Predicting Smoking and Nicotine Dependence from the *DSM-5* Alternative Model of Personality Disorders

Alexandra L. Halberstadt

Carnegie Mellon University

Advisor: Kasey Creswell, PhD

Abstract

Individuals with personality disorders (PDs) have higher morbidity and mortality than the general population, and this may be due to maladaptive health behaviors such as smoking. Individual differences in underlying personality dimensions of behavioral undercontrol, affective dysregulation, psychoticism, and antagonism are thought to explain the high comorbidity between PDs and smoking and nicotine dependence. However, little is known about how the *Diagnostic and Statistical Manual of Mental Disorders (5th Ed.; DSM-5)* Section III trait model of personality pathology relates to smoking and nicotine dependence. The current study examined this question in a sample of 500 participants using the Levels of Personality Functioning Scale to assess general personality dysfunction, the Personality Inventory for *DSM-5* to measure specific traits, the Fagerstrom Test for Nicotine Dependence to assess nicotine dependence, and questions about current and past smoking to assess lifetime smoking behavior. Results demonstrated that two of the five higher-order personality traits (i.e., negative affectivity and detachment) predicted smoking status (current vs former/never smokers), but none of the personality traits predicted level of nicotine dependence within the smokers. General personality pathology was not predictive of smoking status or nicotine dependence. The relationships between negative affectivity and detachment and smoking status were still significant after controlling for other smoking risk factors (i.e., drug/alcohol use and depression/anxiety symptoms), and after accounting for general personality pathology. Findings are discussed in regard to the general validity of this new personality disorder diagnostic system.

Keywords: nicotine dependence, smoking, personality traits, DSM-5 personality pathology, five-factor model

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Personality disorders (PDs) are broad, stable impairments in self and interpersonal functioning that start in adolescence or early adulthood and lead to distress or impairment (*Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition* [*DSM-5*]; American Psychiatric Association [APA], 2013). Individuals with personality disorders have higher morbidity and mortality than the general population (e.g., Dixon-Gordon, Whalen, Layden & Chapman, 2015; Fok, Hayes, Chang, Stewart, Callard, & Moran, 2012), and studies suggest that this is at least partially due to maladaptive health behaviors, including smoking, alcohol use, and drug use (e.g., Frankenburg & Zanarini, 2004). Individuals with PDs are particularly likely to smoke cigarettes (e.g. di Giacomo, Colmegna, Pescatore, Aspesi, Fotiadou, & Clerici, 2018). For example, using a nationally representative sample, Trull and colleagues (2010) found that the lifetime prevalence of nicotine dependence was more than double (48%) in those with PDs compared to the general population (21%). Smoking is the leading cause of disease and premature death in the United States, and smoking has been causally linked to cancer, asthma, chronic obstructive pulmonary disease, and coronary heart disease, as well as many other chronic diseases (U.S. Department of Health and Human Services, 2014). Understanding why individuals with PDs are especially likely to smoke will advance efforts to tailor treatments to this vulnerable population. This is particularly important given that typical smoking cessation treatments have been shown to be less effective for individuals with personality disorders (e.g. Piñeiro, López-Durán, del Río, Martínez, & Becoña, 2013; Donald, Chartrand, & Bolton, 2013).

Personality Pathology

Personality disorders (PDs) are defined by an "enduring pattern of inner experience and behavior that deviates markedly from the expectations of the individual's culture" (APA, 2013, p. 645). Symptoms of PDs are evident over a broad range of situations, are inflexible, and cause marked distress or impairment (APA, 2013). In the *DSM-5*, Section II details a categorical model of PDs, including ten PD diagnoses (i.e., paranoid, schizoid, schizotypal, antisocial, borderline, histrionic, narcissistic, avoidant, dependent, obsessive-compulsive) (APA, 2013). This categorical model has been widely criticized for not providing a clinically valid and useful model of personality pathology (e.g., Widier & Trull, 2007; Krueger & Eaton, 2010). There is high comorbidity across the ten PDs and a great deal of heterogeneity within disorders (Trull & Durrett, 2005). Additionally, PDs have arbitrary diagnostic cutoffs and low stability over time (Skodol et al., 2011). Calls for a more empirical model of PDs led to the creation of the Alternative Model of Personality Disorders (AMPD) (APA, 2013), which is in Section III of the *DSM-5*.

The AMPD draws a distinction between general personality dysfunction and specific maladaptive personality traits, and the presence of both are necessary for the diagnosis of a PD. That is, individuals must show at least moderate impairment in self- and interpersonal functioning (i.e., identity, self-direction, empathy, and intimacy; Criterion A) and the presence of specific maladaptive personality traits (i.e., Criterion B) for the diagnosis of a PD using the AMPD (APA, 2013). Criterion A encompasses pathology that is common to all PDs (general personality dysfunction), and Criterion B captures differences in expression of personality pathology that is captured with elevations in a system of 25 primary traits (i.e., facets), organized into five higher-order domains: disinhibition, negative affectivity, antagonism, psychoticism, and detachment.

The AMPD is rapidly gaining support among researchers and clinicians for several reasons. Criteria A and B are connected to a broad literature on interpersonal relationships and normative personality traits, respectively. Criterion A relates to multiple paradigms of personality assessment including the interpersonal, psychodynamic, and personological paradigms of research (Pincus & Roche, in press). The five trait domains of Criterion B align with the widely used Five Factor Model of personality (i.e., neuroticism, introversion, agreeableness, conscientiousness, and openness; Costa & McCrae, 1992), which contributes to the validity and usefulness of the AMPD as being a research-oriented dimensional model of PDs (Few et al., 2013; Trull & Widiger, 2013).

