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Personality and Substance Use in Midlife: Conscientiousness as a Moderator and the Effects of Trait Change

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Abstract

Personality traits predict substance use in adolescence, but less is known about prospective substance use in middle age and beyond. Moreover, there is growing interest in how personality change and the multiplicative effects among personality traits relate to substance use. Participants included approximately 4,000 adults aged 25–74 who participated in two waves of the Midlife in the U.S. (MIDUS) study. Higher levels of neuroticism, extraversion, openness, and lower levels of conscientiousness and agreeableness predicted longitudinal substance use. Increases in neuroticism and openness predicted increased substance use while increases in conscientiousness and agreeableness predicted decreased substance use. Higher levels of conscientiousness moderated two of the other trait main effects. Personality, trait change, and interactions among traits reliably forecasted 10-year substance-use behaviors.

Keywords

personality; interactions; change; conscientiousness; substance use; smoking; drinking; drug

1. Introduction

Personality traits have emerged as critical predictors of various substance-use behaviors including the use of cigarettes, alcohol, and illicit drugs (Hampson & Friedman, 2008; Bogg & Roberts, 2004). These substances are leading risk factors for poor health and earlier mortality (McGinnis & Forege, 1993). Although there is rich empirical support linking personality traits to substance-use behaviors, most investigations concentrate on only one

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personality trait (usually conscientiousness) and typically do not examine interactions among traits. The current study sought to further investigate the association between each of the Big Five personality traits and three distinct substance-use behaviors (i.e., smoking, drinking, and drug use) by utilizing the prospective design of the Midlife in the U.S. (MIDUS) survey. We also tested whether conscientiousness moderated any effects of the other Big Five traits with substance use since high levels of conscientiousness may play a particularly important self-regulatory role in terms of health-damaging behaviors. Lastly, we tested if personality change would predict long-term substance use above baseline level of each personality trait. Our overall goal was to provide a clearer understanding of how multiple aspects of personality prospectively predicts 10-year substance use in a large national sample of adults.

1.1 Personality and Substance Use: The Evidence

The evidence connecting conscientiousness with substance use is larger and more compelling than for any other personality trait. Booth-Kewley and Vickers (1994) were among the first to document the robust effect of individuals high in conscientiousness refraining from detrimental substance use. Since then, investigations utilizing diverse samples have demonstrated a strong and clear connection between conscientiousness and substance-use behaviors (Kashdan, Vetter, & Collins, 2005; Malouff, Thorsteinsson, Rooke, & Schutte, 2007; Malouff, Thorsteinsson, & Schutte, 2006; Terracciano, Lockenhoof, Crum, Bienvenu, & Costa, 2008). In fact, a meta-analysis of 194 studies confirmed that conscientiousness-related traits were negatively associated with many different health behaviors, including tobacco use, excessive alcohol use, and drug use (Bogg & Roberts, 2004).

Conscientiousness effects appear to retain their predictive power even over extensive longitudinal periods. Teacher ratings of childhood conscientiousness predicted many unhealthy behaviors such as smoking and drinking at midlife in the Terman Life Cycle Study, a sample followed for over 70 years (Friedman et al., 1995). Specifically, those children labeled as less conscientious were more likely to become smokers and consume greater quantities of alcohol in adulthood. Similarly, a 24-year study of children from the Czech Republic found that lower levels of conscientiousness measured in childhood predicted higher drinking quantity and smoking in middle-age (Kubicka, Matejcek, Dytrych, & Roth, 2001). Longitudinal findings from the 40-year Hawaii Personality and Health cohort of 963 elementary school children also revealed similar findings regarding the effect of conscientiousness (Hampson et al., 2006).

Neuroticism also has clear associations with substance use with neurotic individuals being more likely to smoke cigarettes and smoke a greater quantity of cigarettes (Malouff et al., 2006; Mroczek, Spiro, & Turiano, 2009; Munafò, Zetteler, & Clark, 2007; Rausch, Nichinson, Lamke, & Matloff, 1990). Those higher in neuroticism are also more likely to abuse alcohol (Grekin et al., 2006; Larkins & Sher, 2006; Malouff, et al., 2007; Terracciano et al., 2008). Longitudinally, findings from the Hawaii Personality and Health cohort provide evidence that children rated lower in emotional stability (high neuroticism) predicted greater alcohol use some 40 years later in middle age (Hampson et al., 2006). The overall domain of neuroticism and underlying facets such as negative affect also have positive relations with marijuana, cocaine, and heroin use (Hopwood et al., 2007; Kashdan et al., 2005).

Much of the empirical evidence connecting agreeableness to substance use concentrates on two underlying facets: hostility and aggression. Hostility and aggression measured in childhood, adolescence, and young adulthood are each associated with higher levels of alcohol, tobacco, and marijuana use (Caspi et al., 1997; Gerrard et al., 2006; Hampson,

Andrews, & Barckley, 2007; Raikkonen & Keltikangas-Jarvinen, 1991; Terracciano et al., 2008); importantly, these findings have been confirmed by meta-analyses (Malouff et al., 2007; Malouff et al., 2006). In fact, findings appear robust using longitudinal study designs —lower levels of childhood agreeableness predicted adulthood smoking among females in the Hawaii Personality and Health cohort study (Hampson et al., 2006) and hostility among college students predicts smoking some 20 years later for both sexes (Siegler, Peterson, Barefoot, & Williams, 1992).

The relationship between extraversion and substance use is less clear (Hampson & Friedman, 2008), but there is some indication that higher levels are associated with smoking and alcohol use. For example, a meta-analysis of 25 studies from 1972 to 2001 indicated higher levels of extraversion were associated with being a smoker (Munafò et al., 2007). However, this effect may depend on smoking prevalence in the country of origin studied. Malouff and colleagues (2006) found that higher levels of extraversion was associated with smoking in studies completed in Japan and Spain (where smoking rates were much higher), but not in studies completed in the U.S. and Canada. In terms of alcohol use, teachers' ratings of extraversion in childhood were associated with higher consumption levels in middle age (Hampson et al., 2006; Tucker et al., 1995), and numerous studies have linked higher levels of extraversion in adolescence and early adulthood with excessive alcohol intake (Allsopp, 1986; Martsh, & Miller, 1997). Part of the inconsistency in associations between extraversion and substance use may be attributable to the large number of studies that use adolescent or college-aged respondents—the very ages when exploration of substances such as tobacco, alcohol and drugs is most common (Johnston, O'Malley, & Bachman, 2001). Lastly, although the empirical literature on openness is sparse, there is some indication that marijuana users score higher on openness measures (Terracciano et al., 2008).

Thus far, empirical evidence has been presented regarding the role of personality trait *level* as a predictor of substance use. However, there is mounting evidence that personality *change* may also be an important predictor of substance use. Emerging evidence suggests there are interindividual differences in personality change throughout adulthood (Mroczek & Spiro, 2007; Roberts, Walton, & Viechtbauer, 2006; Small, Hertzog, Hultsch, & Dixon, 2003). Although a large proportion of individuals remain stable on personality, others either increase or decrease in certain traits. Trait change is important to examine because accumulating evidence demonstrates that personality trait change alters substance-use behaviors/problems (Hampson et al., 2010; Littlefield, Sher, & Wood, 2009; 2010) and health outcomes (Mroczek & Spiro, 2007; Turiano et al., 2011). Given this emerging body of evidence, it is essential that prospective studies include measures of personality as well as personality change in order to clearly elucidate whether neither, either, or both predict substance use later in life.

