

UC San Diego

UC San Diego Previously Published Works

Title

Do personality characteristics predict future alcohol problems after considering current demography, substance use, and alcohol response?

Permalink

<https://escholarship.org/uc/item/5x35z48h>

Journal

Alcoholism Clinical and Experimental Research, 47(6)

ISSN

0145-6008

Authors

Schuckit, Marc A
Smith, Tom L
Danko, George
[et al.](#)

Publication Date

2023-06-01

DOI

10.1111/acer.15085

Copyright Information

This work is made available under the terms of a Creative Commons Attribution License, available at <https://creativecommons.org/licenses/by/4.0/>

Peer reviewed

Do personality characteristics predict future alcohol problems after considering current demography, substance use and alcohol response?

Marc A. Schuckit, Tom L. Smith, George Danko, Kathleen K. Bucholz, Victor Hesselbrock, Michie Hesselbrock, Samuel Kuperman, John Kramer, John I Nurnberger, Dongbing Lai; Grace Chan, Chella Kamarajan, Sally Kuo, Danielle M Dick, Jake Tear, Lee A. Mendoza, Howard J. Edenberg, Bernice Porjesz

Abstract 336 words; Text 5308 words; 4 tables.

Submitted to ACER 1/19/2023

Revised 3/8/23

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the [Version of Record](#). Please cite this article as doi: [10.1111/acer.15085](https://doi.org/10.1111/acer.15085)

This article is protected by copyright. All rights reserved.

The Collaborative Study on the Genetics of Alcoholism (COGA), Principal Investigators B. Porjesz, V. Hesselbrock, T. Foroud; Scientific Director, A. Agrawal; Translational Director, D. Dick, includes ten different centers: University of Connecticut (V. Hesselbrock); Indiana University (H.J. Edenberg, T. Foroud, Y. Liu, M.H. Plawecki); University of Iowa Carver College of Medicine (S. Kuperman, J. Kramer); SUNY Downstate Health Sciences University (B. Porjesz, J. Meyers, C. Kamarajan, A. Pandey); Washington University in St. Louis (L. Bierut, J. Rice, K. Bucholz, A. Agrawal); University of California at San Diego (M. Schuckit); Rutgers University (J. Tischfield, D. Dick, R. Hart, J. Salvatore); The Children's Hospital of Philadelphia, University of Pennsylvania (L. Almasy); Icahn School of Medicine at Mount Sinai (A. Goate, P. Slesinger); and Howard University (D. Scott). Other COGA collaborators include: L. Bauer (University of Connecticut); J. Nurnberger Jr., L. Wetherill, X., Xuei, D. Lai, S. O'Connor, (Indiana University); G. Chan (University of Iowa; University of Connecticut); D.B. Chorlian, J. Zhang, P. Barr, S. Kinreich, G. Pandey (SUNY Downstate); N. Mullins (Icahn School of Medicine at Mount Sinai); A. Anokhin, S. Hartz, E. Johnson, V. McCutcheon, S. Saccone (Washington University); J. Moore, F. Aliev, Z. Pang, S. Kuo (Rutgers University); A. Merikangas (The Children's Hospital of Philadelphia and University of Pennsylvania); H. Chin and A. Parsian are the NIAAA Staff Collaborators. We continue to be inspired by our memories of Henri Begleiter and Theodore Reich, founding PI and Co-PI of COGA, and also owe a debt of gratitude to other past organizers of COGA, including Ting- Kai Li, P. Michael Conneally, Raymond Crowe, and Wendy Reich, for their critical contributions. This national collaborative study is supported by NIH Grant U10AA008401 from the National Institute on Alcohol Abuse and Alcoholism (NIAAA) and the National Institute on Drug Abuse (NIDA).

ABSTRACT

Background: Several personality traits predict future alcohol problems but also relate to demographic and substance-related variables that themselves correlate with later adverse alcohol outcomes. Few prospective studies have evaluated whether the personality measures predict alcohol problems after considering current demography and substance related variables.

Methods: Data from 414 drinkers without alcohol use disorder (AUD) from the Collaborative Study on the Genetics of Alcoholism (average age 20, 44% male) were followed over an average of nine years. Time 1 (baseline) demography, AUD family history (FH), substance use and problems, and psychiatric histories were gathered using a standardized interview, the Level of Response (LR) to alcohol was measured by the Self-Report of the Effects of alcohol (SRE) questionnaire, and seven personality dimensions were extracted from the NEO Five-Factor Personality, Barratt and Zuckerman scales. Analyses involved product-moment correlations of each baseline measure with the highest number of DSM-IV AUD criteria endorsed in any follow-up period, and hierarchical regression analyses evaluated if the personality domains added significantly to the prediction of the outcome after adjusting for other baseline variables.

Results: Significant correlations to the outcome were observed for baseline age, sex, length of follow-up, AUD family history, past cannabis use, and all alcohol-related baseline variables, including SRE-based Level of Response, but not prior mood or anxiety disorders. All personality characteristics except extraversion also correlated with

outcomes. A hierarchical regression analysis that included all relevant personality scores together demonstrated significant contributions to the prediction of future alcohol problems for demography in Step 1, demography and most baseline alcohol items, including response level, in Step 2, and cannabis use in Step 3, after which demography, Level of Response, baseline alcohol problems, cannabis use, and higher sensation seeking added significantly in Step 4. Regression for each personality domain separately revealed significant contributions to Step 4 for all personality domains except openness.

Conclusions: Most tested personality scores contributed to predictions of later alcohol problems even after considering baseline demography and substance use. Lower Levels of Response to alcohol added significantly to all regression analyses.

