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## Individual Variation in Social Behaviours of Male Lab-reared Prairie voles (*Microtus ochrogaster*) is Non-heritable and Weakly Associated with V1aR Density

Andrea R. Vogel<sup>1,2,3</sup>, Heather B. Patisaul<sup>1,2</sup>, Sheryl E. Arambula<sup>1,2</sup>, Francesco Tiezzi<sup>3,4</sup> & Lisa A. McGraw<sup>1,2,3</sup>

The genetic and environmental factors that contribute to pair bonding behaviour remain poorly understood. Prairie voles (*Microtus ochrogaster*) often, but not always, form stable pair bonds and present an ideal model species for investigating the genetic and environmental factors that influence monogamy. Here, we assessed variation in partner preference, a measure of pair bonding, and related social behaviours in a population of laboratory-reared prairie voles under controlled environmental conditions. We evaluated to what extent variation in these behaviours correlate with vasopressin 1a receptor (V1aR) expression in the ventral pallidum (VP) and retrosplenial cortex (RSC), and estimated the heritability of these behaviours and V1aR expression. We found substantial variation in partner preference and measures of aggression, paternal care, and anxiety-like behaviours, but no correlation between these traits. We also found variation in V1aR density in the VP and RSC can account for behavioural components of paternal care and aggression, but not in partner preference. Heritability estimates of variation in partner preference were low, yet heritability estimates for V1aR expression were high, indicating that the extensive variation in partner preference observed within this population is due largely to environmental plasticity.

Monogamy, defined as a mated pair that stays together through several breeding seasons, is rare among mammals, and when it occurs, monogamy is typically accompanied by the formation of pair bonds – strong, lasting social bonds between mates<sup>1</sup>. Prairie voles (*Microtus ochrogaster*) are socially monogamous rodents that often form pair bonds but, in their natural habitats, display great variation in their level of social monogamy<sup>2–6</sup>. For example, male prairie voles vary considerably in their mating strategies, ranging from “resident” strategies, where they defend a territory with their respective paired female; to “wanderer” strategies, where they do not have defined territories and gain paternity through extra-pair matings<sup>2–5,7,8</sup>. In addition to decades of field research describing mating system variation in their natural habitats, prairie voles have also become an invaluable laboratory species for understanding the neurobiological and genetic basis of pair bonding and related social behaviours. While these laboratory studies have increased our understanding of the biological basis of the pair bond, our understanding of why individuals show such strong variation in mating strategies, including whether or not they form pair bonds at all, is still poorly understood. In this study, we set out to further characterise natural genetic variation in male pair bonding and related social behaviours, its neurobiological biological correlates, and the heritability of these traits in a controlled laboratory environment.

Pair bonding and related social behaviours in prairie voles have been studied in the laboratory using standard rodent behavioural assays. The pair bond is commonly measured using the partner preference test, which measures the amount of time a focal animal spends with its mate (partner) versus an unrelated, unfamiliar animal of the same sex (stranger). In prairie voles, males typically form a “partner preference” whereby they spend more

<sup>1</sup>Department of Biological Sciences, North Carolina, USA. <sup>2</sup>W. M. Keck Center for Behavioral Biology, North Carolina, USA. <sup>3</sup>Program in Genetics, North Carolina, USA. <sup>4</sup>Department of Animal Science, North Carolina, USA. Correspondence and requests for materials should be addressed to A.R.V. (email: [arvogel@ncsu.edu](mailto:arvogel@ncsu.edu))

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