



Associations of personality traits with marijuana use in a nationally representative sample of adolescents in the United States

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ABSTRACT

Introduction: Identifying adolescents at risk for marijuana use who can be targeted for intervention efforts is critical. Certain personality traits are strongly associated with substance use, including marijuana use. We investigated the associations of impulsivity (and its subscales sensation seeking and lack of planning), aggression, and neuroticism with marijuana use (lifetime and frequency of past 12-month use) in a national sample of adolescents.

Methods: We used data from the National Comorbidity Survey: Adolescent Supplement, a nationally representative, cross-sectional study of 8495 U.S. adolescents aged 14 to 18 years. We calculated adjusted prevalence ratios and odds ratios to assess associations of the five personality scales with lifetime use and frequency of past 12-month use and examined gender as a potential moderator of these associations.

Results: Each of the personality traits was positively associated with lifetime use (all $p < 0.001$). Impulsivity (the total scale and both subscales) and aggression (all $p < 0.05$) were positively associated with frequency of past 12-month use. The neuroticism–lifetime use association was stronger among girls ($p < 0.001$) than boys ($p < 0.05$), and the associations of impulsivity and lack of planning with frequency of use were significant only among girls, with moderate female users reporting higher levels of the personality scales than infrequent users (both $p < 0.01$).

Conclusions: Our study highlights the potential importance of identifying personality traits, specifically disinhibition-related traits such as impulsivity and aggression, to reduce and prevent adolescent marijuana use.

1. Introduction

Marijuana remains the most widely used illicit drug among adolescents (Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2016). Most people initiate marijuana use in adolescence (Schulden, Thomas, & Compton, 2009), highlighting the importance of prevention and early intervention. Personality, an individual's behavioral, cognitive, and emotional response tendencies (Shiner & Caspi, 2003), has been proposed as a key risk factor for youth substance use (Conrod, 2016; Sher, Bartholow, & Wood, 2000; Woicik, Stewart, Pihl, & Conrod, 2009).

A recent meta-analysis identified conscientiousness, agreeableness, and neuroticism as key correlates of adult substance use (Kotov, Gamez, Schmidt, & Watson, 2010). Findings from cross-sectional and prospective studies with non-nationally representative samples of adolescents suggest that disinhibition-related personality traits such as conscientiousness and agreeableness are strongly associated with marijuana use (Flory, Lynam, Milich, Leukefeld, & Clayton, 2002; Kong et al., 2013; Malmberg et al., 2012; Muro & Rodríguez, 2015;

VanderVeen, Hershberger, & Cyders, 2016). Assessing personality traits and their relationships with marijuana use in a nationally representative adolescent sample is a key next step in solidifying the evidence regarding these associations, which in turn guide intervention efforts. Evidence suggests altering the trajectory of maladaptive personality traits is possible with cost-effective, early psychological interventions (Barlow, Sauer-Zavala, Carl, Bullis, & Ellard, 2014; Kennedy, Rapee, & Edwards, 2009; Rapee, Kennedy, Ingram, Edwards, & Sweeney, 2010).

We used cross-sectional, nationally representative data from the National Comorbidity Survey: Adolescent Supplement (NCS-A) (Kessler, Avenevoli, Costello, et al., 2009; Kessler, Avenevoli, Green, et al., 2009; Merikangas, Avenevoli, Costello, Koretz, & Kessler, 2009). We examined impulsivity, aggression, and neuroticism as assessed by the Zuckerman Kuhlman Personality Questionnaire (ZKPQ) (Zuckerman, Michael, Joireman, Teta, & Kraft, 1993), which was adapted for use in the NCS-A. These ZKPQ personality traits correspond with NEO-PI-R (Costa & McCrae, 1992)'s conscientiousness, agreeableness, and

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neuroticism, respectively (Zuckerman, 2002; Zuckerman et al., 1993). We explored gender as a potential moderator of personality–marijuana use associations.