Introduction

Many characteristics predict future alcohol-related problems, including sociocultural factors, several major psychiatric disorders, experience with other drugs, family histories of alcohol problems, and prior alcohol-related practices (Reilly et al., 2017; Schuckit, 2018; 2022). Personality attributes have also been reported to be associated with problematic alcohol use, especially externalizing-related characteristics (e.g., high impulsivity and sensation seeking along with low conscientiousness) as well as internalizing traits reflecting lower mood or higher anxiety (Pryor et al., 2009; Schuckit, 2022; Reilly et al., 2017; Slutske et al., 2002). Such a broad range of predictors of future alcohol patterns makes it difficult to understand how personality characteristics relate to future alcohol intake because results are likely to differ depending on the alcohol behavior being measured, the demography and recent substance use characteristics of the population being studied, and the personality attribute being considered (e.g., Hakulinen et al., 2015; Liu et al., 2022).

Externalizing characteristics have been relatively consistently observed at higher rates in individuals with elevated alcohol use disorder (AUD) risks, including children of individuals with AUD, and are seen at elevated rates in those with AUD themselves (Rosenstrom et al., 2018; Sher et al., 2000, 2005). Externalizing phenomena such as high impulsivity (acting on the spur of the moment without appropriate consideration of potential consequences) and high sensation seeking (tendencies toward seeking novel and stimulating experiences) are both related to higher frequencies and quantities of alcohol use, binge drinking, and to concomitant use of alcohol and cannabis (Adan et al., 2017; Dick et al., 2010; Ellingson et al., 2018; Gmel et al., 2020; Lac and

Donaldson, 2021; Littlefield and Sher, 2010; Sargent et al., 2010; Slutske et al., 2002; Waddell et al., 2022; Zuckerman, 1978). Sensation seeking and impulsivity are correlated but are distinct characteristics, as, for example, sensation seeking involves preferences for stimulating activities while impulsivity is not necessarily related to a drive for stimulation (Ravert and Donnellan, 2021).

Some additional personality traits are related to alcohol problems. Lower levels of conscientiousness (relative absence of adherence to rules, goal orientation, and efforts to carry out tasks to the best level possible) are associated with greater probabilities of consuming alcohol and drugs and of developing alcohol-related problems (Adan et al., 2017; Bogg and Roberts, 2004; Costa and McCrae, 2008; Hakulinen et al., 2015; Malouf et al., 2007; Turiano et al., 2012; Waddell et al., 2022). Higher extraversion (being outgoing and energetic, enjoying being with other people, and cheerfulness) has been reported to be associated with transitions to heavier alcohol consumption and binge drinking (Adan et al., 2017; Costa and McCrae, 2008; Hakulinen et al., 2015; Wennberg 2002). However, compared to impulsivity, sensation seeking and conscientiousness, there is less consistent evidence of association of extraversion with adverse substance-related outcomes (LoCastro et al., 2000; Sher et al., 2005; Sher et al., 2000). Somewhat limited data are also available regarding relationships to future alcohol problems for low levels of agreeableness (absence of being courteous, cooperative, and considerate) and higher levels of openness (being more likely to try new and novel foods, entertain new theories, and higher curiosity), and there is some disagreement regarding whether the impact of some of these personality measures has

positive or negative valences (Costa and McCrae, 2008; Gmel et al., 2020; Hakulinen et al., 2015; Littlefield and Sher, 2010; Liu et al., 2022; Luchetti et al., 2018).

Internalizing personality attributes make up another personality domain of interest.

These traits involve aspects of negative mood and anxiety symptoms that are central components of major mood and anxiety disorders (e.g., DSM-IV; American Psychiatric Association, 1994) and are also the core of the “dark side” of substance use disorders that are linked to neurochemical changes that can occur during alcohol intoxication and/or withdrawal (Koob, 2015). Elevated levels of sadness and anxiety are part of the personality trait of neuroticism and reflect feelings of insecurity, worry, tenseness, helplessness and feeling discouraged (Costa and McCrae, 2008). There is some evidence that neuroticism is associated with heavy drinking and alcohol problems (Adan et al., 2017; Hakulinen et al., 2015; Hell et al., 2021; Sher et al., 2000, 2005), but under some circumstances higher neuroticism might actually be protective regarding adverse alcohol outcomes (Larkens and Sher et al., 2006; Liu et al., 2022; Papachristou et al., 2016; Pocuca et al., 2019).

Many personality traits correlate with each other, which can make it difficult to determine which trait contributes most robustly to the relationship with heavier drinking or alcohol problems (Ellingson et al., 2018; Rosenstrom et al., 2018). In addition, many investigations have only evaluated cross-sectional and retrospective relationships between externalizing and internalizing personality traits and substance use and problems, and fewer longer-term prospective investigations have established the ability of these personality domains to predict future substance-related problems (e.g., Sher et al., 2000). Some of those prospective studies have reported that relationships between

personality attributes and future substance related problems are bidirectional (Gmel et al., 2020; Kaiser et al., 2016; Lac and Donaldson, 2021; Sher et al., 2005; Hakulinen et al., 2015).

Personality domains are just one type of AUD risk factor. An additional series of vulnerabilities center on the manner and intensity with which a person responds to alcohol. One such characteristic involves higher stimulation that is most prominent at rising blood alcohol concentrations (BACs) (King et al., 2021; Newlin and Renton, 2010), and another relates to the magnitude of variations in resting heart rate (Cheng et al., 2019). Our research team has had extensive experience with a third type of alcohol response, the low Level of Response (low LR) to alcohol typically observed at peak and falling BACs (Goncalves et al, 2017a; McKenna et al., 2022; Schuckit 2018, 2022; Schuckit and Smith 2017; Schuckit et al., 2008, 2021). Low Level of Response involves the need for higher numbers of drinks and higher BACs to produce alcohol related changes in feelings of intoxication, standing steadiness, and/or alterations in physiologic effects of alcohol, including those seen in electroencephalographic, event-related potentials/oscillations, brain connectivity, hormonal, and/or functional magnetic imaging measures (Schuckit, 2022; McKenna et al., 2022). These effects have been observed even after controlling for recent drinking patterns and demographic characteristics, (e.g., Goncalves et al., 2017a,b; Schuckit, 2018).

