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The Value of Unusual Animal Models for Alcohol Research A commentary on: Anacker, Loftis, and Ryabinin, “Alcohol Intake in Prairie Voles is Influenced by the Drinking Level of a Peer”

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Abstract

The recent study by Anacker, Loftis, and Ryabinin used a novel animal model, the prairie vole, to investigate social effects on drinking. Their finding that same-sex peers modulate their drinking to match each other has intriguing implications for the fields of alcohol research as well as research on social relationships.

Love has often been compared to an addiction (Insel, 2003). The first researchers to take this literally worked on maternal behavior in rats, and showed that infants are very motivating to mothers (Wilsoncroft, 1968) and that dopamine metabolism is involved (Frankova, 1977). However, pregnancy and early motherhood are characterized by a unique suite of hormonal circumstances that are not applicable to non-mothers.

To study social bonds in adolescents and adults, one must study species that demonstrate these bonds. Rats and laboratory mice, while usually preferring social housing, have not been shown to form bonds to specific individuals as adults. The monogamous prairie vole has been the rodent model for adult social bonds, given its formation of heterosexual pair-bonds (Carter et al., 1995). In addition, prairie voles are cooperative breeders – over 70% of offspring stay in their natal group and help raise their siblings, leading to lifelong associations between family members (McGuire et al., 1993). Finally, for unmated voles affiliative behavior is generally high even towards strangers (Bales and Carter, 2003). All of these factors make prairie voles a natural model for studying the neurobiology of many different types of social bonds.

Similarities in the process of pair-bonding and drug addiction include the involvement of dopamine D2 and D1 receptor systems (Aragona et al., 2003; Aragona et al., 2006) via the cAMP signaling cascade (Aragona and Wang, 2007), and the release of dopamine during mating or drug use (Gingrich et al., 2000). Amphetamine use impairs the formation of a pair-bond (Liu et al., 2010), via nucleus accumbens dopamine. Developmental exposure to a dopamine D2 antagonist affects later social behavior and anxiety (Hostetler et al., 2010).

Given these similarities between addiction and social bonding, it may be somewhat surprising that prairie voles have not been used before in alcohol research. Social relationships are widely appreciated to exert a strong influence on alcohol drinking, especially in adolescence (Chartier et al., 2010). In an earlier paper (Anacker et al., 2011), Anacker and colleagues found that there were significant correlations in alcohol

consumption between same-sex adult siblings when pair-housed, but not when the siblings were isolated. The correlation was not found for saccharin consumption. When pair-housed, voles showed a high ethanol preference (with no sucrose fading necessary), and preferred ethanol more than singly-housed voles.

In the current study, Anacker and colleagues took this research several steps further by attempting to determine the behavioral relationships leading to these correlations in drinking behavior. They paired low and high alcohol drinkers and found that high drinkers lowered their alcohol consumption to match their partners'. Low drinkers, for the most part, did not change their consumption, although there was variability with some low drinkers increasing to match their high drinking partner. The decrease in high drinkers continued when they were isolated. When voles with similar levels of drinking were matched, they did not change their drinking patterns; neither did saccharin elicit this type of matching behavior.

These findings are fascinating for a number of reasons. The paucity of animal models for peer influences in alcohol drinking makes this a highly valuable model [but see fascinating work by Randall and Lester on C57BL/6 and DBA/2 mice (Randall and Lester, 1975a; Randall and Lester, 1975b; Randall and Lester, 1975c)]. The authors suggest that the variability demonstrated in which animals change their drinking behavior (high to low vs. low to high) may be due to dominance relationships within the pairs. Dominance is a bit of a curious concept in prairie voles. In the wild, unrelated males would not typically be sharing nests in this way and there is little overlap between home ranges. Nonresident animals (more often males, but females also), do visit nests of other groups (Getz and Hofmann, 1986), perhaps providing a context for interactions between unrelated animals; however, the resident males in these encounters are usually aggressive (McGuire and Getz, 1991). Interaction between non-sibling, same-sex animals remains an interesting and underexplored area of social behavior (Beery and Zucker, 2010), even given the increasing popularity of the "social interaction test" in mice (File, 1993).

Another intriguing finding, or "non-finding" in the present study, is that sex differences in alcohol drinking were not consistent across different experiments. Sex differences in behavior are extremely common in prairie voles (Bales et al., 2003; Bales et al., 2004; Carter, 2007; DeVries and Carter, 1999). In the present study, females drank more than males; while in the previous study (Anacker et al., 2011), depending on the experiment and outcome variable, there were no sex differences or males had a higher preference. It is possible that subtle aspects of developmental environment (Bales et al., 2007; Carter, 2003) can affect the direction of sex differences in juvenile and adult animals; this aspect of the results calls for additional study.

In summary, the exploration of alcohol drinking in an unusual animal model, the prairie vole, lends credence to the hypothesis that central modulation of social behavior is tied to the central modulation of addictive behavior. Many aspects of the model remain to be explored. This novel model for alcohol drinking will contribute both to our understanding of addictive behavior, and to our knowledge of the sociophysiology of prairie voles.

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