Submitter Name: Carter Allen
Submitted email: allen.2554@buckeyemail.osu.edu

A statistical framework for network-based discovery of opioid use sub-populations in rats using the Bayesian stochastic block model

Carter Allen[1], Brittany N. Kuhn[2], Nazzareno Cannella[3], Ayteria Crowe[2], Analyse T. Roberts[2], Veronica Lunerti[3], Massimo Ubaldi[3], Gary Hardiman[4], Leah Solberg Woods[5], Dongjun Chung[1], Roberto Ciccocioppo[3], Peter W. Kalivas[2]

[1]Department of Biomedical Informatics, The Ohio State University
[2]Department of Neuroscience, Medical University of South Carolina
[3]School of Pharmacy, University of Camerino
[4]School of Biological Sciences, Queen's University Belfast
[5]Department of Internal Medicine, Wake Forest University

Opioid use disorder is a psychological condition that affects over 200,000 people per year in the U.S., causing the CDC to label the crisis as a rapidly spreading public health epidemic. It has been found that the behavioral relationship between opioid exposure and development of opioid use disorder varies greatly between individuals, implying existence of sup-populations with varying degrees of opioid susceptibility. In this study, we analyzed behavioral data from over 300 rats of pre- and post-heroin experience, which were collected from two geographically distinct cohorts of adult male and female heterogeneous stock. A stress and anxiety-related behavioral baseline was established for each rat using the elevated-plus maze and open field task experiments. Then, rats were exposed to heroin self-administration training and follow-up behavioral tests. To analyze the effect of heroin exposure on behavioral changes, we developed a network-based data analysis workflow. Specifically, we integrate different cohorts of rats, remove possible batch effects, and construct a rat-rat similarity network based on their behavioral patterns. We then implemented community detection on this similarity network using a Bayesian degree-corrected stochastic block model to uncover sub-populations of rats with differing levels of opioid susceptibility. We discovered three distinct behavioral sub-populations, each with significantly different behavioral outcomes that allowed for unique characterization of each cluster in terms of susceptibility to opioid dependence. In this presentation, we will present a generalized workflow and open source software, named `behavioR`. Finally, we gently illustrate sub-population identification analysis using this workflow and interpretation of the results.