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Language recognition is as much about brains as it is about hearing

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Summary: Researchers have learned the efficiency by which people recognize spoken words depends as much on the mind as on hearing ability. In a new study, the researchers examined how well adults across the life span process spoken language.

FULL STORY

How well we understand spoken language may depend more on our brains than our ears.

In a new study, University of Iowa researchers investigated how quickly people across the life span -- from youths to adults nearly 80 years old -- correctly identified spoken words. They unearthed these findings:

• The speed, or efficiency, at which people heard and understood spoken words peaked in their mid-20s to early-30s, suggesting a longer period over which language skills are developing than had been known previously.

• Spoken-word efficiency began to decline beginning in the mid-40s. This is a younger age than expected.

• As expected, older adults, in general, were slower in recognizing spoken words than other age groups. But neither hearing ability nor general cognitive abilities explained differences in this age group. The researchers think cognitive processes that are used to support language may be in play, and these processes may vary among individuals over the lifespan.

"This study basically introduces a bunch of mysteries," says Bob McMurray, F. Wendell Miller Professor in the Department of Psychological and Brain Sciences, who has studied spoken-word recognition at Iowa for nearly two decades. "Here's a bunch of questions we just didn't even know about something so basic, like recognizing words, and that's really exciting."

Less of a mystery has been the idea that older adults are less adept at recognizing words. But did that have to do mostly with hearing? To test the hypothesis, the researchers enrolled older adults with little to no hearing impairments. Yet even after eliminating the effects of hearing, the researchers found language-processing speed varied within this older group by as much as one-eighth of a second -- about the length of a short word like "cat."

"It's not a question of accuracy," McMurray says. "Older adults arrive at the correct word, but the amount of time to get to that target word varies. So, for those who lag with one word, that delay could cascade when you add more words, such as would happen in a sentence, or during a conversation. You may not be able to catch up."

The question, then, is why do older adults differ in recognizing spoken words? The answer is that no one knows -- although there are some theories.

One intriguing possibility for the difference in language processing speed among older adults could be how much they socialize and are engaged in society. It could be that older adults who are more efficient at recognizing spoken words are "plugged in" socially, such as having regular encounters with other people that keep their cognitive processing skills sharp.

Those who don't interact as much socially, the thinking goes, could see more deterioration in their efficiency to process spoken language, potentially furthering their distance from society.

"It's an important issue given how many people are aging," says Sarah Colby, a postdoctoral researcher in McMurray's lab who designed the study. "We frankly don't know how common deficits in language are in older adults. We don't have many studies on that."

Colby and McMurray are teaming up with Ethan Kutlu, assistant professor in linguistics at Iowa with an expertise in social network analysis, to determine whether social engagement may affect spoken-word efficiency.

"You can look at it two ways," says Colby of the research, a new $430,000 effort funded through the National Institutes of Health. "On one side, older adults who are slower to recognize words may have their social relationships affected. But on the other side, having a smaller circle of friends, or less frequent social contacts -- that, too, may impact their cognitive abilities, which could slow their ability to recognize spoken words, and further compound their social relationships."

For this study, participants of all ages sat at a computer screen in a soundproof booth and heard a word. Their job was to match the word to a picture on the screen. At least one of the other pictures shown on the screen depicted a word with a similar sound to the target word. For example, if the target word was "sandal," the pictures might include "sandwich" or "candle." Using computerized eye-tracking technology, the researchers determined how long each participant took to identify and click on an icon signifying the correct word, and tracked their eyes to determine how much they considered the other options.

The 111 participants ranged from 11 to 78 years of age. The researchers cataloged the time it took for each participant to identify the spoken word after it was told to them.

It's the same test procedure McMurray's team has employed for several years with the Growing Words Project, a multimillion-dollar, NIH-funded effort to test several hundred elementary-age children on their ability to recognize words, build a vocabulary, and develop crucial reading skills. But while Growing Words is testing children up through sixth grade, this new study cataloged the entire life span.

A main finding was that the speed, or efficiency, of recognizing spoken words improved through the 20s (and in some cases until the early 30s). This is much later in the life span than previous research had shown. But that peak optimal speed (efficiency) to understand spoken language didn't last long: The researchers found peak word-recognition abilities began to decline beginning in the mid-40s and continuing through the life span, at which point some older participants were as much as one-fifth of a second slower at recognizing spoken words than participants in their 40s.

No one knows why the peak seems to occur well into the 20s, nor why the slowing in recognizing spoken words begins in the mid-40s. One theory is that people reach a maximum vocabulary capacity (think a computer with a maximum storage capacity) at about 30,000 words.

If that's the case, McMurray says, "it could be that now you've reached a sort of tipping point for how many words you have to sort through while you're recognizing words, and that process is just going to take longer because there's more there for you to sort through. It could be that the mid-40s is where people, at least in this sample, were hitting that point."

The NIH funded the work.