Based on prior empirical evidence, we hypothesize that the individuals possessing the greatest likelihood of smoking tobacco, drinking alcohol in larger quantities, endorsing alcohol problems, or using illicit substances will be low in conscientiousness, high in neuroticism, and/or low in agreeableness. Moreover, increases in neuroticism and openness, and decreases in conscientiousness will increase the likelihood of engaging in detrimental substance-use behavior. Given the mixed and limited findings regarding extraversion and openness in midlife, our hypotheses are exploratory. Yet, understanding how these traits and trait change relate directly to future substance use is only part of the picture. It is equally important to understand whether and how traits interact with one another to further increase (or decrease) the likelihood of substance use.

1.2 Multiplicative effects among personality traits

Although there are many investigations of Big Five main effects on substance-use outcomes, far fewer have considered interactions among personality traits. This oversight is troubling as Hampson and Friedman (2008) have argued that an exclusive focus on main effects may mask multiplicative or synergistic associations between traits. Personality factors may interact in ways that lead certain individuals to become prone to engaging in health-damaging substance-use behaviors. Moreover, consideration of interactions can potentially illuminate the important phenomenon of buffering effects. Personality traits may buffer one another in their effect on substance use in that a risk factor such as low agreeableness or high neuroticism may be mitigated by a protective factor such as high conscientiousness.

Indeed, a handful of recent studies focusing on smoking indicate that trait interactions are important and collectively point toward the special role of conscientiousness. For example, Terracciano and Costa (2004) found that adults scoring both low in conscientiousness and high in neuroticism were about 3 times more likely to be current smokers than those characterized by high conscientiousness and high neuroticism. Hong and Paunonen (2009) found that college undergraduates characterized by both low conscientiousness and agreeableness were most likely to smoke. Vollrath and Torgersen (2002) considered various combinations of extraversion, neuroticism, and conscientiousness, but found that the particular combination of high neuroticism and low conscientiousness was most associated with smoking. This combination of traits was also related to higher self-reports of drunkenness, elevated rates of drunk driving, and higher levels of marijuana use when compared to other personality combinations. Earlier investigations into neuroticism and the Eysenckian dimension of psychoticism parallel these findings. Specifically, a combination of high psychoticism (combination of low conscientiousness and agreeableness) and high neuroticism was predictive of heavier drinking (Allsopp, 1986; Kjaerheim et al 1996; Patton et al., 1997). These studies hint at the special role that high conscientiousness may play in buffering the detrimental effects of other trait levels (e.g., high neuroticism, low agreeableness) on substance use. However, most of the extant literature has focused on only the outcome of smoking or used limited samples such as college students. No study of trait interactions has yet considered a comprehensive array of substance-use outcomes in a large national sample. The current study sought to fill this particular gap in the literature.

1.2.1 Conscientiousness: A Key Buffer—Why does high trait conscientiousness lower the likelihood of substance use, even in the face of other factors that raise the likelihood? These patterns are directly predicted by current two-mode models of self-regulation and temperament (Carver, Johnson, & Joormann, 2009; Depue & Lenzenweger, 2005). These models describe a neurophysiological architecture in which basic functions of approach and avoidance make up one mode of functioning. This first mode of functioning is thought to be more automatic and responsive to immediate environmental stimuli. Specifically, approach functions associated with reward-seeking behavior make a person prone to behaviors that are immediately gratifying, like drug and alcohol consumption. Countering this is the avoidance system, which alerts people to the potential pain and suffering that might occur with specific behaviors.

Governing these two automatic functions is a second mode that is more deliberative in nature, which is thought to explicitly moderate the effects of the automatic mode of functioning. Carver et al. (2009) describe this mode as reflecting the ability to plan and anticipate long-term consequences of all modes of automatic functioning. In the stereotypic example, a person who has strong appetites can control these impulses because they have a well-functioning effortful control system. More interestingly, it is also proposed that people who exhibit problematically low levels of approach behavior, a cardinal characteristic of

depressed individuals, can overcome this lethargy with a well-functioning control system. Similarly, a person with an overactive avoidance system can control their fears long enough to potentially face them and thus overcome them. Thus, the control mode of functioning is explicitly proposed to moderate the more basic mode of functioning.

For the purposes of our paper, this two-mode model of self-regulation is highly relevant because these modes are roughly equated with various domains of the Big Five. The automatic modes of approach and avoidance are clearly linked to extraversion and neuroticism, whereas the control mode is equated to conscientiousness and in part agreeableness (Depue & Lenzenweger, 2005; Carver et al., 2008). In fact, Carver et al. (2009) argue that conscientiousness should moderate the effects of people on the extremes of both extraversion and neuroticism. We believe this two-mode model highlights why conscientiousness likely plays a critical role in buffering the effects of other, more detrimental trait levels, hence making it a particularly important moderator when considering trait interactions on substance-use behaviors.

Thus, we hypothesized that high levels of conscientiousness will not only predict that individuals will abstain from using substances (main effects), but will also buffer the deleterious effects of other personality traits such as neuroticism on substance use engagement. The measure of conscientiousness used in the current study taps the responsibility, organizational, and carelessness aspects of conscientiousness, which parallels Carver et al.'s (2009) effortful control domain.

2. Methods

2.1 Sample and Longitudinal Design

The first wave of the MIDUS study (MIDUS 1) included 7,108 non-institutionalized, English-speaking adults living in the coterminous United States, aged 25 to 74. Data were collected in 1995-96. A longitudinal follow-up of the original MIDUS study was conducted in 2004-06 (MIDUS 2). Every attempt was made to contact all the original respondents and invite them to participate in a second wave of data collection. The average longitudinal follow-up interval was approximately 9 years and ranged from 7.8 to 10.4 years. Of the 7,108 participants in MIDUS 1, 4,963 were successfully contacted to participate in another phone interview of about 30 minutes in length (75% total response rate – adjusting for the 8% too ill to be interviewed or were deceased; see Radler and Ryff, 2010, for more information on participant retention). Of those 4,963 who completed phone interviews, 4,660 participants also completed the self-administered questionnaires (SAQ), from which several key variables in this study were measured. Therefore, this latter *N* defined the longitudinal panel that the current study drew upon. With regard to socio-demographic characteristics, the sex distribution of MIDUS participants was generally balanced, with 47% male and 53% female. Participants were largely Caucasian (approximately 93%) and ranged in age from 35 to 84 (at MIDUS 2) with a mean of 55 ($SD = 12.5$). More than 67% of participants had more than a high school education and approximately 70% of MIDUS participants were married at MIDUS 1 in 1995-96.

Attrition analyses revealed that respondents who did not participate in MIDUS 2 differed from those who participated in the longitudinal panel on certain variables. Specifically, participants in the longitudinal sample reported higher conscientiousness, $t(6265) = 4.26$, $p < .001$, lower neuroticism, $t(6262) = 2.43$, $p < .01$, and agreeableness, $t(6264) = 1.95$, $p < .05$. Participants lost to follow-up reported higher average alcohol use, $t(7022) = 6.06$, $p < .001$; were more likely to be drug users, χ^2 (1, $N = 6294$) = 5.44, $p < .01$; and were more likely to have smoked at some point in their lives, χ^2 (1, $N = 7105$) = 34.02, $p < .001$.