The AMPD also aims to more closely carve nature at its joints, relating PDs to the broader replicable domains of personality, and to use traits derived in a bottom-up fashion from analysis on large samples (Wright & Simms, 2015). Although it has been difficult to empirically tease apart maladaptive functioning from maladaptive traits, as many pathological traits *imply* dysfunction (Clark & Ro, 2014), there is much support for this alternative model in the literature. Indeed, across multiple studies, a general factor of personality dysfunction, which Criterion A of the AMPD is thought to represent, has been empirically derived from the diagnostic criteria for PDs (e.g., Sharp et al., 2015; Wright, Hopwood, Skodol, & Morey, 2016; Wright & Simms, 2015). Criterion A also shows concurrent validity, and there is a strong relationship between Criterion A and *DSM-IV* PDs (Hentschel & Livesley, 2013). Further, Criterion A and Criterion B scores explain between-person variance in severity of impairments when modeled together (Roche, Jacobson, & Pincus, 2016).

Criterion B traits have also been well-studied, and the five-domain structure of Criterion B has replicated over multiple studies (e.g., Wright, Thomas, Hopwood, Markon, Pincus, & Kruger,

2012; Morey, Krueger, & Skodol, 2013). Clinician and self-report measures of Criterion B traits show high convergence, which supports the reliability of these constructs (Few et. al, 2013). Criterion B traits also have high concurrent validity, and trait domains relate to *DSM-IV* PD diagnoses (Few et al., 2013) and general interpersonal dysfunction, which is consistent with the idea that the PD diagnoses requires dysfunction in core personality domains, including self and interpersonal dysfunction (Wright, Pincus, Hopwood, Thomas, Markon, & Krueger, 2012). Finally, unlike the PD diagnoses, Criterion B traits show mean-level and rank-order stability, and these traits are able to significantly predict relationship problems and interpersonal distress over time (e.g., Wright, Calabrese, Rudick, Yam, Zelazny, Williams, Rotterman, & Simms, 2015).

The utility, reliability, and usability of the AMPD has also been widely investigated. For instance, this alternative model of PDs has shown concurrent and criterion validity (e.g., Few, Miller, Rothbaum, Meller, Maples, Terry, Collins, & MacKillop, 2013; Fassati, Krueger, Markon, Borroni, & Maffei, 2013), predictive validity (Wright & Simms, 2015), and clinicians have rated it highly on utility (Morey, Skodol, & Oldham, 2014) and usability (Zimmerman, Benecke, Bender, Skodol, Schauenburg, Cierpka, & Leising, 2014). In fact, clinicians rated the AMPD as more useful than the *DSM-IV* categorical model in every respect aside from "professional communication" (Morey, Skodol, & Oldham, 2014, p. 403).

Personality Pathology and Smoking/Nicotine Dependence

There is much interest in examining the link between PDs and smoking/nicotine dependence, both because of the high rate of smoking and nicotine dependence in those with PDs and the implications for treatment of nicotine dependence in those with comorbid PDs (Trull et al., 2010; Cooperman, Lu, Richter, Bernstein, & Williams, 2016). The most compelling theory for why PDs are related to smoking is the common factor theory (Oldham, Skodol, & Bender, 2009). This

model posits that there is a third factor that is related to both the etiology of personality disorders and of nicotine dependence. Specifically, individual differences in underlying personality dimensions of disinhibition (behavioral undercontrol), negative affectivity (affective dysregulation), psychoticism, and antagonism, which are risk factors for both PDs and smoking, are thought to explain the comorbidity between PDs and nicotine dependence (e.g., Kale, Stautz, & Cooper, 2018; Hakulinen, Hintsanen, Munafò, Virtanen, Kivimäki, Batty, & Jokela, 2015; Campbell, Henry, Hammelman, & Pignatore, 2014).

While prior studies have examined the relationships between smoking/nicotine dependence and both categorical PD diagnoses (e.g., Hasin et al., 2011; Trull et al., 2010) and underlying dimensions of personality (e.g., Gilbert, 1995), far less is known about the association between smoking and the *DSM-5* AMPD. Using a trait-based model of personality pathology will help us to better understand what the common vulnerability is between smoking/nicotine dependence and PDs. This information will allow us to identify populations that are most at risk for nicotine dependence and to tailor interventions to common factors underlying both PDs and smoking/nicotine dependence. The following paragraphs describe research suggesting that four of the five higher-order personality domains in the DSM-5 trait model (i.e., disinhibition, negative affectivity, antagonism, and psychoticism) are particularly important in predicting smoking and nicotine dependence.

Disinhibition. Disinhibition is defined by impulsivity, irresponsibility, distractibility, risk-taking, and lack of perfectionism (APA, 2013). High levels of disinhibition are necessary for the diagnosis of both borderline and antisocial PDs using the AMPD (APA, 2013). Borderline and antisocial PDs show a robust positive correlation with nicotine dependence (Trull, Wadudby, & Sher, 2004; Trull, Jahng, Tomko, Wood, & Sher, 2010; Zimmerman & Coryell, 1989; Hasin, Fenton,

Skodol, Krueger, Keyes, Geier, Greenstein, Blanco, & Grant, 2011; Pulay, Stinson, Ruan, Smith, Pickering, Dawson, & Grant, 2010). In fact, Zimmerman and Coryell (1989) found that *only* these two disorders were significantly related to nicotine dependence when controlling for other personality disorders, and Trull and colleagues (2010) found that antisocial and borderline PDs had the strongest correlation to nicotine dependence compared to other PDs.

