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Machine learning reveals common and specific predictors of alcohol, cannabis, and nicotine dependence

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Background: The goal of this study was to identify behavioral markers that classify alcohol dependence (AD), cannabis dependence (CD), and nicotine dependence (ND) using machine-learning. Based on our findings with opiate (OD) and stimulant dependence (SD) (Ahn & Vassileva, 2016), we expected to find both common and substance-specific predictors.

Methods: The sample included 595 participants (42 with AD, 92 with CD, 187 with ND, 168 with SD, and 159 with OD). We used demographic, psychiatric, personality, and neurocognitive measures to predict AD, CD, and ND. Psychiatric measures included length of abstinence, conduct disorder, antisocial personality disorder, psychopathy, depression, and anxiety. Personality measures included trait impulsivity, aggression, sensation seeking, and anxiety sensitivity. Neurocognitive measures included Iowa Gambling, Cambridge Gambling, Immediate Memory, Delay Discounting, Balloon Analogue, Go/No-Go, and Stop-Signal tasks.

Results: The machine-learning analyses achieved high out-of-sample classification accuracy (AD AUC=0.85; CD AUC=0.79; ND AUC=0.69). For AD, CD, and ND, psychopathy was both the strongest predictor and the only common predictor for all drug classes. Sensation seeking was a common predictor of AD and CD, depression – of AD and ND. We also found specific predictors of AD (attentional trait impulsivity), CD (anxiety sensitivity), and ND (delay aversion).

Conclusions: Consistent with our earlier findings, current results reveal both common and substance-specific predictors of AD, CD, and ND, which has important implications for genetics. For example, because psychopathy was highly significant and common across all five substances, it may be an important endophenotype tapping an underlying construct common across addictions to different drug classes.