

Recovery from amphetamine use disorder affects positively and negatively valenced interoceptive processing

M.P. Paulus, A.C. May, and J.L. Stewart

Interoception (Paulus and Stewart 2014), i.e. the processing and integration of afferent information coming from inside the body, and its influence on motivated behavior play an important role in the initiation of drug-taking behavior (Migliorini, Stewart et al. 2013, Berk, Stewart et al. 2015) but may also undergo change as a function of recovery from substance use. Insular cortex receives body-relevant information and integrates this with ongoing activities and context. In a series of studies, we aimed to examine the effect of positively and negatively valenced interoceptive stimulation on individuals with current methamphetamine use disorder relative to individuals who have been in remission for at least 1 year.

Methods: Methamphetamine users were recruited from residential recovery programs in the San Diego area and the Veterans Administration Substance Abuse Residential Rehabilitation Treatment Program (VA-SARRTP). All participants underwent two sessions: (1) a detailed clinical interview session employing the Semi-Structured Assessment for Drug Dependence and Alcoholism (SSADDA) to calculate lifetime substance use and determine presence of DSM-5 disorders; and (2) a functional magnetic resonance imaging (fMRI) session, wherein they were subjected to two paradigms: (a) an inspiratory breathing load paradigm (Stewart, Juavinett et al. 2015), which makes it difficult for subjects to inspire, resulting in mild-to-moderate aversion; and (2) an affective touch paradigm (May, Stewart et al. 2013), optimized to stimulate C-tactile afferent fibers important for homeostatic regulation of social affiliation (Olausson, Wessberg et al. 2010).

Results: Participants with active methamphetamine use disorder showed significant attenuation of both negatively and positively valenced interoceptive processing in insula and other neural substrates that are important for salience processing. Individuals abstinent from methamphetamine use disorder for at least one year exhibited attenuated processing of positively valenced interoception. In comparison, these subjects showed appropriate activation to negatively valenced interoceptive stimuli. Although, there were no significant differences in subjective report, these results show that some aspects of interoceptive processing undergo changes as a function of remission status.

Discussion: Both positive reinforcement (Berridge and Robinson 2003), i.e. increased drug-taking behavior as a consequence of a positive hedonic state, and negative reinforcement mechanisms (Koob 2013), i.e. the use of drugs to avoid a negatively valenced state, have been proposed to play an important role in substance use disorders. Our findings support the hypothesis that neural substrates that process aversive states undergo significant changes as a function of recovery from acute substance use disorder, which are consistent with the idea that prolonged substance use is associated with an allostatic state. Future investigation need to be based on longitudinal follow up studies to chart the trajectory to recovery and its implication for susceptibility to relapse.

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