There is also an extensive literature linking smoking and nicotine dependence to trait impulsivity, and other traits related to disinhibition. Disinhibition-related traits like risk taking and impulsivity are correlated with smoking in cross-sectional studies (e.g., Bloom, Matsko, & Cimino, 2013; Kale, Stautz, & Cooper, 2018), and prospectively predict smoking initiation in longitudinal studies (e.g., Collins, Sussman, Rauch, Dent, Johnson, Hansen, & Flay, 1987), suggesting that disinhibition may act as a risk factor for smoking. Further, conscientiousness, which is negatively correlated with disinhibition (Trull & Widiger, 2013), has been shown to be a protective factor against smoking in multiple studies (e.g. Zvolensky, Taha, Bono & Goodwin, 2015; Hakulinen, Hintsanen, Munafò, Virtanen, Kivimäki, Batty, & Jokela, 2015; Campbell, Henry, Hammelman, & Pignatore, 2014). In the current study, it is hypothesized that disinhibition will be related to smoking such that those higher in impulsivity will be more likely to be current (versus former or never) smokers.

Nicotine dependence is also related to disinhibition and its constituent facets. For example, Flory and colleagues (2009) found that nicotine dependence, defined by the Fagerstrom Test for Nicotine Dependence, was related to disinhibition but not reward seeking, while smoking was related to both. This supports the theory that initial cigarette use is driven by the reward system, while continual use is linked to lack of inhibitory control (Dawe, Gullo, & Loxton, 2004). Those high in impulsivity are less able to maintain abstinence from smoking, so investigating the

relationship between smoking and disinhibition has implications for smoking cessation treatment (Cosci, Corlando, Fornai, Pistelli, Paoletti, & Carrozzi, 2009; VanderVeen, Cohen, Cukrowicz, & Trotter, 2008). The current study will examine links between trait disinhibition and both smoking and nicotine dependence, and determine whether trait disinhibition continues to predict smoking and nicotine dependence after accounting for individuals' levels of general personality dysfunction (i.e., Criterion A of the AMPD).

Negative affectivity. Negative affectivity, or lack of emotional stability, is also related to smoking behavior and nicotine dependence. Borderline PD is most related to negative affectivity, as the characteristics of emotional lability, anxiousness, separation insecurity, and depressivity of this disorder are encompassed by the domain of negative affectivity (APA, 2013). Research demonstrates a strong and consistent correlation between smoking/nicotine dependence and borderline PD (Trull, Waudby, & Sher, 2004; Trull, Jahng, Tomko, Wood, & Sher, 2010; Zimmerman & Coryell, 1989; Hasin, Fenton, Skodol, Krueger, Keyes, Geier, Greenstein, Blanco, & Grant, 2011; Pulay, Stinson, Ruan, Smith, Pickering, Dawson, & Grant, 2010). Further, studies have shown that smoking and nicotine dependence are associated with higher trait negative affectivity (e.g., Mercado, Rogers, Rodriguez, Villarreal, Terracciano, & Nguyen-Finn, 2016; Chambliss, Blust, Hartl, & Lannon, 2016; Zvolensky, Taha, Bono, & Goodwin, 2015) and higher neuroticism (Hakulinen, Hintsanen, Munafò, Virtanen, Kivimäki, Batty, & Jokela, 2015; Choi, Payne, Ma, & Li, 2017; McChargue, Cohen, & Cook, 2004; Munafo, Zetteler, & Clark, 2007), which is related to negative affectivity (Trull & Widiger, 2013). Interestingly, in one study, dependent smokers (defined by the DSM-III-R definition of nicotine dependence) were higher in neuroticism than non-dependent smokers and non-smokers (Breslau, Kilbey, & Andreski, 1994). In the current study, we will examine the relationships between trait negative affectivity and both smoking status and

nicotine dependence, as well as determining whether negative affectivity continues to predict smoking and nicotine dependence after accounting for individuals' levels of general personality dysfunction (i.e., Criterion A of the AMPD). We predict that negative affectivity will be positively related to smoking status and nicotine dependence, such that higher levels of negative affectivity will predict current smoking status and greater nicotine dependence.

Psychoticism. Psychoticism is a trait comprised of odd and eccentric thinking, beliefs, experiences, and behavior (APA, 2013). High psychoticism is the main trait required for the diagnosis of schizotypal PD in the categorical diagnoses of the AMPD (APA, 2013). Schizotypal personality disorder has been consistently related to nicotine dependence across multiple studies (e.g., Trull, Waudby, & Sher, 2004; Pulay, Stinson, Ruan, Smith, Pickering, Dawson, & Grant, 2010; Hasin, Fenton, Skodol, Krueger, Keyes, Geier, Greenstein, Blanco, & Grant, 2011). In one study, paranoid, schizoid, and schizotypal symptom counts (i.e, Cluster A symptoms, which encompass trait psychoticism; APA, 2013) predicted tobacco use disorder when controlling for gender, substance use disorder diagnoses, and personality trait scores (Trull, Waudby, & Sher, 2004). Further, schizophrenia, which shares genetic similarities to schizotypal PD (Ettinger, Meyhöfer, Steffens, Wagner, & Koutsouleris, 2014; Barrantes-Vidal, Grant, & Kwapil, 2015) is strongly associated with smoking (e.g., Bastiaens et al., 2017; de Leon & Diaz, 2005; Gurillo, Jauhar, Murray, & MacCabe, 2015). In the current study, we will examine links between trait psychoticism and smoking and nicotine dependence, and determine if trait psychoticism continues to predict smoking and nicotine dependence after accounting for general personality dysfunction (i.e., Criterion A of the AMPD). We predict that higher levels of trait psychoticism will predict smoking and greater levels of nicotine dependence.

Antagonism. Trait antagonism (behavior that puts the individual at odds with others) is associated with smoking and nicotine dependence (APA, 2013). Antagonism is a trait needed for the diagnosis of both borderline and antisocial PDs. As discussed above, there is strong evidence that antisocial and borderline PDs are related to smoking behavior (Trull, Wadudby, & Sher, 2004; Trull, Jahng, Tomko, Wood, & Sher, 2010; Zimmerman & Coryell, 1989; Hasin, Fenton, Skodol, Krueger, Keyes, Geier, Greenstein, Blanco, & Grant, 2011; Pulay, Stinson, Ruan, Smith, Pickering, Dawson, & Grant, 2010).

