# Teenage brain development study helps predict drinking behavior

September 21 2023, by Freda Kreier

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Mapping out brain networks in teens can help predict current and future risky drinking behavior, according to Sarah Yip, Ph.D., associate professor of psychiatry and in the Yale Child Study Center.

Teenage brains are furiously forming new connections during adolescence. Two of the systems that are rewired during this time are networks related to reward and inhibition—systems that tend to develop differently in males and females.

In a study published in JAMA Psychiatry, Yip and her colleagues sorted through a massive MRI dataset of teenage brains to see if they could predict drinking behavior in adolescents by looking at how these two systems rewire during development.

The study revealed that the way inhibitory and reward pathways—which broadly regulate "brake" and "go" behavior—develop can help forecast how likely those teens are to drink heavily in the years to come.

Specifically, the study revealed that the way the brain responded during performance of inhibitory and reward tasks could predict how likely teens were to engage in risky drinking in the future. But while data from both tasks could predict alcohol use in girls, only the inhibitory task data were helpful in predicting behavior in boys. Taking a closer look at these systems could help researchers develop new therapies for alcohol use, says Yip.

## Mapping out the teenage brain

It's not just bodies that change during adolescence. Ask any parent, and you'll find that how their kids behave changes radically during their teenage years. But the shape these changes take can vary between people and sexes.

For instance, girls tend to develop their inhibitory systems—the connections that can tell them not to do something—earlier than boys. This could help explain why researchers sometimes spot different drinking patterns between male and females during adolescence, with boys more likely to engage in risky drinking behavior than girls.

Yip and her colleagues, including key contributors Sarah Lichenstein, Ph.D., assistant professor of psychiatry; Godfrey Pearlson, MBBS, MA, professor of psychiatry and of neuroscience; and Qinghao Liang, Ph.D. candidate, wanted to see if they could spot these sex differences in the brain. "We knew that there are potential sex differences in development of alcohol use," she says. "So [we wanted to know] if different brain networks might relate to alcohol use in men versus women."

The team wanted to use cutting-edge machine learning to look for sex differences. To do that, they needed a lot of data to help train their algorithm. So, Yip and her colleagues used MRI images from the IMAGEN consortium—a project out of Europe that collected genetic and neurological data on approximately 2,000 teens.

As part of this study, 14-year-olds were asked to perform various tasks while having their brain imaged in an MRI. Some of these tests were intended to activate the reward and inhibitory systems, such as having participants play a game for money or resist pressing a button in response to a stop signal. These same teens were then brought back when they turned 19 to take the same tests.

## A unique opportunity to study teens over time

By following these teens over time, the researchers were able to map out how the brain changed over that five-year period. This type of dataset is "very rare," says Yip. As such, it is "uniquely poised to let us ask questions that haven't been possible before," she says.

That includes questions like whether brain development could predict drinking behavior. Yip and her colleagues used brain images from 1,359 of these teens to search for patterns in brain connectivity to see if they correlated to how much those teens reported drinking as 14- and 19-year-olds.

## Boys and girls differed

Their analysis revealed that connections in at least two pathways could help predict risk for heavy drinking. However, which pathways predicted alcohol use depended on whether the participants were male or female.

In boys, only brain imaging data collected during the inhibition task—a task that tests how well people "hit the brakes" on certain behaviors—could reliably predict drinking behavior. On the other hand, brain imaging data collected during both the inhibitory and reward tasks were related to future alcohol use in female participants.

The fact that girls' inhibitory pathways form earlier during adolescence than boys' may be part of the reason, says Yip. To further test these trends, the team looked for patterns in brain networks in approximately 115 college students at the University of Connecticut, who were both older and geographically removed from the original European cohort.

True to form, the same systems and sex differences played out across male and female students—so that "even though it was different countries and different settings, the same networks predicted risky drinking behavior," says Yip.

In theory, researchers could use this information to develop new therapies for treating risky drinking behavior in both teens and adults. These findings also suggest that targeting treatments for male and female patients may be a helpful approach to improve treatment outcomes. Imaging these brain networks might also help clinicians determine whether their treatments are working for their patients, says Yip.

**More information:** Sarah W. Yip et al, Brain Networks and Adolescent Alcohol Use, *JAMA Psychiatry* (2023). DOI: 10.1001/jamapsychiatry.2023.2949

Provided by Yale University