2.2 Measures

2.2.1 Demographic Variables—Age, sex, race, education and marital status were treated as control variables in the current study because they have known associations with substance use. First, the overall trend of substance use shows a peak during late adolescence and young adulthood, and then appears to decline afterward (Johnston et al., 2001). Second, there are generally sex differences in substance use, with men more likely to engage in substance use than women (e.g., Kashdan et al., 2005). Lastly, individuals with greater education and those married are less likely to smoke, drink heavily, and use illicit drugs (Bachman, Freedman-Doan, O'Malley, Schulenberg, & Johnston, 2008; Merline, O'Malley, Schulenberg, Bachman, & Johnston, 2004).

2.2.2 Personality Traits—The key predictor variables were assessed via the self-administered questionnaire (SAQ) portion of MIDUS 1 in 1995-96 and MIDUS 2 in 2005-06. Personality traits were assessed using adjectival measures of the Big Five markers. Respondents were asked how much each of 25 adjectives described themselves on a scale ranging from 1 (*not at all*) to 4 (*a lot*) (for more detail see Prenda and Lachman, 2001). Specifically, each of the Big Five traits were indexed as follows: neuroticism (moody, worrying, nervous, calm, $\alpha = .74$); extraversion (outgoing, friendly, lively, active, talkative, $\alpha = .76$); openness (creative, imaginative, intelligent, curious, broad-minded, sophisticated, adventurous, $\alpha = .77$); conscientiousness (organized, responsible, hardworking, careless, $\alpha = .58$); agreeableness (helpful, warm, caring, softhearted, sympathetic, $\alpha = .80$). After reversing the appropriate items, scales were created by taking the average across the items, with higher scores denoting higher levels of that trait. These Big Five scales have good construct validity (Mroczek & Kolarz, 1998), correlating well with NEO measures of the same traits (Lachman & Weaver, 1997; Prenda & Lachman, 2001). Descriptive statistics for personality traits at both time points are presented in Table 1.

To index personality change, difference scores were created between the two measurements for each personality trait. Specifically, trait scores from the MIDUS 1 were subtracted from MIDUS 2 scores for each of the Big Five. Positive scores denote increases in a given trait over time, whereas negative scores represent decreases over time. The mean change scores were as follows: conscientiousness change ($M = -.06$, $SD = .39$); neuroticism change ($M = -.16$, $SD = .55$); extraversion change ($M = -.09$, $SD = .44$); agreeableness change ($M = -.03$, $SD = .42$); openness change ($M = -.11$, $SD = .42$). To note, neuroticism has the largest mean change score in terms of magnitude and also the highest standard deviation, suggesting greater individual differences in amount of change compared to the other four traits.

2.2.3 Smoking Variables—Participants answered questions regarding their smoking habits through the phone questionnaire at both MIDUS 1 and MIDUS 2. At both waves, participants answered a series of questions if they had ever had a cigarette, ever smoked regularly (at least a few cigarettes every day), if they were currently smoking, or if they had quit smoking. Utilizing information from smoking reports at both waves we were able to construct four groups of representing smoking status: (a) never smokers were individuals who reported never smoking in their lives at both time points ($n = 1{,}334$); (b) constant smokers were individuals who reported smoking at both waves of MIDUS ($n = 743$); (c) new smokers were individuals who had started smoking between the MIDUS 1 and MIDUS 2 ($n = 25$); and (d) former smokers were individuals who had smoked at some point in their lives and had quit ($n = 1{,}586$). Among the former smokers, 318 quit between MIDUS 1 and MIDUS 2. Table 2 presents the means and standard deviations of each personality trait by smoking status.

2.2.4 Alcohol Variables—Participants answered questions regarding their alcohol drinking habits through the phone questionnaire portion of MIDUS 2. Participants first indicated whether they drank any alcohol beverages in the past month. Of the 4,606 participants who responded to the alcohol question, 1,887 (41%) reported zero drinks within the past month. Trained interviewers explained to participants that had drank in the past month that one drink meant a bottle of beer, a wine cooler, a glass of wine, a shot of liquor, or a mixed drink. With that definition in mind, participants were asked "on the days when you drank, about how many drinks did you drink on the average". Among drinkers, the average consumption was approximately 2 drinks per drinking occasion ($M = 1.97$; $SD = 1.50$; range = 1 – 13).

To index problem drinking behavior, participants responded *yes* (1) or *no* (0) to whether during the past 12 months they had any of the following problems while drinking or because of drinking alcohol: (a) Did you have any emotional or psychological problems from using alcohol, such as feeling depressed, being suspicious of people, or having strange ideas; (b) Did you have such a strong desire or urge to use alcohol that you could not resist it or could not think of anything else; (c) Did you have a period of a month or more when you spent a great deal of time using alcohol or getting over its effects; (d) Did you find that you had to use more alcohol than usual to get the same effect or that the same amount had less effect on you than before. A dichotomous variable was constructed to indicate whether a person experienced any of the alcohol problems (coded as 1) versus those who did not experience any of the problems (coded as 0). A total of 170 participants (4%) indicated at least one of the four drinking problems.

2.2.5 Drug Variables—Drug use information was obtained through the SAQ portion of MIDUS 2. Participants first reported on whether "on your own (we mean either without a doctor's prescription, in larger amounts than prescribed, or for a longer period than prescribed) did you ever use any of the following substances during the past 12 months?". Participants responded *yes* or *no* to a total of 10 substances: sedatives, tranquilizers, stimulants, painkillers, depression medications, inhalants, marijuana, cocaine, hallucinogens, and heroin. To index the use of *illegal drugs*, categories were created for those that reported using cocaine, marijuana, cocaine or hallucinogens/LSD (coded as 1; $n = 220$; 5%) and those that did not report using any of these substances over the past year (coded as 0; $n = 3758$; 95%). To index *prescription drug abuse*, categories were created for those that reported using sedatives, tranquilizers, stimulants, painkillers, depression medications, or inhalants (coded as 1; $n = 390$; 10%) and those that did not report using any of these substances over the past year (coded as 0; $n = 3608$; 90%). Descriptive analyses revealed the following four drugs as the most commonly used substances: painkillers ($n = 185$); marijuana ($n = 151$); sedatives ($n = 133$); tranquilizers ($n = 102$).

2.2.6 Prior Substance Use—To clearly demonstrate that personality traits and interactions predicted prospective substance use over a 10-year period, we adjusted models involving alcohol and drug use for prior substance use. We did not adjust for prior smoking behavior since the outcome variable itself indexed smoking behavior over the 10 year follow-up.

Through the phone questionnaire at MIDUS 1 participants were asked "during the period in your life you *drank most*, about how many drinks would you usually have on the days that you drank?" This question could index current drinking levels in 1995-96 or at an earlier point in their life when they drank more heavily ($M = 3.66$; $SD = 3.76$; range = .5 – 60). Drug use in 1995-96 at MIDUS 1 was assessed in the same manner as MIDUS 2. Participants reported on the use of 10 controlled substances without the direction of their physician in the past 12 months. Categories were created to index illegal drug use (non-users

coded as 0; n = 6910, 95%; users coded as 1; n = 424; 6%) and prescription drug abuse (non-abusers coded as 0; n = 6734, 92%; abusers coded as 1; n = 600, 8%).