The research linking low agreeableness (which is related to high antagonism; Trull & Widiger, 2013) to smoking and nicotine dependence is mixed, however. Some studies did not find an association between low agreeableness and smoking (e.g., Zvolensky, Taha, Bono, & Goodwin, 2015; Hakulinen, Hintsanen, Munafò, Virtanen, Kivimäki, Batty, & Jokela, 2015), while others have shown that low agreeableness is positively related to smoking (e.g., Mercado, Rogers, Rodriguez, Villarreal, Terracciano, & Nguyen-Finn, 2016; Terracciano & Costa, 2004; Malouff, Thorsteinsson, & Schutte, 2006). Low agreeableness does not fully encompass the range of maladaptive behaviors that define trait antagonism, though (Costa & McCrae, 1992), and trait antagonism has been consistently linked to smoking behavior. Thus, we predict that high levels of antagonism will be associated with smoking and greater levels of nicotine dependence. We will also test whether trait antagonism provides additional information above the general level of personality functioning in predicting smoking and nicotine dependence.

Detachment. Detachment (withdrawal from social experiences, reduced emotional expression, low extraversion) (APA, 2013) has been inconsistently linked to smoking and nicotine dependence. Studies investigating the relationship between level of nicotine dependence and PDs related to detachment (i.e., avoidant, obsessive-compulsive, and schizotypal PDs) show mixed

results. As discussed above, schizotypal PDs are related to nicotine dependence. However, in these same studies, avoidant and obsessive-compulsive PDs were not related to nicotine dependence (Trull, Waudby, & Sher, 2004; Zimmerman & Coryell, 1989; Hasin, Fenton, Skodol, Krueger, Keyes, Geier, Greenstein, Blanco, & Grant, 2011), suggesting that it is trait psychoticism (and not detachment) driving the link between schizotypal PD and nicotine dependence.

We are not aware of prior studies that have investigated the role of trait detachment in predicting smoking, though many studies have looked at extraversion and smoking. High extraversion (low detachment) has been related to smoking in some studies (e.g., Munafò & Black, 2007; Hakulinen, Hintsanen, Munafò, Virtanen, Kivimäki, Batty, & Jokela, 2015), but not in others (e.g., Terracciano & Costa, 2004; Zvolensky, Taha, Bono, & Goodwin, 2015; Schiep & Cieślik, 2011). Extraversion has also not been linked to nicotine dependence in some studies (e.g., Choi, Payne, Ma, & Li, 2017), but has been linked to nicotine dependence in others (e.g., Schiep and Cieślik, 2011). The present study will determine whether detachment is associated with nicotine dependence and smoking, and assess whether detachment provides additional information in predicting smoking and nicotine dependence beyond the level of personality functioning. Due to the evidence presented above, we predict that there will not be a relationship between detachment and smoking or nicotine dependence in the current study.

Current Study

The current study is the first to use the alternative model of PDs in the *DSM-5* to investigate whether specific personality traits (Criterion B) provide additional information, beyond general personality dysfunction (Criterion A), in the prediction of smoking and nicotine dependence in a sample of 500 participants recruited through a Qualtrics panel (more information is included below on the panel). Since nicotine dependence and smoking are differentiable constructs (i.e.,

individuals who smoke may or may not be dependent on nicotine; e.g., Donny, Griffin, Shiffman, & Sayette, 2008; Shiffman, Paty, Kassel, Gnys, & Zettler-Segal, 1994), and because relationships to personality pathology have at times differed across smoking and nicotine dependence variables, the current study will examine these variables separately. On the basis of prior research (e.g., Flory & Manuck, 2009; Zvolensky, Taha, Bono, & Godwin, 2015; de Leon & Diaz, 2005; Hakulinen, Hintsanen, Munafò, Virtanen, Kivimäki, Batty, & Jokela, 2015; Choi, Payne, Ma, & Li, 2017), we predict that the domains of negative affectivity, disinhibition, antagonism, and psychoticism will be related to smoking status. We predict that those with higher levels of these traits will be more likely to smoke and have higher levels of nicotine dependence. Given substantial shared variance between normal range and pathological personality traits, we will additionally explore unique associations between the trait domains and smoking and nicotine dependence, controlling for all other traits and general personality pathology. Finally, this study will explore whether these traits provide additional information in predicting smoking status and the level of nicotine dependence in current smokers after controlling for other smoking risk factors (i.e. depression and anxiety symptoms, alcohol use, and drug use; e.g., Black, Zimmerman, & Coryell, 1999; Breslau, Peterson, Schultz, Andreski, & Chilcoat, 1996[1]; Strat, Ramoz, & Gorwood, 2010).

Methods

Participants

The study was approved by the Carnegie Mellon University Institutional Review Board, with all participants providing informed consent. Participants were recruited through a Qualtrics panel, a survey platform that uses multiple sources to recruit survey participants (e.g., Amazon Mechanical Turk). Reliable and valid personality and substance use data can be obtained through

[1] Alcohol dependence decreased the likelihood of smoking cessation.

