Can a mother's voice spur recovery from a coma?

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Karen Schroeder's voice, recorded on a CD, reminded her son, Ryan, of his 4-H project when he was 10 and decided to raise pigs. "You bid on three beautiful squealing black and white piglets at the auction," she said softly. "We took them home in the trunk of our Lincoln Town Car, because we didn't have a truck."

Recordings from Ryan's mother, father or sister were played through headphones for him four times a day. They were part of a new clinical trial investigating whether repeated stimulation with familiar voices can help repair a coma victim's injured brain networks and spur his recovery.

In January 2009, Ryan, a 21-year-old college student from Huntley, Ill., was in a coma after he had been flung from his snowmobile into a tree during an ice storm. He had a traumatic brain injury; the fibers of his brain had been twisted and stretched from the impact.

He regained consciousness after nearly one month in the trial and has made steady progress during the past year. Researchers, however, won't know for certain if the therapy helped his recovery until the study is over.

The trial is being led by Theresa Pape, a research assistant professor of physical medicine and rehabilitation at Northwestern University Feinberg School of Medicine and a research health scientist at Hines VA Hospital. Funded by the U.S. Department of Veteran Affairs, the research may be useful to young people like Ryan as well as soldiers

injured in combat, who have a high rate of traumatic brain injuries from roadside bombs.

"Traumatic brain injury is a huge issue in our society," Pape said. "Every 21 seconds, we have a new head injury and about one-third of those will be severe."

The most common cause of severe head injury in the civilian population is motor vehicle accidents, and the highest-risk group is 16-to-24-year-old males. In the military, the risk of traumatic brain injury is three times that of civilians, even in peacetime. While the actual number is not known, an estimated 8,470 soldiers were diagnosed with traumatic brain injury from January 2003 through September 2008. (Pape thinks that number is low, because many troops have not been evaluated for mild traumatic brain injury.)

Pape hopes the study will provide an answer to the question that families are desperate to know when a loved one is in a coma: 'Can he hear me?' She is especially eager to know if these family voices can facilitate repair of the brain to improve the subject's ability to function and process and understand information.

Pape's hypothesis is that repeated exposure to familiar voices could help repair the brain's neural networks, some of which become sheared in traumatic brain injury. In a previous small pilot study, Pape observed that subjects in a vegetative state responded more to the voices of people who are familiar to them compared with non-familiar voices.

When those subjects heard voices of their family members, an MRI scan showed that parts of their brain were activated, appearing as bright yellow and red blobs of light scattered in an unorganized pattern. With unfamiliar voices, there was little activation.

"The question became are the familiar voices therapeutic in some way?" Pape asked. "Will they spur an improvement in behavior?"

Her background as a speech pathologist inspired the research. "I was weaned on language processing, how the brain responds to different linguistic stimuli as well as familiar or non-familiar voices, different sounds," Pape said. "This is a very speech pathology-based study."

When a subject is enrolled in the trial, Pape does a baseline functional MRI scan of his brain, examining the reaction to familiar versus unfamiliar voices. In a healthy person, she would expect to see a family member's voice activate the temporal lobe, the site of memory, and the frontal lobe, the part of the brain that pays attention when your name is called aloud. She doesn't see that in her subjects with new severe traumatic brain injury.

"As they recover, we want to see if these areas become activated in the way we'd expect in a healthy person," Pape said.

Pape also tracks the state of their axons, the thick white fibers that comprise the brain's networks and allow different parts of the brain to communicate with each other. In a traumatic brain injury, the axons can become ripped and twisted like interstate highways in a Hollywood disaster movie.

"In a healthy brain, the networks function in a very organized manner, from front to back, for example," Pape said. "The injured brain has a disorganized direction we don't understand. The axons are sheared, torqued and twisted. We're trying to figure out how and if they work after a severe brain injury. Maybe they zigzag or connect with an unexpected neuron."

For the trial, subjects are divided into three groups: high dose, who hear

10 minutes of stories daily four times a day for six weeks; low dose, who hear five minutes of stories and 35 minutes of silence four times a day; and the "sham" group who wear the head phones but don't hear any stories. After six weeks, Pape measures how the subject's behavioral condition compares to changes she sees in the brain on new MRI images.

The trial is double blinded, meaning Pape will not know whether subjects were in the high, low or sham dose group until the study, which will enroll about 45 subjects, is completed in 2011. The earlier description of Karen Schroeder's voice being played for Ryan occurred after the initial double-blinded part of the study. After this part, all subjects receive the high dose of stories for six weeks to make sure that if there is a benefit, everyone has the same advantage.

Pape's imaging data of a subject's brain before and after the voice treatment will reveal if networks are better connected as a result of the therapy, and if that is linked to improvement in the subject's functioning.

When Schroeder enrolled her son in the trial in late February 2009, about a month after his accident, he could not follow commands or make purposeful movements. His eyes were open, but he did not seem to be aware of his environment. At the time, a doctor had told Schroeder to make arrangements to place her son in a nursing home.

But after three weeks in the trial, Schroeder began to notice changes in her son. First, she said, Ryan began to notice the lights outside the window of his room in the Northwestern University Clinical Research Unit on the 10th floor of Northwestern Memorial Hospital, the location where he received the voice therapy.

"I could tell he was starting to come around," Schroeder said. "Before, he would lay in the bed and a herd of cattle could walk through and he would not be aware that they were there. Now, little by little he would

start to respond."

Then, he began to slowly follow a command to push a ball out of his hand. A little more than a year later, Ryan now texts his friends, brushes his teeth and walks with a walker or a four-prong cane. He is practicing walking without a device. While he struggles with poor balance, he recently started eye therapy, which may or may not help his balance. A palate lift several months ago greatly improved his speech, according to Schroeder. Ryan continues with physical, occupational and speech therapies at the Rehabilitation Institute of Chicago in Wheeling.

"Given the extent of his injuries, Ryan has recovered well," Pape said. "But I can't draw any conclusions yet. We have to wait until we have all the study data."

In the meantime, Ryan helps at his family's asphalt paving business where he enters data into the computer. He doesn't remember his accident or hearing the tapes of his family. "He continues to make progress. It is truly a remarkable recovery," said Karen Schroeder. "The good Lord keeps throwing us ropes. We got involved in this by the grace of God."

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