2. Material and methods

2.1. Study design and participants

The NCS-A (2001–2004) (Kessler, Avenevoli, Costello, et al., 2009; Kessler, Avenevoli, Green, et al., 2009; Merikangas et al., 2009) is a nationally representative, cross-sectional dataset containing information on prevalence and correlates of major mental disorders for 10,148 U.S. adolescents aged 13 to 18. We excluded 13 year olds because they had very low levels of marijuana use, yielding a sample of 8495 adolescents. We received authorization to access restricted NCS-A data from the Interuniversity Consortium for Political and Social Research and also obtained university IRB approval.

2.2. Measures

2.2.1. Marijuana use

Interviewers asked, “Have you ever used marijuana or hashish, even once?”, to determine *lifetime marijuana use* (yes: $n = 2214$, never: $n = 6262$). For *frequency of past 12-month marijuana use*, interviewers asked “How often did you use marijuana or hashish in the past 12 months- nearly every day, 3 to 4 days a week, 1 to 2 days a week, 1 to 3 days a month, or less than once a month?” to adolescents who responded affirmatively to marijuana use in the past 12 months ($n = 1379$). We categorized the data into three groups: frequent use (nearly every day or 3–4 days a week: $n = 380$), moderate use (1–2 days a week or 1–3 days a month: $n = 410$), and infrequent use (less than once a month: $n = 580$).

2.2.2. Personality scales

The adapted version of the ZKPQ was used in the NCS-A to assess adolescents' personality. The ZKPQ has good test/retest reliability as well as good convergent and discriminant validity (Zuckerman, 2002; Zuckerman et al., 1993). We utilized five ZKPQ personality scales: 1) *impulsivity-sensation seeking* (11 items; 2) *sensation seeking* (a 7-item subscale of impulsivity); 3) *lack of planning* (a 4-item subset of impulsivity); 4) *aggression-hostility* (7 items); and 5) *neuroticism-anxiety* (8 items) (labeled ‘impulsivity’, ‘sensation seeking’, ‘lack of planning’, ‘aggression’, and ‘neuroticism’ hereafter). Internal consistencies of each scale were acceptable (Cronbach's alpha for impulsivity = 0.77; sensation seeking = 0.71; lack of planning = 0.66; aggression = 0.80; neuroticism = 0.77).

We separately assessed sensation seeking and lack of planning—subscales of ZKPQ impulsivity—to better understand the “active ingredients” of impulsivity, as evidence for the association of impulsivity and marijuana use among adolescents is mixed, possibly due to differential associations of separate features of impulsivity with marijuana use (VanderVeen et al., 2016).

2.2.3. Sociodemographic variables

Adolescents' self-reported age (range: 14–18 years), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, “other”), gender (girl, boy), and educational attainment of either parent (less than high school, high school graduate, some college, college graduate) were covariates.

2.3. Statistical analyses

Lifetime prevalence of marijuana use and frequency of past 12-month marijuana use were dependent variables. Impulsivity, sensation seeking, lack of planning, aggression, and neuroticism were independent variables; each was examined in a separate regression

model.

We calculated descriptive statistics for age, race/ethnicity, gender, and parent education and identified their associations with the personality scales and marijuana use variables using weighted Chi-square and adjusted Wald tests. We used generalized linear modeling to calculate adjusted prevalence ratios in assessing associations between the five personality scales and lifetime use. We used multinomial logistic regression to calculate relative risk ratios in examining associations between the five personality scales and frequency of use. We adjusted for age, race/ethnicity, gender, and parent education, as these variables were associated with substance use in previous studies (Dierker et al., 2012; Keyes et al., 2015; Muro & Rodríguez, 2015). To examine gender as a potential moderator, we created terms to represent the interaction between each personality scale and gender and entered these interaction terms into our regression models. We planned gender-stratified analyses in the event that the coefficient for an interaction term was significant. As < 1% of responses were missing, we used listwise deletion by default to handle missing data. Complex survey weights were applied prior to analyses to account for the NCS-A sampling method. Statistical significance was set at p -values < 0.05. Analyses were conducted using Stata13 (StataCorp, 2013).

