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**Speech Insights Sound Off in the Brain (selected article)**

**Author/s: Bruce Bower**

Talk is cheap and, not surprisingly, plentiful. It gushes from our mouths like water from a burst dam. Yet we capture meaning from the conversations cascading around us with seemingly little effort. This impressive achievement depends as much on the ability to track the rhythm and intonations of spoken language as on the more obvious need to interpret word meanings and grammar, according to a new study.

Brain cells react in a unique pattern and with lightning speed to so-called prosodic features of speech, such as drawing out a word, pausing for emphasis, and raising the pitch of one's voice, reports a team of neuroscientists headed by Karsten Steinhauer of the Max Planck Institute of Cognitive Neuroscience in Leipzig, Germany. Immediate neural responses to these speech modulations allow listeners to get a head start in decoding the sometimes fuzzy meanings of sentences, Steinhauer and her colleagues contend.

Their findings dovetail with recent evidence, gathered by psychologists such as Peter W. Jusczyk of Johns Hopkins University in Baltimore, indicating that infants and young children closely track prosodic aspects of speech to gain a foothold on its grammatical structure.

"I'm not surprised that there are specific brain responses linked to prosodic features of language," Jusczyk comments. "We find that infants as young as 2 1/2 months begin to notice prosodic cues used by adult speakers and use them to mark phrases within sentences."

Traditional theories of language comprehension have held that adults employ prosodic cues only to flesh out a sentence's meaning after they have deciphered its grammatical structure. For instance, rising pitch toward the end of an utterance signals a question, whereas falling pitch indicates a statement.

The new study, published in the February *Nature Neuroscience*, places prosodic cues at the core of understanding the grammatical structure of speech.

The researchers placed caps studded with electrodes on the scalps of 56 native German speakers. The setup allowed for recordings of electrical activity at the brain's surface as the volunteers heard a series of sentences.

Some sentences were grammatically straightforward, such as "Since Jay always jogs a mile and a half this seems like a short distance to him." Others were harder to understand, such as "Since Jay always jogs a mile and a half seems like a very short distance to him." Especially for readers, "a mile and a half" is first perceived as the object of "jogs" rather than the subject of the subsequent verb "seems," as required in the second sentence.

When sentences such as these are spoken, differences in the duration of words and pauses and variations in pitch and loudness serve to group words into distinct "intonational phrases," Steinhauer's group asserts.

While listening to both straightforward and ambiguous sentences, participants exhibited neither of two brain-wave responses known to indicate difficulty at understanding words, the scientists say. The researchers then spliced the recorded sentences so that prosodic cues did not match sentence structure. Upon hearing the first word in a sentence that signals its grammatical structure ("seems" in the second sentence above), volunteers displayed the neural signs of confusion about word meaning.

Moreover, a distinct type of brain-wave response occurs within a fraction of a second after the conclusion of each intonational phrase in a sentence, the investigators find.

The discovery of this new component of the brain's electrical activity suggests that the detection of intonational phrases is a crucial aspect of speech perception, note psychologists Cyma Van Petten and Paul Bloom of the University of Arizona in Tucson in a commentary on Steinhauer's article.

"Intonational cues may control initial decisions about sentence structure," Van Petten and Bloom remark.

### Speech Insights Sound Off in the Brain

Brain-wave recordings indicate that word duration and other intonational cues are immediately noted by listeners and provide crucial insights into sentence meaning.

#### **References:**

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#### **Sources:**

Paul Bloom  
University of Arizona  
Department of Psychology  
Tucson, AZ 85721

Karsten Steinhauer  
Max Planck Institute of Cognitive Neuroscience  
Department of Neuropsychology  
P.O. Box 500-355  
D-04303 Leipzig  
Germany

Cyma Van Petten  
University of Arizona  
Department of Psychology  
Tucson, AZ 85721

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