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Discriminability of personality profiles in isolated and Co-morbid marijuana and nicotine users

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ABSTRACT

Specific personality traits have been linked with substance use disorders (SUDs), genetic mechanisms, and brain systems. Thus, determining the specificity of personality traits to types of SUD can advance the field towards defining SUD endophenotypes as well as understanding the brain systems involved for the development of novel treatments. Disentangling these factors is particularly important in highly co morbid SUDs, such as marijuana and nicotine use, so treatment can occur effectively for both. This study evaluated personality traits that distinguish isolated and co-morbid use of marijuana and nicotine. To that end, we collected the NEO Five Factor Inventory in participants who used marijuana-only ($n=59$), nicotine-only ($n=27$), both marijuana and nicotine ($n=28$), and in non-using controls ($n=28$). We used factor analyses to identify personality profiles, which are linear combinations of the five NEO Factors. We then conducted Receiver Operating Characteristics (ROC) curve analysis to test accuracy of the personality factors in discriminating isolated and co-morbid marijuana and nicotine users from each other. ROC curve analysis distinguished the four groups based on their NEO personality patterns. Results showed that NEO Factor 2 (openness, extraversion, agreeableness) discriminated marijuana and marijuana + nicotine users from controls and nicotine-only users with high predictability. Additional ANOVA results showed that the openness dimension discriminated marijuana users from nicotine users. These findings suggest that personality dimensions distinguish marijuana users from nicotine users and should be considered in prevention strategies.

1. Introduction

Despite the high co-morbidity between marijuana (MJ) and nicotine (NIC) use, only few studies have directly addressed the mechanisms that lead to their concurrent use. A recent review by Agrawal describes multiple etiologies that influence their co-morbidity. This includes route of administration (inhaled), cross-drug adaptation, response to treatments, environmental effects and genetic factors (Agrawal et al., 2012). Others have also alluded to the "gateway drug" hypothesis whereby the use of one drug may potentiate the effects of the other. For example, in a longitudinal study in 14–15 year olds, marijuana use increased the likelihood of initiating nicotine use up to 8 times and developing nicotine dependence up to 3 times suggesting marijuana's role as a gateway drug (Patton et al., 2005). This was further supported by findings showing that women who used marijuana were at 4.4 odds of later developing nicotine use and dependence (Agrawal et al., 2008). The same group also reported in 43,093 adults that nicotine smoking increased the risk for marijuana use and dependence up to 3 times (Agrawal and Lynskey, 2009). This latter finding suggests a bi-directional potentiating effect and indicates that more complex factors may drive combined use. Although the animal literature has characterized the neural mechanisms that may underlie these potentiating effects, it is also possible that personality factors contribute to this phenomenon.

Combined marijuana and nicotine use has been associated with differential effects on clinical diagnoses, cognitive and psychosocial problems, and outcomes (Ketcherside and Filbey 2015; Filbey et al., 2015; Peters et al., 2012). For example, Bonn-Miller and colleagues examined associations between negative emotions (depression and anxiety) that discriminate marijuana-only users from co-morbid marijuana and nicotine users (Bonn-Miller et al., 2010). They found that, in general, nicotine-only using individuals had significantly greater negative emotionality than marijuana users, co-morbid marijuana and nicotine users, and non-using controls. Earlier work by Degenhardt showed that while nicotine and marijuana use were both individually associated with

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increased rates of negative emotion, this relationship appeared to be driven by neuroticism in marijuana users (Degenhardt et al., 2001). Taken together, these studies argue for different patterns of co-morbidity in nicotine and marijuana using populations. To date, however, distinctions in trait markers, such as personality factors, have not yet been addressed in this ubiquitous group of co-morbid users.

These differences suggest the need for fine-tuning the ability to discriminate risk-profiles between these groups as they also relate to clinical treatment outcomes. Factors that contribute to risk profiles include personality traits that have been examined as putative markers for treatment outcomes. For example, in a prospective four-year study in 112 adults with chronic alcoholism, Krampe et al. (2006) determined that the presence of any personality disorder was associated with a decrease in four-year abstinence probability. Similarly, using the NEO Personality Inventory-Revised (NEO PI-R) Betkowska-Korpala (2012) found that following treatment, abstinent patients have higher levels of agreeableness and conscientiousness than patients who relapsed within a year following the therapy. This suggests that personality profiles have high predictive values for SUD outcomes and should be considered during treatment programs.