3. Results

3.1. Sample characteristics

Adolescents aged 15 and older ($\chi^2 = 71.63$, $p < 0.001$) and those whose parents had not graduated college ($\chi^2 = 10.55$, $p < 0.001$) were more likely to report lifetime marijuana use. More boys than girls ($\chi^2 = 4.98$, $p = 0.01$) and more adolescents in the “other” race/ethnicity group than their non-Hispanic White counterparts ($\chi^2 = 3.03$, $p = 0.03$) reported high frequency of past 12-month marijuana use.

As displayed in Table 1, impulsivity-lack of planning differed by age ($p < 0.05$), impulsivity (total and both subscales) and neuroticism differed by gender ($p < 0.001$), impulsivity (total and both subscales) differed by race/ethnicity ($p < 0.05$), and impulsivity-lack of planning, aggression, and neuroticism differed by parent education level ($p < 0.05$).

3.2. Personality scales and marijuana use

All five personality scales were positively associated with lifetime prevalence of marijuana use (all $p < 0.001$). Impulsivity (including both sensation seeking and lack of planning), and aggression were positively associated with higher frequency of past 12-month marijuana use (all $p < 0.01$) (see Table 2).

3.3. Moderation by gender

Gender was a significant moderator of the neuroticism–lifetime use association ($\beta = 1.05$, 95% confidence interval [CI] = 1.01, 1.08, $p = 0.013$), the impulsivity–frequency of use association (moderate vs. infrequent: $\beta = 1.08$, CI = 1.02, 1.14, $p = 0.013$), and the lack of planning–frequency of use association (moderate vs. infrequent: $\beta = 1.23$, CI = 1.07, 1.42, $p = 0.006$). The neuroticism–lifetime use association was stronger in girls (aPR = 1.05, CI = 1.03, 1.06, $p < 0.001$) than boys (aPR = 1.02, CI = 1.01, 1.04, $p = 0.021$). Among girls, moderate users showed higher impulsivity (aOR = 1.09, CI = 1.05, 1.14, $p < 0.001$) and higher lack of planning (aOR = 1.18, CI = 1.06, 1.31, $p = 0.003$) than infrequent users. Among boys, moderate users did not differ from infrequent users in impulsivity (aOR = 1.02, CI = 0.98, 1.07, $p = 0.240$) and lack of planning (aOR = 0.97, CI = 0.88, 1.08, $p = 0.577$).

Table 1
Associations of participant characteristics with the five personality scales in the National Comorbidity Survey: Adolescent Supplement (2001–2004).

Characteristics	Personality traits				
	Impulsivity	Impulsivity-sensation seeking	Impulsivity-lack of planning	Aggression	Neuroticism
Mean score (SE)	16.4 (0.1)	11.6 (0.1)	4.8 (0.1)	11.6 (0.1)	8.6 (0.1)
Age					
14 (ref)	16.5 (0.2)	11.5 (0.2)	5.0 (0.1)	11.6 (0.2)	8.3 (0.2)
15	16.5 (0.2)	11.6 (0.1)	4.8 (0.1)	11.6 (0.2)	8.8 (0.2)
16	16.4 (0.2)	11.7 (0.2)	4.7 (0.1)*	11.7 (0.2)	8.5 (0.2)
17–18	16.3 (0.2)	11.8 (0.1)	4.5 (0.1)***	11.5 (0.2)	8.7 (0.2)
Gender					
Female (ref)	15.7 (0.2)	11.2 (0.1)	4.5 (0.1)	11.5 (0.1)	9.7 (0.1)
Male	17.1 (0.1)***	12.1 (0.1)***	5.1 (0.1)***	11.7 (0.1)	7.5 (0.1)***
Race/ethnicity					
Non-Hispanic White (ref)	16.7 (0.1)	11.9 (0.1)	4.9 (0.1)	11.5 (0.1)	8.6 (0.1)
Non-Hispanic Black	15.2 (0.2)***	10.8 (0.1)***	4.3 (0.1)***	12.0 (0.2)	8.2 (0.2)
Hispanic	16.7 (0.2)	11.8 (0.2)	4.9 (0.1)	11.5 (0.3)	8.5 (0.1)
Other	15.4 (0.4)**	11.1 (0.3)*	4.3 (0.2)*	11.3 (0.3)	9.2 (0.4)
Parent education					
Did not complete than high school	16.6 (0.3)	11.6 (0.3)	5.0 (0.1)**	11.9 (0.2)**	8.9 (0.2)**
Completed high school	16.5 (0.2)	11.7 (0.1)	4.8 (0.1)*	12.1 (0.2)***	8.7 (0.2)
Attended college	16.5 (0.2)	11.6 (0.1)	4.9 (0.1)**	11.8 (0.1)***	8.6 (0.2)
College graduate (ref)	16.2 (0.1)	11.6 (0.1)	4.6 (0.1)	10.9 (0.1)	8.3 (0.1)

