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Learning to Speak Again

By Aalok Mehta
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A common long-term consequence of stroke is aphasia: difficulty using and comprehending language. New research, however, suggests that the brain is flexible enough to regain lost language abilities even years after a stroke—and that, instead of slowly building up language abilities, starting with the hardest tasks may provide the most benefit.

One-quarter of the more than 600,000 stroke survivors each year in the U.S. suffers some language impairment, according to the National Stroke Association. This includes problems understanding what other people are saying, reading difficulties, or trouble translating thoughts into coherent sentences. “Aphasia is a very equal opportunity disorder,” said Nan Ratner, a professor of hearing and speech sciences at the University of Maryland, College Park, at a recent meeting of the American Association for the Advancement of Science. “Anyone sitting in this room can become aphasic without much notice.”

For many years, medical experts considered the window of opportunity for treating stroke symptoms to be relatively small, and focused therapy on the months immediately following the stroke. Many insurance companies fund such treatments only for weeks or months following a stroke.

In recent years, however, scientists and therapists have discovered that the brain's ability to reshape and built new connections—also known as neuroplasticity—is quite broad, allowing it to reroute its functions around damaged areas. “People do change, people do improve, even 10 years after a stroke,” says Cynthia Thompson, a professor of communication sciences at Northwestern University. “The brain is a neuroplastic mechanism. This occurs in healthy people throughout their lifetimes, and it occurs in people with stroke.”

In 2010, Thompson discovered that a stroke's impact is not limited to the tissue damaged during the injury, in which the blood supply to the brain is disrupted by a blockage or bleeding. Using functional magnetic resonance imaging (fMRI), which allows researchers to track blood flow and brain activity, Thompson and her colleagues found that areas of the brain both near and distant to stroke locations showed reduced blood flow (also called hypoperfusion) many months after a stroke. Previously, hypoperfusion was believed to occur immediately following a stroke but improve within a few months. “The tissue is still alive—it's just not completely functional,” Thompson says. In addition, more hypoperfusion led to poorer stroke recovery. Whether these changes are caused by subtle damage to blood vessels or changes in how the body manages blood flow in the brain is not clear.

However, Thompson—who studies patients whohave problems with complex grammar and sentence construction—has also found that language training following a stroke can improve brain activity. Undamaged brain areas associated with language-processing and other tasks showed significant increases in activity, even in patients several years post-stroke. The training, she says, helps patients “recruit” brain areas predisposed for language to assist with grammatical tasks and other lost functions.

Based on these findings, her team has designed a training regimen for people with grammar difficulties that focuses on teaching complex sentence structures, not simpler ones. “The upshot—that turns speech and language pathology clinically on

its head—is that training complex sentences first results in generalization or improvement to less complex structures," she said at the AAAS meeting. "This is extremely important and completely counterintuitive."

Thompson is now leading a $12 million program that aims to fill longstanding gaps in knowledge about stroke recovery using fMRI and other brain imaging technologies. For example, one research project is to investigate whether "resting state" brain activity—the ranging thoughts people have when not focusing on anything specific—is abnormal in stroke survivors and whether it shows changes as they recover. Another project uses diffusion tensor imaging, a technique that allows researchers to trace connections between brain regions, to see how brain networks change during a year of stroke recovery, particularly in regions involving language processing.

Thompson is not the only one to find that more challenging stroke treatment regimens might be more successful. Sheila Blumstein, a professor of cognitive, linguistic, and psychological sciences at Brown University, has demonstrated similar results in a set of distinct but related patients—those who have trouble getting out single words instead of constructing sentences.

Her treatment involves having patients speak similar sounding words, such as pear and bear, "based on the notion that words that sound similar require greater precision in producing them and ultimately in distinguishing them," she says. Participants also switch speaking styles from session to session, from talking in a singsong voice one day—a classic technique known as melodic intonation therapy that takes advantage of the fact that many people can sing words easier than they can speak them—to using a slower-than-normal speech pattern the next, for example. In preliminary tests, three out of four patients with aphasia, between six and 20 years post stroke, improved not only on words that they had rehearsed but to other words as well.

"People do better if they have a variety of things to do, than if they always speak the same way," says Blumstein, whose work is partially funded by the Dana Foundation. "It's like tennis—if all you do is practice forehand swings, then you won't do well with a backhand." The fact that such results generalize, she added, demonstrates the cascading effects of rehabilitation techniques on language networks in the brain.

Blumstein is now awaiting data from patients who complete a full treatment regimen of 20 biweekly sessions. In addition to tracking changes in language ability, her team will also map the extent of stroke damage in each patient to see if the severity of a stroke affects recovery.

Nevertheless, she, like other stroke researchers, agrees the new findings already mandate expanding the treatment window for patients with aphasia.

"Although we have ways of improving the lives of people with aphasia, the current medical system—in terms of reimbursement—limits the way in which people can take advantage of these services, especially many years post-stroke," Ratner said. "This is an example of science being able to inform some changes in health care delivery."