2.3 Analytic Strategy

Given the diversity of the multiple substance-use outcomes, we utilized several analytic techniques to test our hypotheses. Specifically, we used multinomial logistic regression for smoking behavior, zero-inflated Poisson (ZIP) regression for average alcohol consumption, and logistic regression to examine alcohol related problems and drug use behavior. For each outcome, we ran a total of four models. Model 1 included all demographic variables (i.e., sex, age, race, education, and marital status) and prior substance-use behavior (e.g., prior alcohol and drug use). Model 2 added main effects for each of the Big Five personality traits. Model 3 added the five personality change scores. The fully adjusted Model 4 included the additional four personality interactions involving conscientiousness (i.e., Conscientiousness X Neuroticism, Conscientiousness X Extraversion, Conscientiousness X Agreeableness, and Conscientiousness X Openness). For purposes of parsimony, rather than testing all possible interactions between traits, we concentrated our analyses on the theoretically based conscientiousness interactions. We also utilized a Bonferroni correction to maintain the familywise alpha level at $p < .05$. Accordingly we set our critical value for our test of interactions to $p < .01$ for each of the four interactions tested. Following the procedures outlined by (Aiken & West, 1991), all significant interactions were plotted using representative points (i.e., ± 1 *SD*) for each independent variable.

3. Results

Zero-order correlations between the each of the substance use variables revealed modest, but significant positive associations. Specifically, smoking was positively related to average number of alcohol drinks consumed (r = .17), problem drinking (r = .12), illegal drug use (r = .16), and prescription drug abuse (r = .09). Higher number of alcoholic drinks consumed was significantly linked to problem drinking (r = .32), illegal drug use (r = .18), and prescription drug abuse (r = .06). Problem drinking was positively associated with illegal drug use (r = .10) and prescription drug abuse (r = .05). Illegal drug use was strongly predictive of prescription drug abuse (r = .41).

3.1 Smoking

Multinomial logistic regression models examined whether personality traits and interactions among traits predicted longitudinal smoking patterns. Multinomial logistic regression is an extension of logistic regression that compares multiple groups through a combination of binary logistic regressions in one unified model. Table 3 displays the comparisons of whether those in the constant smoker, new smoker, and former smoker groups differed from the referent group (never smokers).

Younger age, being male, Caucasian, non-married, and lower levels of education were associated with increased odds of being in the constant smoker group compared to the never smoking group. Higher levels of neuroticism and openness, and lower levels of conscientiousness predicted increased odds of being in the constant smoker group compared to the never smoking group.

Although the number of individuals who started smoking in the 10 years between MIDUS 1 and MIDUS 2 was very small (n = 25), younger individuals, those not married, and those with lower education had increased odds of initiating smoking over the 10-year follow-up compared to those who never smoked. Moreover, those scoring lower in conscientiousness and higher in openness had increased odds of initiating smoking over the 10-year follow-up.

Lastly, comparing those who had never smoked to those that quit demonstrated that older individuals, males, Caucasian, and those with lower education were more likely to be in the former smoking group than the never smoking group. Again, higher levels of neuroticism and openness, and lower levels of conscientiousness predicted increased odds of being in the former smoker versus never smoking group [1]. Lastly, there were no interactive effects involving conscientiousness or personality change effects found as significant predictors of smoking group status.

3.2 Alcohol Use

We utilized ZIP regression models to evaluate the unique predictive ability of personality traits on average levels of alcohol use. ZIP regression modeling is the most appropriate statistical tool to use with count data such as alcohol use particularly when there is a greater probability for a large number of 0 scores. For example, 41% of participants in the current sample indicated that they either had not drank in the past month or had not drank alcohol at all in their lives. ZIP models correct for this type of distribution and yield odds ratios or risk ratios associated with a unit change in each independent variable for those who were not abstinent. Specifically, ZIP models allow one to interpret if increases in an independent variable are associated with either decreased or increased odds of consuming a greater quantity of alcoholic drinks per drinking occasion.

Results from these models are displayed in Table 4. In Model 1, younger age, being male, not married, lower education, and higher levels of prior drinking were associated with an increased probability of consuming higher amounts of alcohol at MIDUS 2. With the addition of personality effects in Model 2, higher levels of neuroticism and extraversion predicted an increased probability of consuming more alcoholic drinks, while higher levels of conscientiousness predicted a decreased probability of alcohol use. In Model 3, increases in trait neuroticism and openness predicted increased odds of consuming more alcohol on average while increases in agreeableness predicted decreased odds of alcohol use. In the fully adjusted Model 4, a significant Neuroticism X Conscientiousness interaction emerged (see Figure 1). Among those high in conscientiousness, there was a modest negative association between neuroticism and the number of drinks consumed per occasion. That is, neuroticism predicted less drinking for those high in trait conscientiousness. For those low in conscientiousness, however, there was a positive association between neuroticism and average drinks consumed per drinking occasion. The specific combination of high levels of neuroticism and low conscientiousness was associated with the highest probability of alcohol use.

A series of logistic regression analyses investigated the effect of personality on problem drinking (See Table 5). Younger age, being male and not married predicted increased odds of endorsing an alcohol problem. In Model 2, higher levels of neuroticism predicted an increased odds while higher levels of agreeableness predicted a decreased odds of having an alcohol problem. Consistent with ZIP models for alcohol use, in Model 3, increases in neuroticism and openness were also associated with increased odds of endorsing an alcohol problem. Lastly, in Model 4, there was evidence for Neuroticism X Conscientiousness interaction ($p < .05$), but the probability level of this effect was above the significance alpha cut-off of .01 for this study. Similar to the significant interaction for average alcohol consumption, higher levels of neuroticism were strongly and positively related to endorsing an alcohol problem. However, the probability of endorsing an alcohol problem for those high in neuroticism was lower for those scoring higher in conscientiousness.

[1] A total of 318 individuals out of the total 1,586 *former smokers* had smoked at MIDUS 1 but had quit by MIDUS 2. Therefore we ran an additional model with only the 318 individuals who actually quit during the 10-year follow-up. Results were similar even with the reduced sample size.

3.3 Drug Use

To determine whether personality and interactions among traits predicted drug use during the past year, we employed a series of logistic regression analyses. Table 6 displays the results for *illegal drug* use. With the exception of prior drug use, none of the demographic variables predicted the use of the four illegal drugs. Individuals using an illegal drug at MIDUS 1 had almost a 15 times greater likelihood of using drugs at MIDUS 2. In Model 2, higher levels of neuroticism and openness, and lower levels of conscientiousness predicted increased odds of using illegal drugs at MIDUS 2. In Model 3, increases in openness predicted an increased odds of using illegal drugs while increases in conscientiousness predicted a decreased odds of engaging in illegal substance use over the 10-year follow-up. In Model 4, an Extraversion X Conscientiousness interaction emerged (see Figure 2). Among those high in conscientiousness there was little association between extraversion and the probability of illegal drug use. However, for those low in conscientiousness, there was a positive association between extraversion and illegal drug use. Specifically, those individuals with a combination of high extraversion and low conscientiousness had the highest probability of being an illegal drug user at MIDUS 2, net of all demographic variables and prior substance use engagement[2].

In contrast to illegal drug use, the effects of personality for prescription drug abuse were not as robust. Being female and using prescription drugs at MIDUS 1 predicted increased abuse at MIDUS 2. Higher levels of neuroticism ($OR = 1.32$, $p < .001$) and lower levels of conscientiousness ($OR = 0.85$, $p < .01$) predicted prescription drug abuse at MIDUS 2. In terms of change, only neuroticism increases ($OR = 1.54$, $p < .001$) predicted prescription drug abuse at MIDUS 2. No interactions involving conscientiousness were discovered.

