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New study finds biomarker differentiating the inattentive and combined subtypes of ADHD

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Using a common test of brain functioning, UC Davis researchers have found differences in the brains of adolescents with the inattentive and combined subtypes of attention-deficit/hyperactivity disorder (ADHD) and teens who do not have the condition, suggesting that the test may offer a potential biomarker for differentiating the types of the disorder.

The differences were observed in brain waves exhibited during electroencephalograms (EEGs) of teens with the inattentive and combined subtypes of the condition and typical adolescents, illustrating that these groups display distinct physiological profiles. The research is published online today in the journal *Biological Psychiatry*.

When preparing to perform a computer task, the researchers found that the teens with the type whose primary symptom is inattentiveness exhibited different brain-wave patterns from those whose symptoms include hyperactivity and impulsivity.

"ADHD subtypes appear subjectively very different in the clinical setting, but there are few objective physiological markers that have been able to detect those differences," said Ali Mazaheri, assistant professor at the Academic Medical Center, University of Amsterdam, the Netherlands, and guest researcher at the UC Davis Center for Mind and Brain. "This study shows that there are changes in brain waves related to visual processing and motor planning that can be used to distinguish

ADHD subtypes."

According to the U.S. Centers for Disease Control and Prevention, in 2007 an estimated 9 to 10 percent, or approximately 5.5 million children 4 to 17 years of age, were diagnosed with ADHD; the percentage of children with parent-reported ADHD increased by 22 percent between 2003 and 2007. ADHD is approximately twice as common among boys as girls, and is one of the most commonly diagnosed psychiatric illnesses among children.

The study was conducted in 57 children between 12 and 17 years, 23 without ADHD and 17 participants who fell into each of the inattentive- and combined-type groups. The collaborative study was conducted between 2009 and 2013 by the UC Davis Center for MIND and Brain and UC Davis MIND Institute.

The teens' brain waves were assessed using EEG caps with 32 electrodes during evaluations of their performance on a computer task in which they received visual cues that could help aide their performance. Some cues were more helpful than others, so the task required the participants to sometimes override an initial impulse in order to respond correctly. Such situations are particularly challenging for people with ADHD.

For example, brain waves were recorded during evaluations of the subjects' performance on a computer task during which they were asked to look at a series of arrows pointing in different directions on a computer screen, and then indicate the direction in which the center arrow pointed by pressing a button for either left or right. In the following series of arrows the center arrow is pointing to the left:

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The researchers examined the teens' alpha and beta brain waves after

they viewed the visual cues, and found differences between the teens with the subtypes of ADHD and typically developing teens. The alpha wave patterns of teens with the inattentive type did not process the important information in the visual cues, limiting their ability to succeed.

The researchers also examined the subjects' beta waves, which are associated with the performance of motor tasks. These also differed among those with and without ADHD and were most deficient in teens with the combined type, suggesting that these teens had greatest difficulty accomplishing the motor task—pressing a button.

Regardless of subtype, the participants with ADHD were less able to control attention to the task than were those without the disorder, validating a finding reported by the current research team in 2010.

"Researchers in the field of ADHD have questioned whether the ADHD combined subtype simply represents a more severe form of ADHD," said Catherine Fassbender, a research scientist with the MIND Institute. Our study suggests differential impairment profiles in the ADHD subtypes, and not simply an additive effect of impairments in the ADHD combined subtype," Fassbender said. "The inattentive group had problems processing the cues, whereas the combined type had problems using the cues to prepare a motor response."

"These differences, alpha wave changes in the brain's visual cortex related to visual processing, and beta changes in the brain's motor cortex related to motor planning could represent unique impairments between the two subtypes," she said.

"This research also gives us clues regarding the development of treatments to address the underlying processing differences between ADHD subtypes," Fassbender said. "Most treatments for ADHD do not take subtype differences into account. Our findings suggest targets for

treatment should differ for the ADHD inattentive versus combined subtypes, and that advanced analysis of brain waves may provide a biomarker for testing treatment responses."

Provided by UC Davis

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