The low response was first documented using laboratory alcohol administration paradigms in young adult drinkers who drank moderately and did not have a current or prior AUD (Schuckit, 2018, 2022). However, because such alcohol challenges are expensive and time consuming, our research group developed the Self Report of the

Accepted Article

Effects of alcohol (SRE) questionnaire, where participants indicate the number of drinks required for up to four effects across three timeframes. A higher average number of drinks needed for effects on the SRE (i.e., a higher SRE score) is a corollary of lower response at a given BAC in alcohol challenges, and each of these characteristics relates to a higher risk for future heavier drinking and alcohol problems (Chung and Martin, 2009; Ehlers et al., 1999; Luczak et al., 2002; Pedersen and McCarthy 2013; Schuckit et al., 2008, 2021).

Several studies have reported modest relationships of low responses to externalizing and internalizing characteristics (Schuckit and Smith 2006; Schuckit et al., 2017; 2021).

In those investigations from the Collaborative Study on the Genetics of Alcoholism (COGA) and San Diego Prospective Study, higher impulsivity correlated modestly with lower responses in both alcohol challenges and self-reports of the number of drinks needed for effects; higher sensation seeking correlated modestly with higher drinks needed for effects on the SRE; but alcohol responses did not correlate as closely with internalizing characteristics (e.g., Schuckit et al., 2017; Schuckit and Smith, 2006).

In summary, relatively few long-term studies have prospectively evaluated how a range of personality measures related to later alcohol problems, and few appear to have controlled for baseline and past drug- and alcohol-related variables. No study has included a measure of the intensity of response to alcohol in their analyses of whether personality characteristics are related to adverse alcohol outcomes. The data presented below evaluate if personality characteristics increased the ability to predict future DSM-IV alcohol problems in young adults who had not yet met criteria for AUD even after considering additional baseline alcohol-related characteristics.

Methods

The Original COGA Protocol

Beginning in 1989 and after approval from Human Subjects' Protections Committees, original COGA probands were selected from six U.S. sites as individuals with AUD themselves and in multiple AUD relatives (Bucholz et al., 1994; Hesselbrock et al., 1999). Comparison subjects and their families were recruited from medical and dental clinics, drivers' license facilities, and university populations using processes that differed across COGA centers. Soon after recruiting the original subjects, efforts were made to interview as many of their available biological relatives as possible.

Subjects and relatives were assessed with the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA) interview (Bucholz et al., 1994; Hesselbrock et al., 1999). Data gathered included current demography and AUD family histories (FHs) along with recent standard (10-12 grams ethanol) usual drinking quantities and frequencies, lifetime histories of alcohol and other drug-related problems, and lifetime mental health histories.

Selection of Subjects for the Current Analyses

With additional Human Subjects Protection Committee approval, the protocol was expanded in 2004 to focus on interviews with younger individuals from COGA families, as the COGA Prospective Study (Bucholz et al., 2017, deViteri et al., 2020). These subjects were recruited as 12- to 23-year-old relatives of original COGA participants, including their grandchildren, nieces, nephews, and offspring. Following their initial interview, COGA Prospective Study participants were reinterviewed approximately every two years using a modified SSAGA that contained self-reported demography as

well as substance use and problems including the 11 DSM-IV AUD criteria (American Psychiatric Association, 1994). Whenever possible, histories of AUD in one or both parents were determined from data extracted from the interviews with the original COGA participants and, in the absence of such first-hand interviews, from reports of family histories from other family members.

During the first interview in which a COGA Prospective Study participant reported repeated experiences with alcohol but did not meet criteria for DSM-IV AUD they were requested to fill out the 12-item SRE (Schuckit et al., 2021). As this measure only takes about three minutes to do, every drinker who filled out personality measures also completed the SRE. This retrospective questionnaire asks the number of standard drinks required to actually experience up to four effects: feeling any effect, slurring speech, feeling unsteady when standing or walking, and unintentionally falling asleep. The average number of drinks needed for those effects during the approximate first five times of drinking produced the SRE-5 score that is likely to be most analytically useful for relatively young drinkers, and average drinks needed for effects during the period of heaviest drinking (SRE-H) is thought to reflect both initial sensitivity and the development of tolerance (Anthenelli et al., 2021; Schuckit 2018, 2022; Schuckit et al., 2021). The SRE has retest and predictive reliabilities regarding alcohol-related problems of .7 or higher (Kalu et al., 2008; Ray et al., 2011; Schuckit, 2022; Schuckit et al., 1997) and current Cronbach alphas for SRE-5 and SRE-H were .84 and .75, respectively.

Documentation of significant positive correlations between higher numbers of drinks needed for effects (i.e., a lower Level of Response per drink) and future heavier alcohol

Accepted Article

intake and alcohol problems have come from the San Diego Prospective Study, COGA, the U.K.-based Avon Longitudinal Study of Parents and Children (ALSPAC), and other investigations (e.g. Chung and Martin, 2009; Schuckit et al., 2008, 2017, 2019; 2021).

Measures of alcohol responses determined by the SRE or from earlier protocols using alcohol challenges overlap about 60% in predicting future drinking quantities and problems (Schuckit et al., 2009). In the current analyses, SRE scores were used as a continuum of the numbers of drinks required for effects, with numbers of drinks beyond two standard deviations winsorized to mitigate the effects of outliers.

The COGA protocol also gathered information regarding personality characteristics. Using data from the first time these personality domains were measured, these included: the Barratt Impulsiveness Scale (Cronbach alpha and retest reliabilities > 0.80) (Muele et al., 2015; Stanford et al., 2009); the Zuckerman Sensation Seeking Scale (Cronbach alpha > .80, retest reliability >.65) (Deditius-Island and Caruso, 2002; Zuckerman et al., 1978) and the Neo Five-Factor Personality Inventory, which included scores for conscientiousness, neuroticism, extraversion, openness, and agreeableness (Cronbach alphas > .74, reliabilities >.80) (Archer et al., 2006; Costa and McCrae, 2008).