4. Discussion

The current study built on previous investigations of personality and substance use. Four aspects of this study were unique. First, we used long-term longitudinal data, thus establishing predictive effects of traits on substance use over the course of a decade, above initial levels of substance use at baseline. Second, we investigated multiple substance-use behaviors within a large national sample of adults spanning in age the majority of the life course, providing a more comprehensive portrait of substance use and personality. Third, we found that not only initial level of personality traits predicted 10-year substance-use behavior, but also change in those traits. Fourth, and perhaps most importantly, we provided evidence for the theoretically-important moderating role of conscientiousness in predicting alcohol and drug use behaviors, extending prior moderation findings regarding smoking. Overall, trait main effects and conscientiousness-based interactions were associated with moderate effect sizes for substance-use outcomes assessed a full decade later. The long lag between assessments of personality and substance-use outcomes demonstrates that traits (and conscientiousness-based interactions) have enduring predictive power even into middle age and regardless of prior substance-use behavior.

Consistent with expectations, higher levels of neuroticism and lower levels of conscientiousness consistently predicted detrimental engagement in all outcomes investigated. Inconsistent with our hypotheses, however, higher levels of openness emerged as a predictor of increased substance use while higher levels of agreeableness predicted decreased odds of alcohol use and alcohol endorsed problems. In addition to main effects for

[2]Sensitivity analyses indicated that in terms of the four most common substances used, higher levels of neuroticism predicted only an increased odds of using sedatives ($OR = 1.17$; $p < .05$) and tranquilizers ($OR = 1.51$; $p < .05$). In contrast, individuals scoring higher in openness had increased odds of using pain killers ($OR = 1.24$; $p < .05$) and marijuana ($OR = 1.42$; $p < .05$). Conscientiousness was also a protective factor against sedative ($OR = 0.83$; $p < .05$) and pain killer use ($OR = 0.76$; $p < .05$).

these traits, changes in personality traits over time predicted substance use in midlife. Specifically, increases in openness and neuroticism predicted increased odds of engaging in all substances, with the exception of neuroticism change and illegal drug use. In fact, odds ratios for personality changes were among the largest in our models, even after taking into account initial level of personality. Collectively, these findings demonstrate that personality traits are not static risk factors and change can be just as important, if not more important, in predicting long-term substance-use behavior.

Most importantly, the current study provides additional support for the utility of testing theoretically-targeted interactions among personality traits in predicting health behaviors (Carver et al., 2009; Depue & Lenzenweger, 2005; Friedman, 2000; Hampson & Friedman, 2008). Specifically, those characterized by high levels of neuroticism and low levels of conscientiousness had a greater likelihood of increased alcohol use (and alcohol problems) compared to those who were high in neuroticism and high in conscientiousness. Moreover, conscientiousness moderated the relationship between extraversion and use of illegal drugs. Individuals scoring high in extraversion and low in conscientiousness were more likely to use illegal drugs compared to those high in extraversion and high in conscientiousness. Because this interaction was not found for prescription drug abuse, it will be interesting for future investigations to determine which personality traits interact to predict the use of specific drugs. In line with our hypotheses, these findings demonstrate that among people who are high in neuroticism or extraversion, and who thus have a higher likelihood of engaging in substance use, high levels of conscientiousness provides a buffer from engaging in such behaviors.

Research on the underlying motivations behind substance use may help explain why conscientiousness buffers the negative effects of such traits as neuroticism and extraversion. Both cross sectional and longitudinal data documents that individuals having difficulty regulating both negative emotions and their impulses (a combination of high neuroticism and low conscientiousness) showed the highest levels of externalizing behaviors such as substance use (Cooper, Frone, Russell, & Mudar, 1995; Cooper, Kuntsche, Levitt, Barber, & Wolf, in press; Cooper, Wood, Orcutt, & Albino, 2003). Instead of neurotics potentially self-medicating feelings of negative affect and anxiety, or extraverts seeking the immediate positive rewards of substance use, high levels of conscientiousness (greater impulse control) counteract these risk factors. Such findings are also consistent with Carver et al.'s (2009) two-mode model of self-regulation that a well-functioning effortful control system (higher levels of conscientiousness) can outweigh more immediate and automatic behaviors associated with certain personality traits such as neuroticism and extraversion. Conscientiousness appears to be one of the most important mechanisms for regulating behavior—especially substance use.

These trait interactions also provide some limited support for the idea of the *healthy neurotic* (Friedman, 2000) and the role conscientiousness potentially plays in this concept. Friedman argued that individuals high in neuroticism may be, in a broad sense, characterized by one of two life paths. The first is depicted by pessimism, resentfulness, and anxiety, leading to poor health behaviors such as self-medication with tobacco, alcohol, or drugs to alleviate chronically high levels of negative affect and perceived stress (Eysenck, 1991; Friedman, 2000; Lerman et al., 2000). Alternatively, the "healthy neurotic" or "neurotic vigilant" life path is characterized by health-treatment adherence and more positive health behavior engagement—behaviors that are made more likely if an individual is also high in conscientiousness. Overall, the idea that high levels of neuroticism may be health protective for certain individuals emphasizes the importance of examining interactions among personality traits in predicting health relevant behaviors and outcomes. Determining whether traits are good versus bad in terms of health should not be the question driving future

studies. Rather, questions should seek to answer under what conditions, when, or for whom are certain personality traits adaptive versus maladaptive.

4.1 Limitations

Despite strengths including a longitudinal design as well as a large national sample, the present study was limited by a number a factors. First, the measure of personality was limited by its relative brevity. With any large national longitudinal study there is a tradeoff between the strength that comes with a large N and a long-term follow-up, and the breadth of the psychosocial constructs included. Given that the Big Five traits were assessed by only four to seven adjectives for each trait, we were unable to investigate underlying facets of each trait. Prior research has hinted that more accurate predictions of the association between personality and substance-use behaviors may be obtained by investigating specific underlying facets (Hampson et al., 2007). As such, future research would benefit from more careful investigation of the effects and potential interactions between facets of the Big Five traits, especially conscientiousness.

There were also limitations with the substance-use outcomes assessed in the current study. First, all outcomes were based on self-reports of substance use, which is the case in nearly all studies in health behavior research. Although correlated self-reports can inflate associations, more objective measures of alcohol use are problematic as no one tends to know one's own substance use better than oneself, especially since such behaviors often occur in private, without any objective witnesses. Prior research has shown that self-reported conscientiousness predicts frequency and quantity measures better than other types of variables (Bogg & Roberts, 2004).

Another limitation with the outcomes investigated was the basic categorization of smoking and drug use behavior, which plagues studies of health behaviors (Munafò et al., 2007). We were able to investigate the quantity of alcohol use, but were limited in the variables we could utilize to determine both smoking and drug frequency. Moreover, the prevalence of both drug use (illegal or prescription) and problem drinking was relatively small (between 4–10% of the sample). Finding a significant Extraversion X Conscientiousness interaction for illegal drug use, as well as our sensitivity analysis conducted on the top four drugs used (see footnote 2), demonstrates the importance of identifying the associations between certain drugs and personality traits. Just as research documents those individuals high in neuroticism and those high in extraversion endorse different motivations for drinking (Cooper et al., 1995; Cooper et al., 2000), it is likely the case that higher or lower levels of personality traits (or interactions among them) result in quite different substance-use behaviors. For example, it may be that neurotic individuals are predisposed to use sedatives and tranquilizers and more extraverted individuals are more apt to use sensation seeking drugs such as marijuana or cocaine.