such online samples (Kim & Hodgins, 2017; McCredie & Morey, 2018; Miller, Crowe, Weiss, Maples-Keller, & Lyman, 2017), and there are several advantages to using these online samples when investigating clinically relevant variables such as personality pathology (e.g., Arditte, Çek, Shaw, & Timpano, 2016; Shapiro, Chandler, & Mueller, 2013). The panel service sent a pre-specified screening questionnaire to recruitment sources with eligibility questions embedded in a more general questionnaire to ensure that participants were unaware of eligibility criteria and to increase the likelihood of honest responding. Ineligible participants were unable to reenter the survey. To control for careless responding, four questions to assess attention were randomly embedded with the survey (e.g., "Select option 3 if you are paying attention."), and Qualtrics omitted careless responders before sending us the final dataset of 500 participants. The survey took approximately 30 minutes to complete. Payment was designated to be $3 through the Qualtrics panel website, and compensation included gift-cards, cash, and frequent flier miles. Eligible participants were over the age of 18 and were currently residing in the United States. The study included 500 participants (50% female based on a 50/50 gender split designated in the Qualtrics panel; M_{age}= 52.28 SD_{age}=15.74). Participants had a median household income of $35,000 to $49,999. The majority of the sample self-identified as Caucasian (85.2%), while 8.2% identified as African American, 3.4% as multi-racial, 2.2% as Asian, 0.6% as American Indian or Alaska Native, and 0.4% as Native Hawaiian or other Pacific Islander. The majority of the sample identified as non-Hispanic/Latino (91.2%). By design, half of the participants endorsed being a current smoker. For the purpose of the analysis 45.4% of the sample were "current smokers" (that is, they both endorsed being current smokers, and they have smoked at least 100 cigarettes in their lifetime). The remaining 54.6% were either never smokers (23.8%) or former smokers (30.8%). The majority of the sample (52.1%) endorsed not drinking alcohol regularly (i.e., at least

1 drink per month for the last 6 months), and 38.0% of the sample endorsed illicit drug use in the past three months. About a quarter of the sample (26.2%) endorsed ever being diagnosed with a psychological or psychiatric condition.

Measures

AMPD Criterion A: Impairment in Self- and Interpersonal Functioning. General personality dysfunction was assessed with the Level of Personality Functioning Scale [LPFS] brief form (20 items), which measures the core personality functions of identity, self-direction, empathy, and intimacy (Morey, 2017). Each item is assessed on a 4-point response scale (1=*totally false, not at all true* to 4=*very true*), and the responses are weighted and summed for a final score. The LPFS has been shown to be valid and reliable (Hopwood, Good, & Morey, 2018), and Cronbach's α for the LPFS was 0.81 in this study.

AMPD Criterion B: Maladaptive Personality Traits*.* Maladaptive personality traits were assessed using the short form (100 items) of the Personality Inventory for the DSM-5 ([PID-5]; Krueger, Derringer, Markon, Watson, & Skodol, 2012), which measures the proposed 25 *DSM-5* personality traits on a 4-point response scale (0=*very false or often false* to 3=*very true or often true*). This measure has 25 primary scales that load onto five higher-order dimensions (disinhibition, psychoticism, negative affectivity, antagonism, and detachment). The 100-item short-form used in this study shows good reliability and validity (Maples et al., 2015), and reliability was excellent in our sample (Cronbach's α=0.97). All subscales also showed good reliability (antagonism's Cronbach α = 0.91; disinhibition's Cronbach's α = 0.80; detachment's Cronbach's α = 0.94; psychoticism's Cronbach's α = 0.90; negative affectivity's Cronbach α = 0.91).

Combustible Cigarette Smoking and Nicotine Dependence. Smoking and nicotine dependence are the main dependent variables in the current study. Participants were asked about

smoking status (current, former, never), and current and former smokers were asked to report the number of cigarettes they smoke(d) per day and the amount of time smoking at that rate. In accordance with the National Health Interview Survey definitions (Centers for Disease Control and Prevention), "current smokers" were defined as those who currently smoke cigarettes and who have smoked 100 or more cigarettes in their lifetime. "Former smokers" were defined as those who have smoked 100 cigarettes in their lifetime, but are not currently smoking cigarettes. "Never smokers" were defined as those who had either never smoked or had smoked less than 100 cigarettes in their lifetime.

Nicotine dependence was measured using the Fagerström Test for Nicotine Dependence ([FTND]; Heatherton, Kozlowski, Frecker, & Fagerström, 1991). The FTND is a six-item measure with yes/no items (e.g., smoking while ill in bed) scored from 0 to 1, and multiple-choice items (e.g., time to first cigarette upon waking) scored from 0 to 3, with a total score of 0-10. Higher scores indicate higher levels of nicotine dependence. The FTND is a reliable and valid measure of nicotine dependence and has been used in a broad range of studies (e.g., Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994). Reliability in our sample was adequate (Cronbach's α=0.62).

Mental Health Variables. Anxiety and depression symptoms were measured using the Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, 1988) and the Beck Depression Inventory (Beck, Steer, & Brown, 1996), respectively. The Beck Anxiety Inventory (BAI) is a 21-item measure that asks participants to rate the how much the symptoms of anxiety have bothered them in the past month (0 = *not at all* to 3 = *severely, I could barely stand it).* The BAI has been shown to be a valid and reliable measure of anxiety (Fydrich, Dowdall, & Chambless, 1992). The BAI had excellent reliability in the current study (Cronbach's α = 0.95). The Beck Depression Inventory

(BDI) is a 21-item measure that asks participants to rate themselves on symptoms of depression (for example, crying, self-dislike, guilty-feelings, etc.). The BDI is the most widely used self-report questionnaire for depression, and it has been shown to reliably discriminate between depressed and non-depressed individuals (Richter, Werner, Heerlein, Kraus, & Sauer, 1998). Reliability on this measure was also excellent (Cronbach's $\alpha = 0.95$).

Hazardous Alcohol Use. The AUDIT (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993) is a 10-item self-report measure that assesses problematic alcohol use and related behavior in the past year (Kokotailo, Egan, Gangnon, Brown, Mundt, & Fleming, 2004). Items assess quantity and frequency of drinking, problems related to drinking behavior, and symptoms of alcohol dependence. A total score was obtained by summing items, with higher scores reflecting more severe alcohol-related problems (Babor, de la Fuente, Saunders, & Grant, 1989). The AUDIT showed good reliability in the current study (Cronbach's $\alpha = 0.85$).

