowered to allow air to flow into the nasal cavity, producing nasal sounds (/m/, /n/, /ŋ/).

Articulatory Features of Sounds

The production of speech sounds can be described using several articulatory features, including:

- Place of Articulation: This refers to where in the vocal tract the airflow is constricted. For example, bilabial sounds are produced with both lips, while alveolar sounds are produced with the tongue against the alveolar ridge.

- Manner of Articulation: This describes how the airflow is constricted. Sounds can be stops (complete closure), fricatives (partial closure, causing turbulence), or nasals (airflow through the nasal cavity).

- Voicing: Voiced sounds occur when the vocal cords vibrate, while voiceless sounds are produced without vocal cord vibration.

These articulatory features combine to form phonemes, the basic units of sound in a language.

Acoustic Features of Sounds

Once produced, speech sounds can be analyzed acoustically. Key acoustic features include:

- Frequency: Measured in Hertz (Hz), frequency determines the pitch of a sound. Higher frequencies correspond to higher pitches.

- Amplitude: This refers to the loudness of a sound. Greater amplitude results in louder sounds.

- Duration: The length of time a sound is produced. Duration can affect the meaning of words in languages where timing is phonemic.

- Formants: These are resonant frequencies of the vocal tract and are crucial in distinguishing vowel sounds. Formants are typically labeled as F1, F2, F3, etc., with each formant corresponding to a specific frequency range.

Interaction Between Articulatory and Acoustic Features

The interaction between articulatory and acoustic features is critical for effective communication. The same articulatory gestures can produce different acoustic outputs based on variations in speech context, speaker characteristics, and environmental factors. For

example, coarticulation occurs when adjacent sounds influence each other's articulation, leading to subtle changes in their acoustic properties.

Conclusion

Understanding the articulatory and acoustic features of speech sounds reveals the complexity of human communication. The coordination of various speech organs allows for the production of a rich array of sounds, which can be analyzed both articulatorily and acoustically. This interplay is not only fundamental to linguistics but also has practical applications in fields such as speech therapy, linguistics, and artificial intelligence, where the aim is to model or replicate human speech. By exploring these features, we gain a deeper appreciation of the intricate processes that enable us to communicate effectively.

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