Although the current study utilized a longitudinal design, it only included two occasions of measurement. As a result, we used difference scores to index personality change. Scholars have argued that three occasions of measurement are needed to accurately measure change (Singer & Willet, 2003). Future investigations involving at least three personality measurements are needed to adequately estimate personality change and rate of change with methods such as multi-level modeling techniques.

Last, it is important to discuss the generalizability of the current findings. First, interaction effects are notoriously difficult to replicate. As such, it is essential that future studies confirm and extend our findings by exploring the moderating role of conscientiousness on substance use. Nevertheless, our results are consistent with several recent studies that discovered interactions among personality traits in predicting substance use (Terracciano &

Costa, 2004; Vollrath & Torgersen, 2002) as well as health outcomes (Friedman, Kern, & Reynolds, 2010). It is also important to mention that although the MIDUS study was a national sample, the participants were primarily Caucasian and well-educated, and it is not clear if findings would replicate in more diverse samples. Moreover, analysis of selective attrition revealed that participants that dropped out the study differed on key predictor and outcome variables. Participants that withdrew were significantly lower on conscientiousness and higher on neuroticism which could bias the findings. Given that conscientiousness and neuroticism are positively associated with substance use, and those who dropped out also engaged in greater alcohol use, smoking, and drug use, it is possible that the current findings underestimate the association between personality and substance use because those potentially most at risk had already dropped out of the study.

5. Conclusions

Notwithstanding these limitations, the present study adds to the extant literature on personality and substance use in four key ways. First, consideration of interactions among personality traits can lead to a more complete understanding of how personality predicts substance-use behaviors specifically, and health more generally. Second, conscientiousness appears to be a central predictor and potential moderator of the personality-health behavior relationship. Third, we demonstrate that personality, as well as the moderating role of conscientiousness, predicts substance use approximately 10 years later, net of prior substance use and change in trait level. Fourth, personality change over a 10-year period predicts substance use engagement in addition to initial trait level. Finding all of these associations in a large national sample of adults strengthens the argument that individual traits, trait change, as well as interactions among traits, can be used to predict long-term substance use. This pattern of results highlights the importance and feasibility of using personality for long-term prediction of health-damaging substance-use behaviors.

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Highlights

- We examined if the Big Five personality traits predicted 10-year substance use
- Higher levels of neuroticism, openness, and extraversion predicted increased use
- Lower levels of conscientiousness and agreeableness predicted decreased use
- Personality change also predicted substance use
- Conscientiousness buffered the negative effects of neuroticism and extraversion

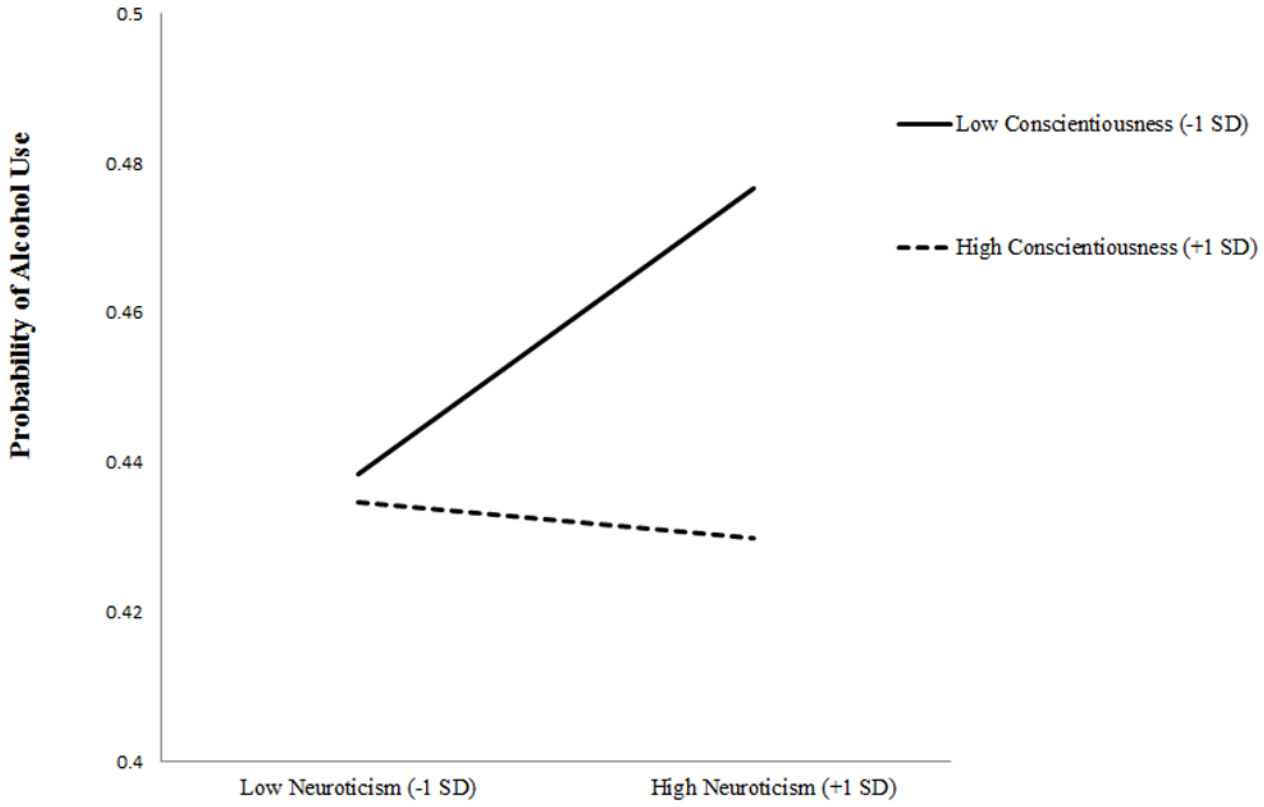

Figure 1.
Neuroticism X Conscientiousness interaction predicting the probability of average alcohol use