Data Analyses

To be included in the current analyses, the individual had to have experience with alcohol, must not have met AUD criteria by Time 1 (baseline), must have filled out the SRE, and must have been followed over time. Maximum likelihood procedures were used to address missing data (Collins et al., 2001), and Little's MCAR test (Little, 1988) supported that data were missing completely at random ($\chi^2 = 40.898$, $df = 40$, $p = .43$).

In an effort to capture relationships of Time 1 characteristics to the most intense period of alcohol problems, the outcome being predicted was the highest number (0 to 11) of the DSM-IV AUD diagnostic criteria endorsed during any two-year follow up period.

Because the total length of follow-up differed across subjects, the number of years of follow-up was included in the regression models to account for the different possible follow-up increments. Follow-up SSAGA questions regarding DSM-IV alcohol criteria first asked if the problem had ever occurred, followed by the ages of first and most recent experience with that problem. The most recent age was used to determine which items were endorsed in the most recent follow-up period.

Table 1 reports Time 1 variable values and the product-moment correlations between each Time 1 variable of interest to our group and the highest number of AUD criteria items endorsed in any follow-up period. Table 2 presents cross correlations among all variables that correlated significantly with a higher number of follow-up AUD criteria in Table 1. Tables 3 and 4 report results of hierarchical multiple regression analyses with relevant personality domains entered in the final step to directly evaluate the hypothesis that the personality measures would add significantly to a person's demography, Level of Response to alcohol, AUD Family History and the patterns of Time 1 substance-related variables in predicting adverse alcohol outcomes.

Results

The first data column in Table 1 presents the baseline values for relevant characteristics for the 414 COGA Prospective Study participants at the time of the first interview in which they reported drinking and filled out the SRE (Time 1 for these analyses). These 414 individuals represent 78% of the 470 subjects who had experience with alcohol all

of whom also filled out the SRE. The remaining 56 participants were excluded because they were missing one or more of the personality questionnaires. A comparison of baseline data for the 414 participants included in the analyses with data from the 56 who were excluded revealed no variable in Table 1 that differed significantly across the two groups. Regarding demography at Time 1, the 414 participants were on average 20 years old, were predominantly of European American heritage, had an average of 12 years of education, 44% were male, and they had been followed for an average of 8.9 (Standard Deviation [SD] 3.75) years.

At Time 1, these participants, none of whom met AUD criteria at baseline, reported SRE-5 and SRE-H average scores of 3 and 5 drinks per effect, respectively. At baseline, in the prior six months they consumed an average of 2.5 drinks per occasion on an average of one day a week and had endorsed an average of 0.4 of the 11 DSM-IV AUD criteria in the prior 2 years. Reflecting COGA's initial emphasis on recruiting original probands who reported multiple relatives with AUD, 70% of these COGA Prospective Study participants had at least one parent with AUD. One-third had smoked at least 100 cigarettes in their lives, a similar proportion had used cannabis in the prior year, and 13% had ever met DSM-IV criteria for a major depressive or major anxiety disorder. Participants' scores on the seven personality questionnaires are listed at the bottom of Table 1.

The second data column of Table 1 gives the product-moment correlation of each Time 1 variable with the maximum number of DSM-IV AUD criteria endorsed in any follow-up period (mean 1.9 criteria, standard deviation 1.98). Three of the demographic characteristics correlated with the highest number of AUD items endorsed during follow-

up , including a younger age, male sex, and a longer follow-up. Significant correlations with future alcohol problems were observed for all six Time 1 alcohol-related variables, for cannabis use, and for all personality questionnaire scores except extraversion.

Personality score correlations with outcomes were in the positive direction except for the negative correlations for conscientiousness and agreeableness. In decreasing order, the significant relationship of outcome with sensation seeking was the most robust, followed by conscientiousness, then impulsivity, neuroticism, agreeableness, and finally openness.

Many of the Time 1 demographic and substance-related characteristics that significantly correlated with the maximum future number of alcohol problems in Table 1 were likely to correlate with each other. Therefore, those relationships are presented in the correlation matrix in Table 2. Impulsivity correlated significantly and positively with higher SRE scores (lower responses per drink), recent usual drinks per occasion, the number of AUD items endorsed at Time 1, and cannabis use. Sensation seeking related negatively to Time 1 age and positively to male sex, higher SRE scores, more Time 1 alcohol problems, and an AUD FH. Higher conscientiousness related to older age, female sex, lower SRE scores (i.e., higher level of response per drink), as well as fewer Time 1 alcohol problems and a lower probability of prior year cannabis use. Higher neuroticism correlated significantly only with cannabis use, higher openness only correlated significantly with usual drinking frequency, and agreeableness did not relate significantly to Time 1 demographic or substance use measures.

Table 2 also describes how the six personality measures that significantly predicted maximum future alcohol problems in Table 1 related to each other in the current

sample. Regarding the four personality scores with the highest number of significant cross correlations with other personality measures, impulsivity correlated positively with sensation seeking and neuroticism, but negatively with agreeableness and conscientiousness. An additional significant positive correlation for sensation seeking was seen for openness and a negative correlation with conscientiousness.

Conscientiousness also correlated positively with agreeableness and negatively with neuroticism and openness. Finally, neuroticism also related negatively with agreeableness. The many correlations among these personality measures raise the question of which personality domains were most robust in predicting alcohol problems when considered in the context of other relevant personality measures.

Table 3 reports the linear hierarchical stepwise regression analysis results of the percent change in the proportion of the variance explained across four sequential steps predicting the highest number of future alcohol problems. As shown in the first data column, Step 1 documented the standardized Betas for significant relationships to the highest number of AUD items endorsed during follow-up for Time 1 demographic variables of younger age, male sex, and the length of follow-ups, with this step explaining 12% of the variance of predicting the AUD items endorsed during follow-up (the R^2).