Note. Adjusted Wald tests were conducted to compare sociodemographic characteristics of participants by personality traits. SE = standard error. Ranges for each style are impulsivity: 0–33; impulsivity-sensation seeking: 0–21; impulsivity-lack of planning: 0–12; aggression: 0–21; neuroticism: 0–24.

Significant (p < 0.05) differences are in bold font.

- * p < 0.05.
- ** p < 0.01.
- *** p < 0.001.

Table 2
Associations between personality and marijuana use in the National Comorbidity Survey: Adolescent Supplement (2001–2004).

Personality traits	Adolescent marijuana use			
	Lifetime use aPR (95% CI)	Frequency of use in the past 12 months aOR ^a (95% CI)		
	Ever (26.5%) vs. never (73.5%)	Infrequent (43.0%)	Moderate (30.0%)	Frequent (27.0%)
Impulsivity	1.08*** (1.06, 1.09)	1.00 (ref)	1.06** (1.02, 1.10)	1.08*** (1.04, 1.13)
Sensation seeking	1.10*** (1.08, 1.12)	1.00 (ref)	1.18** (1.03, 1.13)	1.09** (1.02, 1.16)
Lack of planning	1.12*** (1.10, 1.14)	1.00 (ref)	1.08* (1.01, 1.16)	1.17*** (1.10, 1.24)
Aggression	1.10*** (1.09, 1.11)	1.00 (ref)	1.07** (0.90, 1.08)	1.08** (1.03, 1.12)
Neuroticism	1.04*** (1.02, 1.05)	1.00 (ref)	1.00 (0.96, 1.05)	1.05 (1.00, 1.11)

Note. CI = confidence interval, aPR = adjusted prevalence ratio, aOR = adjusted odds ratio, regression models were adjusted for age, race/ethnicity, gender, and education attainment of either parent.

Past 12-month frequency of use: frequent use = nearly every day or 3 to 4 days a week; moderate use = 1 to 2 days a week or 1 to 3 days a month; infrequent use = less than once a month.

^a Relative risk ratios from multinomial logistic regression interpreted as odds ratios.

- * p < 0.05.
- ** p < 0.01.
- *** p < 0.001.

4. Discussion

We examined associations of personality scales with lifetime marijuana use and frequency of past 12-month marijuana use in a

nationally representative sample of U.S. adolescents. Each personality scale showed small but significantly positive associations with lifetime use, indicating higher levels of impulsivity, aggression, and neuroticism may distinguish adolescents who have ever used marijuana from those who have not. Impulsivity and aggression but not neuroticism were positively associated with frequency of use, suggesting adolescents with higher levels of impulsivity and aggression were more frequent users of marijuana than their peers without such tendencies. Our moderation analyses showed that the association of neuroticism and lifetime use was stronger among girls than boys, and the association of impulsivity (the total impulsivity score and the lack of planning subscale) with frequency of use was significant for girls but not boys, with significant associations for girls who reported moderate but not infrequent use.