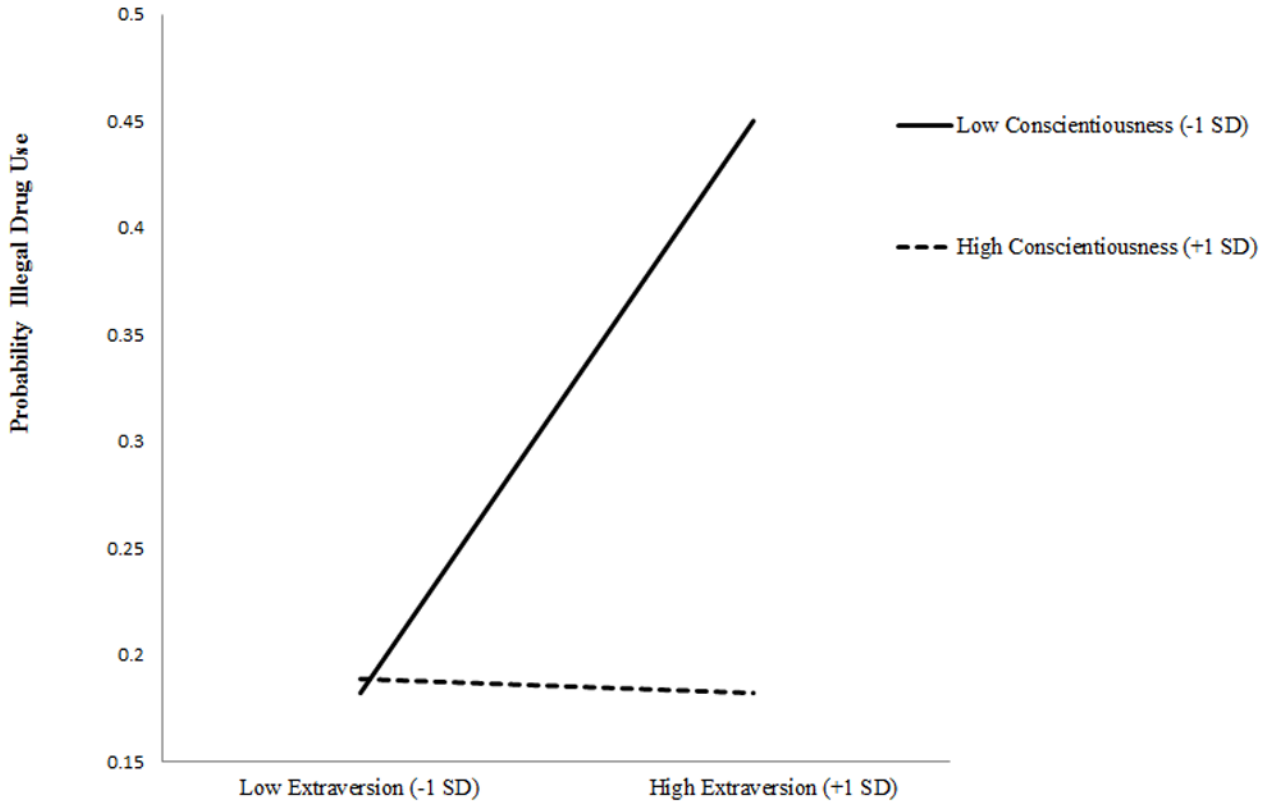

Figure 2.
Extraversion X Conscientiousness interaction predicting the probability of being an illegal drug user in the past year

Table 1

Personality, Means, Standard Deviations, and Correlations.

	1	2	3	4	5	6	7	8	9	10
1. Conscientiousness (M1)	--									
2. Neuroticism (M1)	−.20***	--								
3. Extraversion (M1)	.27***	−.16***	--							
4. Agreeableness (M1)	.29**	−.05***	.53***	--						
5. Openness (M1)	.27***	−.17***	.51***	.34***	--					
6. Conscientiousness (M2)	.61***	−.15***	.18***	.19***	.20***	--				
7. Neuroticism (M2)	−.15***	.64***	−.12***	−.05**	−.14***	−.20***	--			
8. Extraversion (M2)	.20***	−.14***	.69***	.36***	.37***	.26***	−.20***	--		
9. Agreeableness (M2)	.21***	−.05***	.35***	.64***	.21***	.27***	−.11***	.50***	--	
10. Openness (M2)	.23***	−.18***	.36***	.22***	.69***	.28***	−.21***	.51***	.33***	--
Mean	3.42	2.24	3.20	3.49	3.02	3.46	2.07	3.10	3.45	2.90
SD	0.44	0.66	0.56	0.49	0.53	0.45	0.63	0.57	0.50	0.54

Note. M1 = MIDUS 1; M2 = MIDUS 2.

*$p < .01$

**$p < .001$.

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Table 2

Personality Means and Standard Deviations by Smoking Status

	Always Smoker *M (SD)*	**New Smoker** *M (SD)*	**Former Smoker** *M (SD)*	**Never Smoker** *M (SD)*
Conscientiousness	3.37 (.46)[a]	3.33 (.73)[ab]	3.40 (.44)[a]	3.50 (.43)[b]
Neuroticism	2.37 (.71)[a]	2.17 (.58)[ab]	2.23 (.65)[b]	2.16 (.66)[bc]
Extraversion	3.21 (.53)[a]	3.32 (.64)[a]	3.19 (.56)[a]	3.22 (.56)[a]
Agreeableness	3.51 (.48)[ab]	3.45 (.70)[ab]	3.46 (.50)[a]	3.51 (.48)[b]
Openness	3.02 (.53)[a]	3.28 (.54)[a]	3.02 (.51)[a]	3.01 (.53)[a]

Note. Across different rows super scripts indicate significant differences between smoking statuses according to Tukey's Honestly Significant Differences (HSD), $p < .05$.

Table 3

Multinomial logistic regression comparisons of whether those in the constant smoker, new smoker, and former smoker groups differed from never smokers (N = 3,408).

	Constant Smoker (*n* = 743)		New Smoker (*n* = 25)		Former Smoker (*n* = 1,586)	
	B (SE B)	**OR**	**B (SE B)**	**OR**	**B (SE B)**	**OR**
Model 1						
Age	−.29 (.06)	0.75***	−.58 (.26)	0.56*	.32 (.04)	1.38***
Male	.45 (.10)	1.57***	.88 (.44)	2.41*	.79 (.08)	2.20***
Non-White	−.59 (.20)	0.55**	.17 (.64)	1.19	−.56 (.16)	0.57***
Non-Married	.65 (.11)	1.92***	.99 (.44)	2.69*	.10 (.09)	1.11
Education	−.73 (.06)	0.48***	−.37 (.24)	0.69	−.33 (.04)	0.72***
Model 2						
Age	−.24 (.06)	0.79***	−.52 (.26)	0.59*	.36 (.04)	1.43***
Male	.43 (.11)	1.54***	.56 (.46)	1.74	.72 (.09)	2.06***
Non-White	−.63 (.20)	0.53***	−.05 (.65)	0.95	−.64 (.16)	0.53***
Non-Married	.57 (.11)	1.77***	.86 (.45)	2.35*	.03 (.09)	1.03
Education	−.74 (.06)	0.47***	−.51 (.25)	0.60*	−.36 (.05)	0.70***
Neuroticism	.25 (.05)	1.29***	−.03 (.23)	0.97	.18 (.04)	1.20***
Conscientiousness	−.22 (.06)	0.81***	−.43 (.22)	0.65*	−.17 (.05)	0.84***
Extraversion	−.05 (.07)	0.96	.10 (.29)	1.10	−.03 (.05)	0.97
Agreeableness	.02 (.06)	1.02	−.24 (.25)	0.78	−.08 (.05)	0.92
Openness	.25 (.06)	1.28***	.75 (.30)	2.12**	.23 (.05)	1.25***

Note: Never Smokers are referent group (*n* = 1,334). Model 1 Chi-square = 2131.97*** *DF* = 5. Model 2 Chi-square = 6775.62 *** *DF* = 28.

* $p < .05$.

** $p < .01$

*** $p < .001$.

Table 4

Zero-inflated Poisson models predicting probability of increased average alcohol use (N = 4,476).