Drug Use. Drug use was assessed through self-reported use of illicit drugs in the past three months. Those that endorsed use of cannabis, cocaine, prescription stimulants, methamphetamines, inhalants, sedatives or sleeping pills, hallucinogens, street opioids, prescription opioids, or any other drug for reasons or in doses other than prescribed by a doctor were coded as 1 for drug users. Those who did not were coded as 0 in the analysis. The questions used to assess drug use were a subset of those used in the World Health Organization's Alcohol, Smoking and Substance Involvement Screening Test ([ASSIST]; WHO ASSIST Working Group, 2002).

Power and Data Analysis

A priori power analyses were conducted using G*Power 3.1.9.2 (Faul, Erdfelder, Lang & Buchner, 2007). We first determined the sample size needed for a logistic regression model with

continuous predictor variables (i.e., personality pathology) and a dichotomous outcome variable (i.e., current smoker vs. former smoker and never smoker). Using an alpha of 0.05, a power of 0.80, a small effect size (odd ratio=1.4), and a one-tailed test, we determined that 500 participants would be needed. This sample size provided adequate power (.89), using an alpha of 0.05, to detect a small effect (f^2=0.07) of personality pathology on the continuous outcome variable of nicotine dependence level within smokers (*n* = 250). Two approaches were adopted to test associations between components of the *DSM-5* AMPD and smoking and nicotine dependence. First, we used Pearson correlations to estimate the strength of the associations. Second, we ran a series of logistic and linear regressions models to predict smoking status and nicotine dependence from demographic variables, general personality dysfunction, trait domains, and other smoking risk factors (e.g., BDI, hazardous alcohol use).

Results

Table 1 shows descriptive statistics for the following main variables of interest: smoking status, FTND scores, LPFS scores, PID-5 trait domains, BDI and BAI scores, AUDIT scores, and prevalence of past three month drug use. Scores on the AMPD traits in this study were lower than those found in a similar online sample recruited from Craigslist and websites with mental health content (Creswell et al., 2015). Nicotine dependence was between “low” and “medium”, with “low” nicotine dependence being 3-4 on the FTND and “medium” being 5 (Heatherton, Kozlowski, Frecker, & Fagerström, 1991). This average was lower than an analysis of the nicotine dependence of daily smokers in other studies, but higher than that of intermittent smokers, which is reasonable given that not all “current smokers” in the study smoke cigarettes daily (e.g., Shiffman, Dunbar, Scholl, & Tindle, 2012).

The scores on the AUDIT, BDI, and BAI, are low, which is expected, given that we did not use a clinical sample for the current study. The average of 3.14 on the AUDIT reflects drinking well below hazardous levels (i.e., a score of 8 or above on the AUDIT) (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). The BDI average score of 12.14 is below the cutoff score of 13 for minimal depression (Beck, Steer, & Brown, 1996), and the BAI average score of 10.65 is within the range of "mild anxiety" (8-15) (Beck, Epstein, Brown, & Steer, 1988). All of the scores on mental health and alcohol use measures are within the expected range for non-clinical samples.

Insert Table 1 about here

Table 2 displays bivariate correlations between the personality variables and the following variables: smoking status, nicotine dependence, mental health measures, and alcohol and drug use measures. As can be observed, smoking status (current vs. former/never smokers) was only correlated with AUDIT scores and past three-month drug use. None of the personality variables were significantly correlated with smoking status. Among current smokers, the level of nicotine dependence was significantly correlated with BDI total scores, and three of the PID-5 (i.e., Criterion B) personality variables (i.e., negative affectivity, detachment, and disinhibition).

Insert Table 2

Table 3 shows results of logistic regression models predicting smoking status from demographic variables, personality variables, and other smoking risk factor variables. In model 1, education was the only demographic variable that significantly predicted whether a participant

was a current (vs. former/never) smoker, with those with fewer years of education more likely to smoke. Model 2 added in the LPFS, which was not a significant predictor of smoking behavior, and education continued to be significantly negatively related to smoking. In the third model, AMPD trait domains were added to the analysis. Detachment was significantly related to smoking, such that higher levels of detachment were associated with smoking. Negative affectivity was close to the traditional threshold of significance but, surprisingly, lower levels of negative affectivity were associated with smoking. Education continued to predict smoking behavior in this model. In the fourth and final model, mental health and drug/alcohol covariates were added. Detachment continued to be significantly positively related to smoking, and negative affectivity continued to be near the traditional threshold for significance with a negative relationship to smoking. Education, past three-month drug use, and hazardous alcohol use were also predictors of smoking in this model.

Insert Table 3 about here

Table 4 shows results of linear regression models predicting nicotine dependence in current smokers from demographic variables, personality variables, and other smoking risk factor variables. As shown, only ethnicity was associated with nicotine dependence, such that being non-Caucasian predicted higher FTND scores. No personality variables entered into the analysis were significant predictors of the level of nicotine dependence of current smokers.

Insert Table 4 about here

Discussion

The aim of the current study was to determine how the *Diagnostic and Statistical Manual of Mental Disorders (5th Ed.; DSM-5)* Section III trait model of personality pathology relates to smoking and nicotine dependence. Specifically, the aim was to test whether maladaptive personality traits (Criterion B) predict smoking and nicotine dependence beyond general personality dysfunction (Criterion A) and associated risk factors for smoking (i.e. hazardous alcohol use, anxiety and depression symptoms, and drug use). Personality traits that contribute to both smoking and personality disorders may be especially useful targets for therapeutic intervention, especially since individuals with PDs may find it more difficult to quit smoking (Zvolensky, Jenkins, Johnson, & Goodwin, 2011). Using logistic regression, we determined that detachment and negative affectivity were the only two AMPD trait domains that predicted smoking status in a sample of 500 individuals collected from an online sample. These traits continued to be predictive of smoking status even after controlling for general personality dysfunction and other risk factors for smoking (e.g., hazardous alcohol use). None of the trait domains predicted the level of nicotine dependence in current smokers. Findings are discussed in regards to the five higher order AMPD trait domains below.