Impulsivity and aggression were significantly associated with marijuana use. Our findings are similar to those of previous studies in non-representative samples that assessed lifetime use (Malmberg et al., 2012), past 12-month use (Muro & Rodríguez, 2015), and past 30-day use (Kong et al., 2013). We also found neuroticism was not associated with frequency of marijuana use and that the association of neuroticism with lifetime use was not as robust as those of impulsivity and aggression with lifetime use. These results are similar to a recent meta-analysis that showed strong associations of both low conscientiousness (i.e., high impulsivity) and low agreeableness (i.e., high aggression) but relatively weak associations of neuroticism with adult substance use disorders. Our findings contribute to the current efforts in developing a comprehensive developmental model of marijuana use, as our findings are consistent with a recent theoretical model that argues for a crucial role of disinhibition-related traits, such as impulsivity and aggression, in substance use and other externalizing behaviors as compared with a key role of neuroticism in internalizing behaviors (Clark & Watson, 2008; Krueger, Markon, Patrick, Benning, & Kramer, 2007).

Associations between neuroticism and lifetime use, as well as between impulsivity (the total impulsivity score and the lack of planning subscale) and frequency of use significantly differed by gender in our study. Girls reported higher neuroticism and stronger positive associations between neuroticism and lifetime use as compared with boys.

Boys reported higher impulsivity and more frequent use of marijuana than girls. Impulsivity and lack of planning were only associated with frequency of use among girls, with moderate female users reporting higher levels of these personality characteristics than infrequent users. Our findings suggest the lack of planning component of impulsivity may be more relevant for marijuana use frequency than the sensation-seeking component. Girls with lack of planning capacities may benefit from a program that teaches them organization skills.

One possible implication of our findings is that personality screening among adolescents may contribute to effective prevention and early intervention strategies for marijuana use. Longitudinal studies have shown that changes in personality traits can prevent future substance use in children (Hampson, Tildesley, Andrews, Luyckx, & Mroczek, 2010) and adults (Turiano, Whiteman, Hampson, Roberts, & Mroczek, 2012). Evidence suggests altering the trajectory of maladaptive personality traits is possible with cost-effective, early psychological interventions (Barlow et al., 2014; Kennedy et al., 2009; Mihalopoulos et al., 2015; Rapee et al., 2010). There is emerging evidence for personality-targeted approaches to substance use prevention, specifically in the Netherlands, England, and Australia (Conrod, 2016; Conrod, Castellanos-Ryan, & Strang, 2010; Mahu, Doucet, O'Leary-Barrett, & Conrod, 2015). The *Preventure Programme* screens high-risk individuals based on their personality scales and target personality-specific pathways to substance misuse (for a detailed description of the *Preventure Programme*, see Conrod, 2016).

This study is limited by the fact that data on personality scales and marijuana use were obtained via self-report. In addition, we cannot make causal inferences about the personality–marijuana use relationship as the NCS-A is cross-sectional in design. However, findings from several prospective studies indicate that maladaptive personality traits are likely to develop before substance use initiation and may predict maintenance and treatment outcome (Bogg & Roberts, 2013; Hengartner, Kawohl, Haker, Rössler, & Ajdacic-Gross, 2016; Lahey, 2009).

5. Conclusions

Our study highlights the potential importance of identifying personality traits, specifically disinhibition-related traits such as impulsivity and aggression, to reduce and prevent adolescent marijuana use. Given emerging evidence for benefits of personality-informed interventions in delaying the onset of or reducing marijuana use among non-U.S. adolescents, we recommend exploring implementation of such interventions in the U.S. Mindfulness-based interventions that promote self-regulation may also be promising in this context. Research has identified an inverse relationship between impulsivity and trait mindfulness (Murphy & MacKillop, 2012; Peters, Erisman, Upton, Baer, & Roemer, 2011) and supported the effectiveness of a mindfulness program in lowering impulsivity and aggression among high school students with behavioral issues (Franco, Amutio, López-González, Oriol, & Martínez-Taboada, 2016). Future research should explore whether such strategies could also be useful in preventing adolescent marijuana use.