In the subsequent Step 2 shown in the second data column of Table 3, after considering the results of Step 1, the group of alcohol-related variables from Table 1 added a significant additional 8% (the change in R^2) of the variance in predicting future alcohol problems, with significant contributions for Time 1 higher SRE-5 score (higher number of drinks needed for effects the approximate first five times of drinking), a higher number

Accepted Article

of Time 1 AUD problems endorsed, and a positive AUD family history. These analyses included only one of the two key SRE values because, as shown in Table 2, the two SRE measures correlated at .68 ($p < .001$) and did not include usual drinking frequency as this variable correlated with drinking quantity at .91. SRE-5 was chosen for inclusion because it is hypothesized to reflect alcohol sensitivity early in a drinker's career rather than the combination of sensitivity and acquired tolerance likely to be seen for SRE-H, and alcohol quantity was chosen because it was felt to relate more closely to alcohol problems. As shown in Supplemental Table 1, if SRE-H was substituted for SRE-5, the results looked very similar to what is reported in Table 3, except that the change in R^2 was a bit higher with SRE-H.

Step 3 then added the drug-related variable that significantly predicted the maximum number of AUD items endorsed in Table 1, prior year cannabis use, a step that accounted for an additional 2% of the variance of future alcohol problems. All variables significant in Step 2 remained significant in Step 3 except for AUD family history. Prior psychiatric anxiety and depressive disorders were not significantly related to the future alcohol problems in Table 1 and, therefore, were not entered into the hierarchical regression analysis.

Step 4 addressed the key question in these analyses. Inclusion of the personality domains accounted for a significant additional 5% of the variance of the prediction of future problems even after considering demographic and substance-related Time 1 variables. Reflecting the high correlations among many of the personality measures, only the standardized Beta for sensation seeking was significant, with a non-significant Beta of $-.09$ ($p = .09$) for conscientiousness. Note that all the significant demographic

variables and cannabis use variables from Step 3 contributed significantly to Step 4, but among the alcohol-related variables significant contributions were limited to the SRE and the Time 1 number of AUD items endorsed.

As shown in Table 4, the evaluations then repeated the analyses in Table 3 but now as a series of separate hierarchical regressions for each personality measure that correlated significantly with the highest number of future AUD criteria endorsed in Table 1. The central question here is whether each relevant personality domain added significantly to Step 4 of the regression analysis after considering Time 1 demography, alcohol-related variables, and drug use. As shown toward the bottom of the table, the change in R^2 when the personality measure was added to the regression in Step 4 was significant for impulsivity, sensation seeking, conscientiousness, neuroticism, and agreeableness, but not for openness. It is interesting to note that a low Level of Response to alcohol (higher SRE-5 score) added significantly to Step 4 in each of the six hierarchical regression results.

Discussion

These results add several findings to an already impressive literature regarding relationships among personality domains and alcohol-related problems. First, this is one of the few longer-term prospective studies of personality that began with drinkers who had not yet met AUD criteria. The current data evaluated the ability of personality dimensions to predict the highest number of AUD items endorsed during follow-up over an average of almost a decade during the early- to mid-twenties. Second, and most importantly, the data demonstrate the ability of most of the personality attributes measured here to predict future alcohol problems even after considering other Time 1

Accepted Article

characteristics that related to personality and problematic drinking. Regarding those results, in Table 3 sensation seeking incremented over the other personality dimensions in predicting alcohol problems when all relevant personality dimensions were considered together in a single logistic regression. In Table 4, when each personality domain was measured individually, sensation seeking, impulsivity, conscientiousness, neuroticism, and agreeableness each predicted alcohol problems after considering demography and substance-related Time 1 variables. Third, the low Level of Response to alcohol predicted future alcohol problems in Step 4 of every hierarchical regression analysis even after considering baseline demography, personality traits, Time 1 alcohol-related variables, and AUD family history.

The results presented here were not generated specifically to evaluate if personality characteristics can predict later alcohol problems, as that conclusion was already well established. Rather, the goal was to address whether those relationships remained robust after considering additional relevant Time 1 predictors. That said, the results are consistent with much of the literature regarding which personality domains more robustly predicted future alcohol problems and how personality domains related to other variables and to each other. It is important to note that the focus was on personality dimensions, not the more complex personality disorders listed in the diagnostic manuals such as DSM-IV (e.g., American Psychiatric Association, 1994; Slutske et al, 2002). In the current study, sensation seeking and conscientiousness were the personality traits with the highest zero-order correlations with higher numbers of future alcohol problems in Table 1, and sensation seeking also contributed significantly to Step 4 of the hierarchical regression analysis in Table 3. These two personality traits were also

among the personality dimensions more commonly mentioned in the literature evaluating how personality domains related to problems with alcohol and other drugs (Ellingson et al., 2018; Lac and Donaldson, 2021; Zuckerman, 1978). Those prior results demonstrated relationships between higher sensation seeking and higher frequencies and quantities of alcohol use, binge drinking, and concomitant use of alcohol and cannabis (Adan et al., 2017; Gmel et al., 2020; Sargent et al., 2010; Waddell et al., 2022). Regarding conscientiousness, low levels have been associated with a greater probability of consuming alcohol and drugs and of developing alcohol-related problems (Adan et al., 2017; Bogg and Roberts, 2004; Hakulinen et al., 2015; Malouf et al., 2007; Turiano et al., 2012; Waddell et al., 2022).

Impulsivity also had significant correlations with future alcohol problems in the literature (e.g., Adan et al., 2017; Dick et al., 2010; Littlefield and Sher., 2010; Slutske et al., 2002; Waddell et al., 2022) and was significantly related to future maximum numbers of alcohol problems in Table 1 and Table 4, but it did not add significantly to the final step of the hierarchical regression analysis in Table 3 when all personality variables were considered together. The restricted performance of this trait in Table 3 might reflect the high correlation of impulsivity with sensation seeking and conscientiousness in Table 2, along with the lower zero-order correlations with the highest number of AUD items endorsed during follow-up for impulsivity compared to those two other personality domains in Table 1.

