How we think before we speak: Making sense of sentences

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We engage in numerous discussions throughout the day, about a variety of topics, from work assignments to the Super Bowl to what we are having for dinner that evening. We effortlessly move from conversation to conversation, probably not thinking twice about our brain's ability to understand everything that is being said to us. How does the brain turn seemingly random sounds and letters into sentences with clear meaning?

In a new report in *Current Directions in Psychological Science*, a journal of the Association for Psychological Science, psychologist Jos J.A. Van Berkum from the Max Planck Institute in The Netherlands describes recent experiments using brain waves to understand how we are able to make sense of sentences.

In these experiments, Van Berkum and his colleagues examined Event Related Potentials (or ERPs) as people read or heard critical sentences as part of a longer text, or placed in some other type of context. ERPs are changes in brain activity that occur when we hear a certain stimulus, such as a tone or a word. Due to their speed, ERPs are useful for detecting the incredibly fast processes involved in understanding language.

Analysis of the ERPs has consistently indicated just how quickly the brain is able to relate unfolding sentences to earlier ones. For example, Van Berkum and colleagues have shown that listeners only need a fraction of a second to determine that a word is out of place, given what the wider story is about. As soon as listeners hear an unexpected word,

their brain generates a specific ERP, the N400 effect (so named because it is a negative deflection peaking around 400 milliseconds). And even more interesting, this ERP will usually occur before the word is even finished being spoken.

In addition to the words themselves, the person speaking them is a crucial component in understanding what is being said. Van Berkum also saw an N400 effect occurring very rapidly when the content of a statement being spoken did not match with the voice of the speaker (e.g. "I have a large tattoo on my back" in an upper-class accent or "I like olives" in a young child's voice). These findings suggest that the brain very quickly classifies someone based on what their voice sounds like and also makes use of social stereotypes to interpret the meaning of what is being said. Van Berkum speculates that "the linguistic brain seems much more 'messy' and opportunistic than originally believed, taking any partial cue that seems to bear on interpretation into account as soon as it can."

But how does the language brain act so fast? Recent findings suggest that, as we read or have a conversation, our brains are continuously trying to predict upcoming information. Van Berkum suggests that this anticipation is a combination of a detailed analysis about what has been said before with taking 'quick-and-dirty' shortcuts to figure out what, most likely, the next bit of information will be.

One important element in keeping up with a conversation is knowing what or whom speakers are actually referring to. For example, when we hear the statement, "David praised Linda because. . .," we expect to find out more about Linda, not David. Van Berkum and colleagues showed that when listeners heard "David praised Linda because he. . .," there was a very strong ERP effect occurring with the word "he," of the type that is also elicited by grammatical errors. Although the pronoun is grammatically correct in this statement, the ERP occurred because the

brain was just not expecting it. This suggests that the brain will sometimes ignore the rules of grammar when trying to comprehend sentences.

These findings reveal that, as we make sense of an unfolding sentence, our brains very rapidly draw upon a wide range of information, including what was stated previously and who the speaker is, in helping us understand what is being said to us. Sentence understanding is not just about diligently combining stored word meanings. The brain rapidly throws in everything it knows, and it is always looking ahead.

Source: Association for Psychological Science