References

- Barlow, D. H., Sauer-Zavala, S., Carl, J. R., Bullis, J. R., & Ellard, K. K. (2014). The nature, diagnosis, and treatment of neuroticism back to the future. *Clinical Psychological Science: A Journal of the Association for Psychological Science*, 2(3), 344–365. <http://dx.doi.org/10.1177/2167702613505532>.
- Bogg, T., & Roberts, B. W. (2013). The case for conscientiousness: Evidence and implications for a personality trait marker of health and longevity. *Annals of Behavioral Medicine*, 45(3), 278–288. <http://dx.doi.org/10.1007/s12160-012-9454-6>.
- Clark, L. A., & Watson, D. (2008). Temperament: An organizing paradigm for trait psychology. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (pp. 265–286). (3rd ed.). New York, NY: Guilford Press.
- Conrod, P. J. (2016). Personality-targeted interventions for substance use and misuse. *Current Addiction Reports*, 3(4), 426–436. <http://dx.doi.org/10.1007/s40429-016-0127-6>.
- Conrod, P. J., Castellanos-Ryan, N., & Strang, J. (2010). Brief, personality-targeted coping

- skills interventions and survival as a non-drug user over a 2-year period during adolescence. *Archives of General Psychiatry*, 67(1), 85–93. <http://dx.doi.org/10.1001/archgenpsychiatry.2009.173>.
- Costa, P. T., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEO-FFI)*. Odessa, FL: Psychological Assessment Resources.
- Dierker, L., Swendsen, J., Rose, J., He, J., Merikangas, K., & Tobacco Etiology Research Network (TERN) (2012). Transitions to regular smoking and nicotine dependence in the Adolescent National Comorbidity Survey (NCS-A). *Annals of Behavioral Medicine: A Publication of the Society of Behavioral Medicine*, 43(3), 394–401. <http://dx.doi.org/10.1007/s12160-011-9330-9>.
- Flory, K., Lynam, D., Milich, R., Leukefeld, C., & Clayton, R. (2002). The relations among personality, symptoms of alcohol and marijuana abuse, and symptoms of comorbid psychopathology: Results from a community sample. *Experimental and Clinical Psychopharmacology*, 10(4), 425–434. <http://dx.doi.org/10.1037/1064-1297.10.4.425>.
- Franco, C., Amutio, A., López-González, L., Oriol, X., & Martínez-Taboada, C. (2016). Effect of a mindfulness training program on the impulsivity and aggression levels of adolescents with behavioral problems in the classroom. *Frontiers in Psychology*, 7(1385). <http://dx.doi.org/10.3389/fpsyg.2016.01385>.
- Hampson, S. E., Tildesley, E., Andrews, J. A., Luyckx, K., & Mroczek, D. K. (2010). The relation of change in hostility and sociability during childhood to substance use in mid adolescence. *Journal of Research in Personality*, 44(1), 103–114. <http://dx.doi.org/10.1016/j.jrp.2009.12.006>.
- Hengartner, M. P., Kawohl, W., Haker, H., Rössler, W., & Ajdacic-Gross, V. (2016). Big five personality traits may inform public health policy and preventive medicine: Evidence from a cross-sectional and a prospective longitudinal epidemiologic study in a Swiss community. *Journal of Psychosomatic Research*, 84, 44–51. <http://dx.doi.org/10.1016/j.jpsychores.2016.03.012>.
- Johnston, L. D., O'Malley, P. M., Miech, R. A., Bachman, J. G., & Schulenberg, J. E. (2016). *Monitoring the future national survey results on drug use, 1975–2015: Overview, key findings on adolescent drug use*. Ann Arbor: Institute for Social Research, The University of Michigan.
- Kennedy, S. J., Rapee, R. M., & Edwards, S. L. (2009). A selective intervention program for inhibited preschool-aged children of parents with an anxiety disorder: Effects on current anxiety disorders and temperament. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48(6), 602–609. <http://dx.doi.org/10.1097/CHI.0b013e31819f6fa9>.