Smoking Status

Contrary to our initial hypotheses, disinhibition, psychoticism, and antagonism were not related to smoking status in the current study, and negative affectivity was negatively related to being a current smoker (with a *p*-value close to the traditional threshold for significance). In addition, detachment was positively related to smoking, while we hypothesized that it would not be related to smoking status. It was hypothesized that high levels of disinhibition would relate to smoking, as those who are high in trait impulsivity and those who are diagnosed with borderline

PD both show high rates of smoking (Bloom, Matsko, & Cimino, 2013; Trull, Wadudby, & Sher, 2004). In addition, we hypothesized that high levels of psychoticism would predict smoking, as schizotypal PDs and schizophrenia have been consistently associated with smoking, and odd and eccentric beliefs are a key feature of these disorders (e.g., Trull, Waudby, & Sher, 2004; Bastiaens et al., 2017). Due to the strong association between antisocial and borderline PDs and smoking, we hypothesized that antagonism would be positively related to smoking, such that high levels of antagonism would predict being a current smoker (vs. a former/never smoker) (Pulay, Stinson, Ruan, Smith, Pickering, Dawson, & Grant, 2010). Finally, due to the fact that research has shown that high negative affectivity and PDs related to high negative affectivity are related to greater chances of smoking, we hypothesized that negative affectivity would be positively related to smoking (e.g., Mercado, Rogers, Rodriguez, Villarreal, Terracciano, & Nguyen-Finn, 2016; Trull, Waudby, & Sher, 2004). However, in the current study, smoking was predicted by lower levels of negative affectivity.

In the current study, detachment was positively related to smoking; those with higher levels of detachment were more likely to be current smokers. Detachment involves low extraversion and withdrawal from social experiences and is a main trait necessary for avoidant, obsessive compulsive, and schizotypal PDs. If detachment was a risk factor for smoking, one would expect those with PDs related to detachment to show higher rates of smoking which, with the exception of schizotypal PD, they do not consistently (e.g. Trull, Waudby, & Sher, 2004). However, the current study provides evidence that in non-clinical samples, levels of detachment are significantly associated with smoking.

Taken together our findings are at odds with the larger literature; results here provide evidence that higher levels of detachment and lower levels of negative affectivity are associated

with smoking behavior. In general, individuals in this study reported lower levels of these maladaptive traits compared to other treatment samples (e.g., Creswell et al., 2015) as well as other community samples (e.g., Krueger, Derringer, Markon, Watson, & Skodol, 2012). Thus, low mean levels of these traits may help to explain these discrepant results. It may also be the case that research on participants with personality disorders (and thus very high levels of these maladaptive traits) does not translate directly to the non-clinical participants included in this sample. For instance, research that suggests a link between psychoticism and smoking may not hold true for participants with low levels of this trait—participants may not hit a threshold where psychotic symptoms may cause them to smoke cigarettes. Furthermore, it may be the case that former smokers are more similar to current smokers than they are to never smokers. We intend to explore additional analyses to determine whether combining current and former smokers (vs. never smokers) leads to more expected results.

Surprisingly, the general level of personality dysfunction, operationalized through scores on the LPFS, did not predict cigarette smoking or levels of nicotine dependence. Due to the strong association between psychiatric disorders and smoking, it was expected that the LPFS scores would predict smoking behavior. In previous studies, problematic alcohol use was predicted by the general level of personality dysfunction, operationalized through the General Assessment of Personality Disorders (Livesley, 2006; Creswell et al., 2015). This evidence suggests that operationalizing the general level of personality dysfunction through another measure may help to determine the contribution that the level of general personality dysfunction has to maladaptive health behaviors such as smoking.

Nicotine Dependence

Nicotine dependence in the current study refers to physical dependence on nicotine, which is caused by nicotine's effects on the mesocorticolimbic dopamine system (Herman, DeVito, Jensen, & Sofuoglu, 2014). The current study aimed to examine whether the AMPD provides information in predicting nicotine dependence. Results showed that there was no relationship between either general personality dysfunction or specific maladaptive personality domains and the level of nicotine dependence in this sample of current smokers. Nicotine dependence assesses the level of physical dependence on nicotine, which may not be affected by personality characteristics that relate to smoking. It is thought that a genetic predisposition to nicotine dependence is a main risk factor for developing nicotine dependence after smoking initiation (Benowitz, 2010).

Our findings that nicotine dependence is not predicted by any maladaptive personality traits is at odds with some literature that suggests a relationship between personality disorders and nicotine dependence (Pulay, Stinson, Ruan, Smith, Pickering, Dawson, & Grant, 2011), as well as normative five-factor model personality traits and nicotine dependence (Choi, Payne, Ma, & Li, 2017). However, none of the previous studies used the AMPD Criterion B traits to investigate whether they would predict smoking and nicotine dependence. In the current study, with the PID-5 measure, AMPD Criterion B traits were unable to predict nicotine dependence scores in a representative sample.

Treatment Implications

If future studies replicate our results and show that detachment is significantly related to smoking, it may be useful to target this personality trait when tailoring smoking cessation treatments to the individual. Promoting a sense of social inclusion within individuals may promote

more adaptive health behaviors, including smoking cessation. Evidence in the current study suggests that those with lower levels of detachment are more likely to be nonsmokers, so promoting social interactions and connection may be one way to promote success during nicotine cessation treatments.