	Model 1	Model 2	Model 3	Model 4
	Incident Count IRR (CI)	**Incident Count IRR (CI)**	**Incident Count IRR (CI)**	**Incident Count IRR (CI)**
Age	0.79 (0.76–0.82) ***	0.80 (0.77–0.83) ***	0.81 (0.78–0.85) ***	0.81 (0.77–0.84) ***
Male	1.54 (1.44–1.65) ***	1.52 (1.42–1.64) ***	1.49 (1.38–1.62) ***	1.50 (1.38–1.62) ***
Non-White	0.87 (0.76–1.01)	0.88 (0.77–1.02)	0.83 (0.69–1.02)	0.82 (0.69–0.98) *
Non-Married	1.12 (1.05–1.21) ***	1.11 (1.03–1.20) **	1.11 (1.02–1.20) **	1.11 (1.02–1.20) **
Education	0.89 (0.85–0.92) ***	0.89 (0.86–0.92) ***	0.88 (0.84–0.92) ***	0.88 (0.84–0.92) ***
Prior Drinking	1.05 (1.04–1.06) ***	1.05 (1.04–1.06) ***	1.05 (1.04–1.06) ***	1.05 (1.04–1.06) ***
Conscientiousness		0.94 (0.91–0.98) ***	0.94 (0.90–0.98) **	0.94 (0.90–0.98) **
Neuroticism		1.04 (1.01–1.08) *	1.07 (1.01–1.12) **	1.06 (1.02–1.11) **
Extraversion		1.08 (1.04–1.13) ***	1.09 (1.04–1.15) ***	1.09 (1.04–1.15) ***
Agreeableness		0.98 (0.95–1.02)	0.93 (0.88–0.97) ***	0.93 (0.89–0.97) ***
Openness		1.02 (0.97–1.06)	1.04 (0.99–1.10)	1.03 (0.98–1.09)
Con Δ			0.94 (0.84–1.04)	0.93 (0.84–1.03)
Neuro Δ			1.10 (1.02–1.19) **	1.11 (1.03–1.20) **
Extra Δ			1.07 (0.97–1.20)	1.09 (0.98–1.21)
Agree Δ			0.80 (0.72–0.89) ***	0.81 (0.73–0.89) ***
Open Δ			1.14 (1.02–1.28) *	1.17 (1.05–1.31) **
Neur X Con				0.95 (0.92–0.99) **
Extra X Con				1.00 (0.96–1.04)
Agree X Con				0.97 (0.93–1.01)
Open X Con				1.02 (0.97–1.06)
Model Fit *AIC*	12552.70	11859.26	10161.05	10159.17

Note: IRR = Incident Rate Ratio. *CI* = 95% Confidence Interval. Δ = Change. *AIC* = Akaike Information Criterion.

* $p < .05$.

** $p < .01$

*** $p < .001$.

Table 5

Logistic Regression Analysis for Variables Predicting Alcohol Problem (N = 3,720)

	Model 1 e^B (C.I.)	Model 2 e^B (C.I.)	Model 3 e^B (C.I.)	Model 4 e^B (C.I.)
Age	0.52 (0.43–0.64) ***	0.57 (0.47–0.69) ***	0.59 (0.48–0.72) ***	0.59 (0.48–0.72) ***
Male	1.84 (1.33–2.54) ***	1.65 (1.16–2.33) ***	1.69 (1.18–2.42) **	1.69 (1.18–2.43) **
Non-White	1.64 (0.96–2.79)	1.66 (0.97–2.85)	1.62 (0.93–2.84)	1.65 (0.94–2.88)
Non-Married	1.66 (1.19–2.31) ***	1.56 (1.12–2.18) **	1.49 (1.06–2.11) *	1.51 (1.07–2.13) *
Education	1.11 (0.93–1.32)	1.16 (0.97–1.40)	1.15 (0.95–1.40)	1.15 (0.95–1.40)
Conscientiousness		0.79 (0.68–0.93) **	0.76 (0.63–0.91) **	0.83 (0.68–1.02)
Neuroticism		1.39 (1.18–1.64) ***	1.67 (1.39–2.02) ***	1.60 (1.32–1.94) ***
Extraversion		1.06 (0.86–1.29)	1.02 (0.82–1.28)	0.99 (0.79–1.24)
Agreeableness		0.81 (0.68–0.97) *	0.79 (0.64–0.96) **	0.78 (0.64–0.96) **
Openness		1.14 (0.93–1.40)	1.25 (1.00–1.57) *	1.19 (0.94–1.49)
Con Δ			0.84 (0.54–1.13)	0.83 (0.53–1.29)
Neuro Δ			1.93 (1.40–2.66) ***	1.96 (1.42–2.71) ***
Extra Δ			0.83 (0.52–1.32)	0.85 (0.53–1.36)
Agree Δ			0.82 (0.53–1.28)	0.83 (0.53–1.29)
Open Δ			1.64 (1.01–2.65) *	1.63 (1.00–2.64) *
Neur X Con				0.83 (0.72–0.97) *
Extra X Con				0.96 (0.80–1.15)
Agree X Con				1.03 (0.88–1.21)
Open X Con				0.85 (0.70–1.02)
χ^2	83.72 ***	116.55 ***	136.24 ***	145.71 ***
df	5	10	15	19

Note: e^B = exponentiated *B*. *CI* = 95% Confidence Interval. Δ = Change.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 6

Logistic Regression Analysis for Variables Predicting Illegal Drug Use (N = 3,781)

	Model 1 e^B (C.I.)	Model 2 e^B (C.I.)	Model 3 e^B (C.I.)	Model 4 e^B (C.I.)
Age	0.99 (0.84–1.17)	1.02 (0.86–1.20)	0.91 (0.75–1.09)	0.91 (0.76–1.10)
Male	0.85 (0.64–1.15)	0.84 (0.61–1.15)	0.97 (0.69–1.37)	0.97 (0.69–1.37)
Non-White	0.67 (0.39–1.15)	0.68 (0.40–1.18)	0.75 (0.39–1.44)	0.75 (0.39–1.42)
Non-Married	1.00 (0.74–1.35)	0.93 (0.69–1.27)	1.05 (0.75–1.47)	1.05 (0.75–1.47)
Education	1.00 (0.86–1.16)	1.00 (0.85–1.17)	0.85 (0.71–1.02)	0.85 (0.71–1.03)
Prior Drug Use	15.28 (10.93–21.37) ***	14.50 (10.31–20.41) ***	22.53 (15.37–33.02) ***	22.55 (15.36–33.09) ***
Conscientiousness		0.71 (0.59–0.86) ***	0.72 (0.60–0.86) ***	0.71 (0.59–0.86) ***
Neuroticism		1.31 (1.08–1.52) ***	1.32 (1.10–1.60) ***	1.31 (1.08–1.58) ***
Extraversion		1.06 (0.88–1.28)	0.97 (0.78–1.20)	0.94 (0.76–1.17)
Agreeableness		0.92 (0.77–1.10)	1.10 (0.89–1.36)	1.10 (0.89–1.36)
Openness		1.36 (1.10–1.72) **	1.38 (1.10–1.72) **	1.38 (1.10–1.72) **
Con Δ			0.46 (0.30–0.71) ***	0.45 (0.30–0.70)
Neuro Δ			1.28 (0.93–1.77)	1.30 (0.94–1.79) **
Extra Δ			0.84 (0.53–1.32)	0.86 (0.54–1.36)
Agree Δ			1.30 (0.82–2.04)	1.29 (0.82–2.03)
Open Δ			2.00 (1.24–3.22) **	2.00 (1.24–3.22) ***
Neur X Con				1.00 (0.86–1.15)
Extra X Con				0.83 (0.68–0.98) **
Agree X Con				1.02 (0.86–1.21)
Open X Con				1.05 (0.88–1.26) **
χ^2	281.15 ***	271.36 ***	368.49 ***	372.87.87 ***
df	6	11	16	20

Note: e^B = exponentiated *B. CI* = 95% Confidence Interval. Δ = Change.

* $p < .05$.

** $p < .01$.

*** $p < .001$.