Many studies in the literature, but not all, suggested a significant relationship between alcohol problems and personality characteristics related to lower mood and higher anxiety, including neuroticism (e.g., Adan et al., 2017; Hakulinen et al., 2015; Hell et al.,

2021; Liu et al., 2022; Luchetti et al., 2018; Sher et al., 2000, 2005). The predicted relationship is consistent with the significant zero-order correlation between neuroticism and later alcohol problems in Table 1 and the individual evaluation of neuroticism in Table 4. However, this relationship was not significant in Step 4 of the hierarchical regression analysis in Table 3. Like the conclusion regarding impulsivity and consistent with data in Table 4, the less robust performance for neuroticism in Table 3 is likely to reflect the high correlations between neuroticism and impulsivity and/or conscientiousness. However, it is interesting to note that prior histories of depressive or anxiety disorders did not correlate significantly with future alcohol problems. Those psychiatric diagnoses are based on the persistent experience of multiple life problems associated with functional impairment or severe distress, problems that are likely to have different correlates than a more limited scope of a score on a personality test (e.g., American Psychiatric Association, 1994).

Lower agreeableness and higher openness both correlated significantly on a zero-order level with future alcohol problems in Table 1 in the current study, and, while neither trait added significantly to predicting outcome in Table 3, only agreeableness added significantly to Table 4. The negative correlation with alcohol problems for agreeableness is consistent with the prior literature (e.g., Hakulinen et al., 2016; Gmel et al., 2020). However, there is disagreement in the literature about the significance and direction of the correlation of openness (Hakulinen et al., 2015; Luchetti et al., 2018). Thus, the less robust performance of openness in the current analyses was not surprising. Finally, regarding the current results, the lack of a significant zero-order correlation of extraversion to future alcohol problems in Table 1 might reflect the

inconsistency of similar results in the literature (LoCastro et al., 2000; Sher et al., 2005; Sher et al., 2000).

The current results are the first to include a low Level of Response to alcohol, itself a relatively robust predictor of future alcohol problems, in studies of whether personality domains predict adverse alcohol outcomes. SRE-5 (likely to relate to alcohol sensitivity and predate acquired tolerance) and SRE-H (likely to reflect both initial alcohol sensitivity and tolerance) had similar high zero-order correlations with future alcohol problems in Table 1 (Anthenelli et al., 2021; Schuckit, 2022; Schuckit et al., 2021). Low Levels of Response also added significantly to Step 4 in every hierarchical regression analysis in Tables 3 and 4 and in Supplementary Table 1. Consistent with the literature (e.g., Schuckit, 2018, 2022; Schuckit et al., 2008; 2021), the relationship of Time 1 low response to future alcohol problems was observed even after controlling for Time 1 demography, usual drinking quantities and frequencies, alcohol problems, AUD family histories, personality traits, and cannabis use.

Also consistent with the prior literature (e.g., Schuckit and Smith 2006; Schuckit et al., 2017; 2021), higher SRE scores (or lower responses per drink) correlated modestly with higher impulsivity and more robustly with higher sensation seeking. The current analyses are the first to report a modest correlation of higher SRE scores with lower conscientiousness and no significant correlations with NEO neuroticism, openness, or agreeableness. However, despite the overlap of higher SRE scores (lower response per drink) with some externalizing personality traits, the low Level of Response measure still contributed significantly to the prediction of higher alcohol problems when considered in along with personality domains the same hierarchical regression analysis.

The results presented here should be interpreted with the following caveats in mind. First, no study results are likely to generalize to all populations, and the source of the current data, the COGA protocol, focused specifically on families with multiple members with AUD. Thus, these subjects were not chosen to be representative of the general US population. Second, a related problem is that only participants who had not developed AUD before their early twenties (Time 1) were included in the analyses. Third, the current findings might not generalize to other outcomes such as drinking versus abstinence or higher alcohol quantities and, fourth, the data were limited to only one measure of each of each personality domain. Fifth, only a limited number of alcohol problems were considered in these analyses, those listed as criteria in DSM-IV. Sixth, in these participants, none of whom had AUD at baseline, the average maximum alcohol problems endorsed during follow-up was about 2, a low number of AUD problems that might have made it difficult to detect statistically significant results in the regression analyses. Finally, only one of several measures of a person's reaction to alcohol, the low Level of Response, had been recorded, and it would be interesting to see how other alcohol response measures perform in similar analyses.

There are several practical implications of the current work. These results suggest the potential importance of including additional alcohol-related predictors (e.g., earlier alcohol problems) in studies evaluating how externalizing and internalizing personality characteristics relate to future alcohol problems. In addition, the ability of the current personality traits to add to the prediction of future alcohol problems in concert with a low Level of Response to alcohol indicates that education about how to mitigate problems associated with externalizing and internalizing characteristics might bolster results from

several alcohol problem prevention studies that focused on low Level of Response as a risk factor (e.g., Conrod et al, 2013; Sargent et al., 2016; Schuckit et al., 2016). Such a step might add to the effectiveness of alcohol-related prevention protocols and to our understanding of the process through which externalizing and internalizing personality domains add to the AUD risk.

References

Adan, A, Forero, DA, Navarro, JF (2017) Personality Traits Related to Binge Drinking: A Systematic Review. *Front Psychiatry*, 8:134.

American Psychiatric Association (1994) *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed., American Psychiatric Press, Washington DC.

Anthenelli, RM, McKenna, BS, Smith, TL, Schuckit MA (2021) Relationship Between Level of Response to Alcohol and Acute Tolerance. *Alcohol Clin Exp Res*, 45(7):1504-1513.

Archer, N, Brown, RG, Boothby, H, Foy, C, Nicholas, H and Lovestone, S (2006) The NEO-FFI is a reliable measure of premorbid personality in patients with probable Alzheimer's disease. *Int J Geriatr Psychiatry*, 21(5), pp.477-484.

Bogg, T and Roberts, BW (2004) Conscientiousness and health-related behaviors: a meta-analysis of the leading behavioral contributors to mortality. *Psychol bull*, 130(6), p.887.

Bucholz KK, Cadoret R, Cloninger CR, Dinwiddie SH, Hesselbrock VM, Nurnberger Jr JI, Reich T, Schmidt I, Schuckit MA (1994) A new, semi-structured psychiatric interview for use in genetic linkage studies: A report on the reliability of the SSAGA. *J Stud Alcohol*, 55(2):149-158.