Future Directions

This study was conducted in a heterogeneous sample of 500 participants, with the only inclusion criteria being 18 years of age and living in the United States (in addition, about 50% of participants were required to be smokers). This sample had somewhat lower levels of the AMPD trait domains than a comparable online study conducted to determine personality predictors of alcohol use disorder (Creswell et al., 2015). This may be because psychopathology generally decreases with age, and the average age of participants was higher in the current study than in comparable studies examining personality pathology and maladaptive health behaviors (e.g., Creswell et al., 2015; Veste, Twamley, Zorrilla, Golshan, Patterson, & Palmer, 2003). Future studies should be conducted in clinical populations (i.e., those showing higher levels of maladaptive personality traits) to determine whether these traits are associated with smoking and nicotine dependence levels in those who report clinically significant levels of these AMPD traits. This study provides evidence that maladaptive traits in online samples that resemble community samples may show different relations to health behaviors than in samples comprised of individuals with PDs. For example, high psychoticism may be a significant predictor of smoking in inpatient samples, but in the present community sample, the levels of this trait do not provide any information to predict smoking status. Future studies should explore the relationships between differing levels of personality pathology and smoking behavior and nicotine dependence. In conclusion, the AMPD traits may be more useful tools to determine personality correlates of

health behaviors when used in more clinical populations. In the general population, low baseline levels of these traits may decrease the ability to find relationships between these traits and health behaviors.

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Tables

Table 1: Descriptive Statistics for Smoking, Personality, and other Risk Factor Variables

Variable	*Mean* (*SD*) / % (*N* = 500)
Smoking Variables	
Current Smoker	45.5 %
Former Smoker	30.8 %
Never Smoker	23.8 %
FTND	4.09 (2.40)
Risk Factor Variables	
BDI Total	12.14 (12.28)
BAI Total	10.65 (12.44)
AUDIT Total	3.14 (5.25)
Past 3 Month Drug Use	38.0 %
AMPD Domains	
Negative Affectivity	1.07 (0.52)
Psychoticism	0.62 (0.61)
Detachment	0.77 (0.67)
Disinhibition	0.92 (0.40)
Antagonism	0.43 (0.46)
LPFS Total	47.67 (17.55)

Table 2: Correlations of Personality and Risk Factor Variables with Smoking Status and FTND Scores

Variable	FTND (*n* = 227) *R*	Current Smoker (*N* = 500) *R*
Risk Factor Variables		
BDI Total	0.14 *	0.07
BAI Total	0.12	0.06
AUDIT Total	0.07	0.14 **
Past 3 Month Drug Use	0.03	0.19 **
AMPD Domains		
Negative Affectivity	0.18 **	-0.01
Psychoticism	0.05	0.08
Detachment	0.15 *	0.07
Disinhibition	0.15 *	0.05
Antagonism	0.03	-0.01
LPFS Total	0.07	-0.02

* $p < .05$. ** $p < .01$.

Table 3: Logistic Regression Results with Smoking Status as the Dependent Variable

	Model 1		Model 2		Model 3		Model 4	
Variable	*Odds Ratio*	*S.E.*	*Odds Ratio*	*S.E.*	*Odds Ratio*	*S.E.*	*Odds Ratio*	*S.E.*
Constant	1.11	0.40	1.33	0.63	1.83	0.71	1.38	0.74
Age	1.00	0.01	1.00	0.01	1.00	0.01	1.00	0.01
Gender	0.88	0.19	0.87	0.20	0.90	0.21	0.97	0.22
Ethnicity	0.71	0.27	0.71	0.27	0.69	0.27	0.71	0.28
Income	0.93	0.19	0.91	0.20	1.01	0.21	0.93	0.21
Education	0.32 ***	0.27	0.33 ***	0.27	0.31 ***	0.27	0.31 ***	0.28
LPFS			1.00	0.01	0.98	0.01	0.98	0.01
Negative Affectivity					0.59	0.27	0.57 †	0.29
Psychoticism					1.45	0.24	1.31	0.25
Detachment					1.70 *	0.24	1.93 *	0.30
Antagonism					0.77	0.30	0.77	0.32
Disinhibition					1.47	0.34	1.27	0.35
Drug Use							2.14 ***	0.21
BAI Total							1.01	0.01
BDI Total							0.98	0.02
AUDIT Total							1.05 **	0.02

* $p < .05$. ** $p < .01$. *** $p < .001$. † $p = 0.053$

Table 4: Linear Regression Results with FTND Scores as the Dependent Variable

	Model 1		Model 2		Model 3		Model 4	
Variable	*B*	*S.E.*	*B*	*S.E.*	*B*	*S.E.*	*B*	*S.E.*
Constant		0.72		1.13		1.23		1.31
Age	-0.07	0.01	-0.05	0.01	-0.03	0.01	-0.02	0.01
Gender	0.07	0.33	0.08	0.33	0.07	0.34	0.07	0.35
Ethnicity	-0.18 ***	0.46	-0.18 **	0.46	-0.17 *	0.46	-0.17 **	0.47
Income	-0.10	0.32	-0.10	0.32	-0.07	0.34	-0.06	0.35
Education	-0.12	0.52	-0.12	0.52	-0.13	0.52	-0.12	0.53
LPFS			0.04	0.01	-0.07	0.02	-0.07	0.02
Negative Affectivity					0.11	0.41	0.14	0.45
Psychoticism					-0.10	0.35	-0.11	0.37
Detachment					0.10	0.34	0.17	0.46
Antagonism					< 0.01	0.47	-0.03	0.49
Disinhibition					0.12	0.51	0.14	0.54
Drug Use							-0.02	0.33
BAI Total							0.05	0.02
BDI Total							-0.14	0.03
AUDIT Total							0.06	0.03

* $p < .05$. ** $p < .01$. *** $p < .001$.