- Kessler, R. C., Avenevoli, S., Costello, E. J., Green, J. G., Gruber, M. J., Heeringa, S., ... Zaslavsky, M. A. (2009). National comorbidity survey replication adolescent supplement (NCS-A): II. Overview and design. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48(4), 380–385. <http://dx.doi.org/10.1097/CHI.0b013e3181999705>.
- Kessler, R. C., Avenevoli, S., Green, J., Gruber, M. J., Guyer, M. H., He, Y., ... Zaslavsky, M. A. (2009). National comorbidity survey replication adolescent supplement (NCS-A): III. Concordance of DSM-IV/CIDI diagnoses with clinical reassessments. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48(4), 386–399. <http://dx.doi.org/10.1097/CHI.0b013e31819a1cbc>.
- Keyes, K. M., Vo, T., Wall, M., Caetano, R., Suglia, S. F., Martins, S. S., ... Hasin, D. (2015). Racial/ethnic differences in use of alcohol, tobacco, and marijuana: Is there a crossover from adolescence to adulthood? *Social Science & Medicine* (1982), 124, 132–141. <http://dx.doi.org/10.1016/j.socscimed.2014.11.035>.
- Kong, G., Smith, A. E., McMahon, T. J., Cavallo, D. A., Schepis, T. S., Desai, R. A., ... Krishnan-Sarin, S. (2013). Pubertal status, sensation-seeking, impulsivity, and substance use in high school-aged boys and girls. *Journal of Addiction Medicine*, 7(2), 116–121. <http://dx.doi.org/10.1097/ADM.0b013e31828230ca>.
- Kotov, R., Gamez, W., Schmidt, F., & Watson, D. (2010). Linking “big” personality traits to anxiety, depressive, and substance use disorders: A meta-analysis. *Psychological Bulletin*, 136(5), 768–821. <http://dx.doi.org/10.1037/a0020327>.
- Krueger, R. F., Markon, K. E., Patrick, C. J., Benning, S. D., & Kramer, M. D. (2007). Linking antisocial behavior, substance use, and personality: An integrative quantitative model of the adult externalizing spectrum. *Journal of Abnormal Psychology*, 116(4), 645–666. <http://dx.doi.org/10.1037/0021-843X.116.4.645>.
- Lahey, B. B. (2009). Public health significance of neuroticism. *The American Psychologist*, 64(4), 241–256. <http://dx.doi.org/10.1037/a0015309>.
- Mahu, I. T., Doucet, C., O'Leary-Barrett, M., & Conrod, P. J. (2015). Can cannabis use be prevented by targeting personality risk in schools? Twenty-four-month outcome of the adventure trial on cannabis use: A cluster-randomized controlled trial. *Addiction (Abingdon, England)*, 110(10), 1625–1633. <http://dx.doi.org/10.1111/add.12991>.
- Malmberg, M., Kleinjan, M., Vermulst, A. A., Overbeek, G., Monshouwer, K., Lammers, J., & Engels, R. C. M. E. (2012). Do substance use risk personality dimensions predict the onset of substance use in early adolescence? A variable- and person-centered approach. *Journal of Youth and Adolescence*, 41(11), 1512–1525. <http://dx.doi.org/10.1007/s10964-012-9775-6>.
- Merikangas, K., Avenevoli, S., Costello, J., Koretz, D., & Kessler, R. C. (2009). National comorbidity survey replication adolescent supplement (NCS-A): I. Background and measures. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48(4), 367–369. <http://dx.doi.org/10.1097/CHI.0b013e31819996f1>.
- Mihalopoulos, C., Vos, T., Rapee, R. M., Pirkis, J., Chatterton, M. L., Lee, Y.-C., & Carter, R. (2015). The population cost-effectiveness of a parenting intervention designed to prevent anxiety disorders in children. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 56(9), 1026–1033. <http://dx.doi.org/10.1111/jcpp.12438>.
- Muro, I., & Rodríguez, A. (2015). Age, sex and personality in early cannabis use. *European Psychiatry: The Journal of the Association of European Psychiatrists*, 30(4), 469–473. <http://dx.doi.org/10.1016/j.eurpsy.2015.02.008>.
- Murphy, C., & MacKillop, J. (2012). Living in the here and now: Interrelationships