Bucholz, K. K., McCutcheon, V. V., Agrawal, A., Dick, D. M., Hesselbrock, V. M., Kramer, J. R., Porjesz, B. (2017). Comparison of parent, peer, psychiatric, and cannabis use influences across stages of off-spring alcohol involvement: Evidence from the COGA prospective study. *Alcoholism, Clinical and Experimental Research*, 41(2), 359–368.

Cheng, YC, Huang, YC and Huang, WL (2019) Heart rate variability as a potential biomarker for alcohol use disorders: A systematic review and meta-analysis. *Drug Alcohol Depen*, 204, p.107502.

Chung T, Martin CS (2009) Subjective Stimulant and Sedative Effects of Alcohol During Early Drinking Experiences Predict Alcohol Involvement in Treated Adolescents. *J Stud Alcohol Drugs*, 70(5):660-667.

Collins, LM (2001) A comparison of inclusive and restrictive strategies in modern missing data problems. *Psychol. Methods* 6, 330-351. <https://doi.org/10.1037/1082-989X.6.4.3.30>.

Conrod, PJ, O'Leary-Barrett, M, Newton, N, Topper, L, Castellanos-Ryan, N, Mackie, C, Girard, A (2013) Effectiveness of a Selective Personality-Targeted Prevention Program for Adolescent Alcohol Use and Misuse. *JAMA Psychiatry*, 70(3):334-342.

Costa, PT, Jr, & McCrae, RR (2008) The Revised NEO Personality Inventory (NEO-PI-R). In GJ Boyle, G Matthews, & DH Saklofske (Eds), *The SAGE handbook of personality theory and assessment*, Vol. 2. Personality measurement and testing (pp. 179–198). Sage Publications, Inc.

Deditius-Island, HK and Caruso, JC (2002) An examination of the reliability of scores from Zuckerman's Sensation Seeking Scales, Form V. *Educ Psychol Meas*, 62(4), pp.728-734.

deViteri SSS, Pandey A, Pandey G, Kamarajan C, Smith R, Anokhin A, Bauer L, Bender A, Chan G, Dick D, Edenberg H, Kinreich S, Kramer J, Schuckit M, Zang Y, McCutcheon V, Bucholz, Porjesz B, Meyers JL (2020) Pathways to post-traumatic

stress disorder and alcohol dependence: Trauma, executive functioning, and family history of alcoholism in adolescents and young adults. *Brain Behav*, 10(11): e01789.

Dick, DM, Smith, G, Olausson, P, Mitchell, SH, Leeman, RF, O'Malley, SS and Sher, K (2010) Understanding the construct of impulsivity and its relationship to alcohol use disorders. *Addict Biol*, 15(2), pp.217-226.

Ehlers, CL, Garcia-Andrade, C, Wall, TL, Cloutier, D, Phillips, E (1999) Electroencephalographic responses to alcohol challenge in Native American Mission Indians. *Biol Psychiatry*, 45(6):776-787.

Ellingson, JM, Slutske, WS, Vergés, A, Littlefield, AK, Statham, DJ and Martin, NG (2018) A multivariate behavior genetic investigation of dual-systems models of alcohol involvement. *J Stud Alcohol Drugs*, 79(4), pp.617-626.

Gonçalves, PD, Schuckit, MA, Smith, TL (2017a) Drinking status between ages 50 and 55 for men from the San Diego Prospective Study who developed DSM-IV alcohol abuse or dependence in prior follow-ups. *J Stud Alcohol Drugs*, 78:512-520.

Gonçalves, PD, Smith, TL, Anthenelli, RM, Danko, G, Schuckit, MA (2017b) Alcohol-related blackouts among college students: impact of low level of response to alcohol, ethnicity, sex, and environmental characteristics. *Braz J Psychiatry*, 40(2):128-137.

Gmel, G, Marmet, S, Studer, J and Wicki, M (2020) Are changes in personality traits and alcohol use associated? A cohort study among young Swiss men. *Front Psychiatry*, p.1440.

Hakulinen, C, Elovainio, M, Batty, GD, Virtanen, M, Kivimäki, M and Jokela, M (2015) Personality and alcohol consumption: Pooled analysis of 72,949 adults from eight cohort studies. *Drug and Alcohol Depend*, 151, pp.110-114.

Hell, ME, Müller, A, Horn, CG and Søgaard Nielsen, A (2022) Personality traits and alcohol consumption: Secondary analysis of the Self-Match Study. *Alcohol Clin Exp Res*, 6(6):1110-1120.

Hesselbrock, M, Easton, C, Bucholz, KK, Schuckit, MA, Hesselbrock, V (1999) A validity study of the SSAGA – A comparison with the SCAN. *Addiction*, 94(9):206-212.

Kaiser, A, Bonsu, JA, Charnigo, RJ, Milich, R and Lynam, DR (2016) Impulsive personality and alcohol use: Bidirectional relations over one year. *J Stud Alcohol Drugs*, 77(3), pp.473-482.

Kalu N, Ramchandani VA, Marshall V, Scott D, Ferguson D, Cain G, Taylor R (2012) Heritability of level of response and association with recent drinking history in non-alcohol dependent drinkers. *Alcohol Clin Exp Res*, 36:1034-1041.

King A, Vena A, Hasin DS, deWit H, O'Connor SJ, Cao D (2021) Subjective responses to alcohol in the development and maintenance of alcohol use disorder. *Am J Psychiatry*, 178(6):560-571.

Koob, GF (2015) The dark side of emotion: the addiction perspective. *Eur J Pharmacol*, 753, pp.73-87.

Lac, A and Donaldson, CD (2021) Sensation seeking versus alcohol use: evaluating temporal precedence using cross-lagged panel models. *Drug Alcohol Depen*, 219, p.108430.

