# The brain's response to sweets may indicate risk for development of alcoholism

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Several human and animal studies have shown a relationship between a preference for highly sweet tastes and alcohol use disorders. Furthermore, the brain mechanisms of sweet-taste responses may share common neural pathways with responses to alcohol and other drugs. A new study using functional magnetic resonance imaging (fMRI) has found that recent drinking is related to the orbitofrontal-region brain response to an intensely sweet stimulus, a brain response that may serve as an important phenotype, or observable characteristic, of alcoholism risk.

Results will be published in the December 2013 issue of *Alcoholism: Clinical & Experimental Research* and are currently available at Early View.

"It has long-been known that animals bred to prefer alcohol also drink considerably greater quantities of sweetened water than do animals without this selective breeding for alcohol preference," explained David A. Kareken, deputy director of the Indiana Alcohol Research Center, a professor in the department of neurology at Indiana University School of Medicine, and corresponding author for the study. "More recently, it has become clear that animals bred to prefer the artificial sweetener, saccharin, also drink more alcohol. Although the data in humans are somewhat more variable, some studies do show that alcoholics, or even non-alcoholics with a family history of alcoholism, have a preference for unusually sweet tastes. Thus, while the precise reasons remain unclear, there does seem to be significant evidence suggesting some link between

the rewarding properties of both sweet tastes and alcohol."

Kareken added that this is the first study to examine the extent to which regions of the brain's reward system, as they respond to an intensely sweet taste, are related to human drinking patterns.

Kareken and his colleagues recruited 16 (12 males, 4 females) right-handed, non-treatment seeking, healthy volunteers with a mean age of 26 years from the community. All participants underwent a taste test using a range of sucrose concentrations, and their blood oxygen dependent (BOLD) activation was measured during an fMRI scan while receiving small squirts of either water or an intensely sweet mixture of sugar in water. All were asked about their drinking patterns.

"Our study was designed to determine which brain areas responded to sweet taste – as compared to plain water – and the extent to which these brain responses were related to subjects' binge-drinking patterns, the number of alcoholic drinks subjects consumed per day when drinking," explained Kareken.

"In addition to 'activating' the brain's gustatory or taste circuits, the sugared water also activated key elements of what neuroscientists consider to be part of the brain's reward system, including the ventral striatum, amygdala, and parts of the orbitofrontal cortex – the inferior frontal lobe surface just above the eyes – that respond to ingested rewards," Kareken said. "We refer to these as 'primary' rewards, being distinct from secondary rewards, like money, which can be used to obtain primary rewards."

What the researchers found was that the response to this intensely sweet taste in the left orbitofrontal area correlated significantly with subjects' drinking patterns.

"Specifically, the trend was such that those who drank more alcohol on drinking days had stronger left orbitofrontal responses to the intensely sweet water," said Kareken. "Subjects' subjectively rated liking of the sweetened water also contributed to this relationship, so that both the brain response itself, as well as liking of the sugared water, collectively correlated with drinking behavior."

While previous human and animal research has noted this association between preferences for both sweet tastes and alcohol intoxication, Kareken believes that this is the first study to examine the human brain mechanism behind this association.

"While much more research needs to be done to truly understand the commonalities between sweet-liking and alcoholism, and while alcoholism itself is likely the product of several mechanisms, our findings may implicate a particular brain region that is more generally involved in coding for the value of 'primary' rewards such as pleasures," he said. "In a more practical sense, the findings are compelling evidence that the brain response to an intensely sweet taste may be used in future research to test for differences in the reward circuits of those at risk for alcoholism. This may be particularly useful since alcohol itself is not an easy drug to work with in this kind of human imaging, and since alcohol exposure is not ethically appropriate for use in all at-risk subjects, or in subjects trying to abstain from drinking."

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