- between impulsivity, mindfulness, and alcohol misuse. *Psychopharmacology*, 219(2), 527–536. <http://dx.doi.org/10.1007/s00213-011-2573-0>.
- Peters, J. R., Erisman, S. M., Upton, B. T., Baer, R. A., & Roemer, L. (2011). A preliminary investigation of the relationships between dispositional mindfulness and impulsivity. *Mindfulness*, 2(4), 228–235. <http://dx.doi.org/10.1007/s12671-011-0065-2>.
- Rapee, R. M., Kennedy, S. J., Ingram, M., Edwards, S. L., & Sweeney, L. (2010). Altering the trajectory of anxiety in at-risk young children. *The American Journal of Psychiatry*, 167(12), 1518–1525. <http://dx.doi.org/10.1176/appi.ajp.2010.09111619>.
- Schulden, J. D., Thomas, Y. F., & Compton, W. M. (2009). Substance abuse in the United States: findings from recent epidemiologic studies. *Current Psychiatry Reports*, 11(5), 353.
- Sher, K. J., Bartholow, B. D., & Wood, M. D. (2000). Personality and substance use disorders: A prospective study. *Journal of Consulting and Clinical Psychology*, 68(5), 818–829.
- Shiner, R. L., & Caspi, A. (2003). Personality differences in childhood and adolescence: Measurement, development, and consequences. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 44(1), 2–32.
- StataCorp (2013). *Stata statistical software: Release 13*. College Station, TX: StataCorp LP.
- Turiano, N. A., Whiteman, S. D., Hampson, S. E., Roberts, B. W., & Mroczek, D. K. (2012). Personality and substance use in midlife: conscientiousness as a moderator and the effects of trait change. *Journal of Research in Personality*, 46(3), 295–305. <http://dx.doi.org/10.1016/j.jrp.2012.02.009>.
- VanderVeen, J. D., Hershberger, A. R., & Cyders, M. A. (2016). UPPS-P model impulsivity and marijuana use behaviors in adolescents: A meta-analysis. *Drug and Alcohol Dependence*, 168, 181–190. <http://dx.doi.org/10.1016/j.drugalcdep.2016.09.016>.
- Woicik, P. A., Stewart, S. H., Pihl, R. O., & Conrod, P. J. (2009). The Substance Use Risk Profile Scale: A scale measuring traits linked to reinforcement-specific substance use profiles. *Addictive Behaviors*, 34(12), 1042–1055. <http://dx.doi.org/10.1016/j.addbeh.2009.07.001>.
- Zuckerman, M. (2002). Zuckerman-Kuhlman personality questionnaire (ZKPQ): An alternative five-factorial model. In B. de Raad, & M. Perugini (Eds.). *Big five assessment* (pp. 376–392). Ashland, OH, US: Hogrefe & Huber Publishers.
- Zuckerman, M., Michael, D., Joireman, J., Teta, P., & Kraft, M. (1993). A comparison of three structural models for personality: The Big Three, the Big Five, and the Alternative Five. *Journal of Personality and Social Psychology*, 65(4), 757–768. <http://dx.doi.org/10.1037/0022-3514.65.4.757>.