

Researchers link alcohol-dependence impulsivity to brain anomalies

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Researchers already know that alcohol dependence (AD) is strongly associated with impaired impulse control or, more precisely, the inability to choose large, delayed rewards rather than smaller but more immediate rewards. Findings from a study using functional magnetic resonance imaging (fMRI) to investigate the neural basis of impulsive choice among individuals with alcohol use disorders (AUDs) suggest that impulsive choice in AD may be the result of functional anomalies in widely distributed but interconnected brain regions that are involved in cognitive and emotional control.

Results will be published in the July 2011 issue of *Alcoholism: Clinical & Experimental Research* and are currently available at Early View.

"Individuals with AD score higher on questionnaires that measure impulsivity – for example, 'I act without thinking' – are less able to delay gratification, and are less able to inhibit responses," said Eric D. Claus, a research scientist with The Mind Research Network and first author of the study.

Given that impulsive choice in AUDs has been associated with impairment of frontal cortical systems involved in behavioral control, Claus explained, this study was designed to examine the neural correlates of one specific aspect of impulsivity, the ability to delay immediate gratification and instead choose rewards in the future.

"We investigated this choice process in individuals with alcohol use

problems ranging from alcohol abuse to severe AD that required treatment," said Claus. "This is the largest study to date that has investigated the neural correlates of impulsive choice in AD, which enabled us to examine the full range of AUDs instead of only examining extreme group differences."

Claus and his colleagues examined 150 individuals (103 males, 47 females) with various degrees of alcohol use. All of the participants completed a delay discounting task – during which two options were presented, a small monetary (e.g., \$10) reward available immediately or a larger monetary reward (e.g., \$30) available in time (e.g., two weeks) – while undergoing fMRI. Impulsive choice was defined as the selection of the more immediate option.

"We showed two things," said Claus. "We replicated previous research by showing that AUD severity was associated with a greater tendency to discount future rewards. In addition, we showed that when individuals with more severe AUDs did delay gratification, they engaged the insula and supplementary motor area – regions involved in emotional processing and response conflict – to a greater degree than individuals with less severe AUDs. In summary, these findings suggest that the dysfunction in these regions is graded and increases as a function of AUD severity, rather than operating as an all-or-none function."

"This work showed that the brains of alcoholics don't behave all that differently from the brains of non-alcoholics during delay discounting but that the alcoholic brain had to work harder when they chose the delayed reward," said Daniel W. Hommer, chief of the Section of Brain Electrophysiology & Imaging at the National Institute on Alcohol Abuse and Alcoholism. "Many different studies have shown similar results, that is, alcoholics have a greater increase in brain blood flow to perform the same task as non-alcoholics."

"The current study suggests that the neural dysfunction underlying impulsive choice seems to increase with AD severity," added Claus. "Now that we know that this neural dysfunction is associated with impulsivity, the next steps are to determine whether this impulsivity predates the onset of AD and whether neural measures of impulsivity can predict who will respond best to particular types of treatment. Further, the particular neural dysfunction that we observed indicates that individuals with more AD may be more impulsive because their brain is aversive to delay gratification, and not because it is rewarding to be impulsive. Clinicians might need to deal directly with the aversion of choosing future benefits over immediate ones."

"The most important thing about this paper is that it leads you to question what people mean by impulsive behavior and how should it be measured," said Hommer. "The field has defined increased discounting of time – failure to delay gratification – as a good measure of impulsiveness, but the results reported in this paper say 'Wait a minute, delay discounting does not correspond to what is usually meant by impulsiveness.' Rather, brain activity during a delay discounting task looks more like how the brain responds during conflicted decision-making than it does during rapid, unconflicted choice of a highly valued goal." Hommer added that this sort of debate is important to researchers, forcing them to think more carefully about what they mean by impulsive choice.

Provided by Alcoholism: Clinical & Experimental Research

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