

EXPERIMENTAL PHONETICS AND INSTRUMENTAL METHODS

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Annotation: This thesis examines the field of experimental phonetics and the instrumental methods used in the study of speech sounds. Experimental phonetics is an important branch of linguistics that investigates the physical, acoustic, and physiological properties of speech through scientific observation and technological analysis. The article discusses the historical development of experimental phonetics, major instrumental techniques, and their applications in modern linguistic research. Special attention is given to acoustic analysis, spectrography, electropalatography, electromyography, ultrasound imaging, and computerized speech analysis. The study highlights the importance of instrumental methods in improving pronunciation teaching, speech therapy, forensic phonetics, and language technology. The study concludes that experimental phonetics has significantly advanced linguistic science by providing objective and measurable data about human speech.

Keywords: experimental phonetics, instrumental methods, acoustic phonetics, speech analysis.

Introduction

Phonetics is the branch of linguistics that studies the sounds of human speech. Traditionally, phonetic research relied mainly on auditory observation and subjective analysis. However, with the development of modern science and technology, linguists began to use experimental and instrumental methods to investigate speech sounds more accurately. This led to the emergence of experimental phonetics, which combines linguistic theory with scientific experimentation.

Experimental phonetics focuses on the physical characteristics of speech sounds, including their production, transmission, and perception. Instrumental methods allow researchers to record, visualize, and measure speech phenomena objectively. These methods have transformed phonetic studies by increasing precision and reliability.

Today, experimental phonetics plays a major role in language teaching, speech therapy, computer speech recognition, forensic investigations, and communication sciences. Understanding instrumental techniques is therefore essential for modern linguistic research and practical applications.

Main Part

The Concept of Experimental Phonetics

Experimental phonetics is a branch of phonetics that studies speech sounds using scientific experiments and technological instruments. Unlike



traditional phonetics, which depends mainly on human hearing and observation, experimental phonetics employs objective methods to analyze speech.

The primary goals of experimental phonetics include:

- ✓ Measuring speech sounds accurately
- ✓ Investigating speech production mechanisms
- ✓ Studying acoustic properties of sounds
- ✓ Analyzing speech perception
- ✓ Developing technological applications related to speech

Experimental phonetics combines knowledge from linguistics, physics, physiology, psychology, and computer science.

Historical Development of Experimental Phonetics

The origins of experimental phonetics can be traced to the nineteenth century, when scientists began using mechanical devices to study speech. Early researchers attempted to analyze sound waves and speech articulation scientifically.

The invention of recording technologies and acoustic instruments in the twentieth century greatly expanded phonetic research. Later, computers and digital technologies revolutionized speech analysis by enabling precise measurements and visual representations of sound.

Today, experimental phonetics uses advanced software and digital tools to conduct highly sophisticated analyses of speech.

Branches of Experimental Phonetics

Experimental phonetics is usually divided into several subfields:

1. Articulatory Phonetics

Articulatory phonetics studies how speech sounds are produced by the speech organs, including the tongue, lips, vocal cords, and palate.

Researchers analyze:

Tongue movement

Lip position

Airflow

Vocal cord vibration

2. Acoustic Phonetics

Acoustic phonetics investigates the physical properties of sound waves produced during speech.

Important acoustic features include:

- Frequency
- Pitch
- Intensity
- Duration
- Formants

3. Auditory Phonetics

Auditory phonetics examines how speech sounds are perceived by the



human ear and processed by the brain.

This field studies:

- Sound perception
- Speech recognition
- Auditory discrimination

Instrumental Methods in Experimental Phonetics

Modern phonetic research depends heavily on instrumental methods.

These techniques provide accurate and objective data.

Spectrographic Analysis

One of the most important instrumental methods is spectrography.

Spectrograph

A spectrograph is a device that visually represents speech sounds through spectrograms. A spectrogram displays:

Frequency

Time

Intensity

This method allows linguists to observe sound patterns that are impossible to detect by hearing alone.

Applications

Spectrographic analysis is used in:

- Pronunciation studies
- Speech recognition systems
- Language teaching
- Forensic phonetics
- Electropalatography (EPG)

Electropalatography is a method used to study tongue-to-palate contact during speech production.

How It Works

Speakers wear an artificial palate containing electrodes. When the tongue touches the palate, the contact patterns are recorded electronically.

Importance

EPG helps researchers:

Analyze articulation disorders

Study pronunciation differences

Improve speech therapy techniques

Electromyography (EMG)

Electromyography measures muscular activity during speech production.

Functions

EMG records the electrical activity of muscles involved in speaking, including.

Lip muscles

Tongue muscles



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Jaw muscles

Applications

This method is valuable in:

19. Neurolinguistics
20. Speech pathology
21. Clinical phonetics

Ultrasound Imaging in Phonetics

Ultrasound technology is widely used in articulatory phonetics.

Purpose

Ultrasound imaging provides real-time visualizations of tongue movement during speech.

Advantages

Non-invasive

Safe

Accurate

Useful for pronunciation training

Researchers can observe hidden articulatory movements that cannot be seen directly.

9. Acoustic Analysis Software

Modern phonetics relies heavily on computer software for speech analysis.

PRAAT Software

One of the most widely used tools is PRAAT, which allows researchers to:

Analyze pitch

Measure vowel formants

Examine speech duration

Create spectrograms

Digital Signal Processing

Computers can process speech signals quickly and accurately, making large-scale phonetic research possible.

Experimental Methods in Speech Perception Studies

Researchers also use experimental techniques to study speech perception.

Listening Experiments

Participants listen to speech samples and identify sounds or meanings.

Reaction Time Measurements

Scientists measure how quickly listeners recognize speech sounds.

Eye-Tracking Technology

Eye-tracking helps researchers understand how visual information influences speech perception.

Applications of Experimental Phonetics

Experimental phonetics has many practical applications.



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a) Language Teaching. Instrumental analysis improves pronunciation instruction and helps learners produce accurate sounds.

b) Speech Therapy

Speech therapists use phonetic instruments to diagnose and treat speech disorders.

c) Forensic Phonetics. Speech analysis helps identify speakers in criminal investigations.

d) Speech Technology.

Experimental phonetics contributes to:

- Speech synthesis
- Voice assistants
- Automatic speech recognition systems
- Clinical Linguistics

Doctors and linguists use phonetic analysis to study communication disorders.

Advantages and Limitations of Instrumental Methods

	Advantages	Limitations
1	Objective analysis	Expensive equipment
2	High precision	Technical complexity
3	Accurate measurement	Need for specialized training
4	Visual representation of speech	Possible laboratory limitations
5	Scientific reliability	

Despite these limitations, instrumental methods remain essential in modern phonetic research.

Conclusion

Experimental phonetics has become one of the most important areas of modern linguistics. By using instrumental methods, researchers can analyze speech sounds objectively and scientifically. Techniques such as spectrography, electropalatography, electromyography, ultrasound imaging, and computerized acoustic analysis have significantly improved the understanding of speech production and perception.

Instrumental methods provide valuable data for language teaching, speech therapy, forensic investigations, and speech technology development. As technology continues to advance, experimental phonetics will play an even greater role in linguistic science and communication studies. The integration of scientific instruments with phonetic theory has transformed the study of speech



into a highly precise and interdisciplinary field.

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