Behavioral Phenotypes of Impulsivity in Substance Dependent Individuals in Protracted Abstinence: Insights from 'Pure' Heroin and Amphetamine Users

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Impulsivity is implicated both as an antecedent risk factor and a consequence of drug addiction. However, progress in the field is hampered by the multi-dimensional nature of impulsivity, characterized by multiple personality, psychiatric, and neurocognitive dimensions that are rarely examined concurrently within the same population. Further, our understanding of how the different dimensions of impulsivity are manifested in users of different classes of drugs is limited by the high rates of polysubstance dependence among drug users. Finally, there is a notable gap in the literature about the role of impulsivity in the protracted abstinence stage of the addiction cycle. To address these gaps, we have developed a program of addiction research in Bulgaria, where we have access to mono-substance dependent ('pure') heroin and amphetamine users. We administered a comprehensive battery of neurocognitive tasks of 'impulsive choice' and 'impulsive action'; self-report personality measures of trait impulsivity and related traits; and psychiatric indices of impulsivity. Participants included 'pure' heroin-dependent individuals (HDI), 'pure' amphetamine-dependent individuals (ADI), and non-substance dependent healthy controls. The majority of substance dependent participants were in protracted abstinence at the time of testing. Our goal was to explore which impulsivity phenotypes are common across addictions and which are unique to specific classes of drugs (opiates vs. stimulants), as well as which persist in protracted abstinence.

Our results reveal important differences between opiate and stimulant addictions that are observable in the protracted abstinence stage. Specifically, computational modeling analyses of the Iowa Gambling Task, one of the most widely used tasks of decision-making, revealed that impaired decision-making in ADI is mediated by hypersensitivity to reward, whereas impaired decision-making of HDI is driven by hyposensitivity to loss. Further, machine-learning analyses revealed substance-specific multivariate impulsivity profiles that classified HDI and ADI in new samples with high degree of accuracy. Out of 54 predictors in the machine-learning model, psychopathy was the only predictor that was common to both opiate and stimulant addictions. Notable dissociations emerged between factors predicting opiate vs. stimulant dependence, some of which showed opposite patterns among HDI and ADI. Impulsivity dimensions were also differentially associated with HIV risk behaviors in HDI and ADI. Overall, our findings challenge the unitary account of drug addiction and suggest that opiate and stimulant addictions may be driven by different underlying mechanisms. Results may have important implications for the development of cost-efficient diagnostic assessment batteries and personalized prevention and intervention programs for HDI and ADI.