Medical Xpress

Tracking the source of "selective attention" problems in brain-injured vets

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An estimated 15-20 percent of U.S. troops returning from Iraq and Afghanistan suffer from some form of traumatic brain injury (TBI) sustained during their deployment, with most injuries caused by blast waves from exploded military ordnance. The obvious cognitive symptoms of minor TBI—including learning and memory problems—can dissipate within just a few days. But blast-exposed veterans may continue to have problems performing simple auditory tasks that require them to focus attention on one sound source and ignore others, an ability known as "selective auditory attention."

According to a new study by a team of Boston University (BU) neuroscientists, such apparent "hearing" problems actually may be caused by diffuse injury to the brain's prefrontal lobe—work that will be described at the 167th meeting of the Acoustical Society of America, to be held May 5-9, 2014 in Providence, Rhode Island.

"This kind of injury can make it impossible to converse in everyday social settings, and thus is a truly devastating problem that can contribute to social isolation and depression," explains computational neuroscientist Scott Bressler, a graduate student in BU's Auditory Neuroscience Laboratory, led by biomedical engineering professor Barbara Shinn-Cunningham.

For the study, Bressler, Shinn-Cunningham and their colleagues—in collaboration with traumatic brain injury and post-traumatic stress disorder expert Yelena Bogdanova of VA Healthcare Boston—presented a selective auditory attention task to 10 vets with mild TBI and to 17 control subjects without brain injuries. Notably, on average, veterans had hearing within a normal range.

In the task, three different melody streams, each comprised of two notes, were simultaneously presented to the subjects from three different perceived directions (this variation in directionality was achieved by differing the timing of the signals that reached the left and right ears). The subjects were then asked to identify the "shape" of the melodies (i.e., "going up," "going down," or "zig-zagging") while their brain activity was measured by electrodes on the scalp.

"Whenever a new sound begins, the auditory cortex responds, encoding the sound onset," Bressler explains. "Attentional focus, however, changes the strength of this response: when a listener is attending to a particular sound source, the neural activity in response to that sound is greater." This change of the neural response occurs because the brain's "executive control" regions, located in the brain's prefrontal cortex, send signals to the auditory sensory regions of the brain, modulating their response.

The researchers found that blast-exposed veterans with TBI performed worse on the task—that is, they had difficulty controlling auditory attention—"and in all of the TBI veterans who performed well enough for us to measure their neural activity, 6 out of our 10 initial subjects, the brain response showed weak or no attention-related modulation of auditory responses," Bressler says.

"Our hope is that some of our findings can be used to develop methods to assess and quantify TBI, identifying specific factors that contribute to difficulties communicating in everyday settings," he says. "By identifying these factors on an individual basis, we may be able to define rehabilitation approaches and coping strategies tailored to the individual."

Some TBI patients also go on to develop chronic traumatic encephalopathy (CTE)—a debilitating progressive degenerative disease with symptoms that include dementia, memory loss and depression—which can now only be definitively diagnosed after death. "With any luck," Bressler adds, "neurobehavioral research like ours may help identify patients at risk of developing CTE long before their symptoms manifest."

Provided by Acoustical Society of America