However, to date, only few studies have examined personality factors that distinguish marijuana from nicotine users and even fewer differentiate isolated use from combined use. In terms of isolated use, high openness but lower agreeableness and conscientiousness in marijuana users relative to non-users has been noted (Fridberg et al., 2011), suggesting that marijuana users differ from non-users on dimensions of normal personality traits as measured by the Big Five model of personality. Conversely, greater extraversion is widely reported in nicotine-only users (Smith, 1970), as well as high neuroticism (Tate et al., 1994) and impulsivity (Costa and McCrae, 1992). Studies that have performed direct contrasts between isolated marijuana and nicotine users have also shown differences between the two groups. For example, using the wide spectrum Five-Factor Model of personality, Terracciano et al. (2008) showed that nicotine users had lower conscientiousness and higher neuroticism whereas marijuana users had high openness, average neuroticism, and low agreeableness and conscientiousness. However, these studies did not examine personality factors in co-morbid nicotine and marijuana users. These traits together suggest that co-morbid users would have a personality profile endorsing high openness and neuroticism, but comparatively less of these traits than isolated users.

Personality factors are markers that can be used as endophenotypes for substance use disorders (SUDs) particularly because brain circuits involved in personality traits are also implicated in SUD (Cloninger, 1987; Dawe et al., 2004; Sher et al., 2000). For example, emergent literature has classified the Big Five personality model via machine learning techniques from resting state fMRI data (Kunisato et al., 2011; Kong et al., 2014). These studies indicate that neuroticism negatively correlated with activity in the middle frontal gyrus and precuneus; extraversion correlated positively with regional activity in the striatum, precuneus, and superior frontal gyrus; openness correlated positively with activity in the thalamus and amygdala, and negatively with the superior frontal gyrus; conscientiousness correlated positively with regional activity of the middle frontal gyrus and correlated negatively with the cerebellum (Kunisato et al., 2011). While these findings have not been consistent across studies, they suggest underlying neurobiological mechanisms/pathways that confer personality factors particularly in similar neural substrates implicated in SUD (i.e., mesocorticolimbic areas) (Korjus et al., 2015; Tingting et al., 2014).

Altogether, better understanding of the links between personality and SUD can provide understanding of the brain circuits implicated in SUD that could improve prevention and intervention. Given the paucity in the literature on personality factors that discriminate co-morbid from isolated marijuana and nicotine use, this study examined differential NEO personality profiles in marijuana only, nicotine only, co-morbid marijuana and nicotine use and non-using controls. Because the existing literature has shown that marijuana users and nicotine users differ on openness and neuroticism, we predict that comorbid users would have a personality profile high on these two personality traits, but intermediate to that of the isolated users.

2. Methods

We obtained written informed consent from all participants in accordance with the Institutional Review Board (IRB) of University of New Mexico and the University of Texas at Dallas.

2.1. Study participants

Participants were recruited from the general community through flyers and newspaper advertisements to participate in a study to determine behavioral and neural associations of substances at the Mind Research Network in Albuquerque, New Mexico. All participants were between the ages of 18 – 55, without current Axis I disorders, not currently taking any psychotropic medications, and, have no history of brain injury. Because these data were collected as part of a larger fMRI study, participants were further required to be free of MRI contraindications (i.e. pregnancy, metallic implants, claustrophobia) and be right-handed. Of the 224 individuals who met study criteria, 80 participants were excluded for having a lifetime substance use disorder other than marijuana and nicotine. Two participants were also excluded due to missing data. Thus, analyses for this study were conducted on a sample size of 142 (Table 1).

We then categorized the participants into four groups based on their primary and regularly-used substance: marijuana-only ($n=59$), nicotine-only ($n=27$), co-morbid marijuana and nicotine ($n=28$) and non-using control ($n=28$) groups. For the marijuana-only group, regular marijuana use was defined as at least four times a week for the previous six months (without regular nicotine use). For the nicotine-only group, regular nicotine use was defined as smoking at least ten cigarettes per day (without regular marijuana use). The combined marijuana and nicotine group consisted of those who use both marijuana and nicotine regularly, as defined by 60 days out of the past 90 of concurrent use. The non-using control group consisted of participants that were neither regular users of marijuana or nicotine. Table 1 summarizes the substance use characteristics for all of the groups.

2.2. Instruments

All assessments took place in the laboratory and were not time-constrained. The typical length of time that participants took to complete questionnaires was 1.5 h (of note, the assessments reported here were collected as part of a larger neuroimaging study).

The study outcome variables consisted of groups of marijuana-only users, nicotine-only users, and, co-morbid users of marijuana and nicotine. Covariates included sex, race (White vs. Non-White), age, and years of education. Marijuana, nicotine and alcohol use was evaluated using the participant's self-reported use on the Timeline Followback as well as the Marijuana History Questionnaire (Sobell et al., 1995). Substance use disorders were evaluated using the Structured Clinical Interview for DSM-IV Disorders (SCID) (First et al., 1996). Personality traits were measured by NEO PI-R (PAR Inc., Lutz, FL, USA). The NEO PI-R scale is based on the