Larkins, JM, Sher, KJ (2006) Family history of alcoholism and the stability of personality in young adulthood. *Psychology of Addictive Behaviors*, 20 (4): pp. 471-477.

Little, RJ, (1988) A test of missing completely at random for multivariate data with missing values. *J. Am. Stat. Assoc.* 83 (404), 1198-1202.

Littlefield, AK and Sher, KJ (2010) The multiple, distinct ways that personality contributes to alcohol use disorders. *Soc Personal Psychol Compass*, 4(9), pp.767-782.

Liu, PP, Chmielewski, M, Trujillo, M, Morris, J, Pigott, TD (2022) Linking the big five domains to alcohol misuse. *Alcohol Alcohol*, 57:58-73.

LoCastro, J, Spiro III, A, Monnelly, E and Ciraulo, D (2000) Personality, family history, and alcohol use among older men: The VA Normative Aging Study. *Alcohol Clin Exp Res*, 24(4), pp.501-511.

Luchetti, M, Sutin AR, Delitala, A, Stephan, Y, Fiorillo, E, Morongiu, M, Masala, M, Schlessinger D, Terracciano, A. (2018) Personality traits and facets linked with self-reported alcohol consumption n biomarkers of liver health. *Add Behav* 82:135-141.

Luczak, SE, Elvine-Kreis, B, Shea, SH, Carr, LG, Wall, TL (2002) Genetic risk for alcoholism relates to level of response to alcohol in Asian-American men and women. *J Stud Alcohol* 63(1):74-82.

Malouff, JM, Thorsteinsson, EB, Rooke, SE and Schutte, NS (2007) Alcohol involvement and the five-factor model of personality: A meta-analysis. *J Drug Educ*, 37(3), pp.277-294.

McKenna, BS, Anthenelli, RM, Smith, TL and Schuckit, MA (2022) Low versus high level of response to alcohol affects amygdala functional connectivity during processing of emotional stimuli. *Alcohol Clin Exp Res*, 46(1), pp.66-76.

Meule, A, Mayerhofer, M, Gründel, T, Berker, J, Beck Teran, C and Platte, P (2015) Half-year retest-reliability of the Barratt Impulsiveness Scale—short form (BIS-15). *Sage Open*, 5(1), p.2158244015576548.

Newlin, DB, Renton, RM (2010) High risk groups often have higher levels of alcohol response than low risk: The other side of the coin. *Alcohol Clin Exp Res*, 34(2):199-202, author reply 203-205.

Papachristou, H, Aresti, E, Theodorou, M, Panayiotou, G (2018) Alcohol outcome expectancies mediate the relationship between social anxiety and alcohol drinking in university students: The role of gender *Cognitive Therapy and Research* 42 (3): 289-301.

Pedersen, SL, McCarthy, DM (2013) Differences in acute response to alcohol between African Americans and European Americans. *Alcohol Clin Exp Res*, 37(6):1056-1063.

Pocuca, N, Hides, L, Quinn, CA, White MJ, Mewton, L, Loxton, NJ (2019) An exploratory study of the relationship between neuroticism and problematic drinking in emerging adulthood. *Personality and Individual Differences* 145:132-244.

Pryor, LR, Miller, JD, Hoffman, BJ and Harding, HG (2009) Pathological personality traits and externalizing behaviour. *Pers Ment Health*, 3(1), pp.26-40.

Ravert, RD and Donnellan, MB (2021) Impulsivity and sensation seeking: Differing associations with psychological well-being. *Appl Res Qual Life*, 16(4), pp.1503-1515.

Ray, LA, Hart, EJ, Chin, PF (2011) Self-Rating of the Effects of Alcohol (SRE): predictive utility and reliability across interview and self-report administrations. *Addict Behav*, 36(3):241-243.

Reilly, MT, Noronha, A, Goldman, D, Koob, GF (2017) Genetic studies of alcohol dependence in the context of the addiction cycle. *Neuropharmacology*, 122:3-21.

Rosenström, T, Torvik, FA, Ystrom, E, Czajkowski, NO, Gillespie, NA, Aggen, SH, Krueger, RF, Kendler, KS and Reichborn-Kjennerud, T (2018) Prediction of alcohol use disorder using personality disorder traits: a twin study. *Addiction*, 113(1), pp.15-24.

Sargent, JD, Tanski, S, Stoolmiller, M and Hanewinkel, R (2010) Using sensation seeking to target adolescents for substance use interventions. *Addiction*, 105(3), pp.506-514.

Schuckit, MA (2018) A Critical Review of Methods and Results in the Search for Genetic Contributors to Alcohol Sensitivity. *Alcohol Clin Exp Res*, 42(5):822-835.

Schuckit, MA (2022) AUD risk, diagnoses, and course in a prospective study across two generations: implications for prevention. *Alcohol Res: Curr Rev*, 42(1).

Schuckit, MA and Smith, TL (2006) An evaluation of the level of response to alcohol, externalizing symptoms, and depressive symptoms as predictors of alcoholism. *J Stud Alcohol*, 67(2), pp.215-227.

Schuckit, MA, Smith, TL (2017) Mediation of effects of the level of response to alcohol and impulsivity 15 years later in 36-year-old men: Implications for prevention efforts.

Drug Alcohol Depen, 180:356-362, 2017.

Schuckit, MA, Smith, TL, Clarke, DF (2021) Cross-Sectional and prospective associations of drinking characteristics with scores from the Self-Report of the Effects of Alcohol questionnaire and findings from alcohol challenges. *Alcohol Clin Exp Res*, 45(11):2282-2293.

Schuckit, MA, Smith, TL, Clausen, P, Fromme, K, Skidmore, J, Shafir, A, Kalmijn, J (2016) The Low Level of Response to Alcohol-Based Heavy Drinking Prevention Program: One-Year Follow-Up. *J Stud Alcohol Drugs*, 77(1):25-37.

Schuckit, MA, Smith, TL, Danko G, Anthenelli, R, Schoen, L, Kawamura, M, Kramer, J, Dick, DM, Neale, Z, Kuperman, S, McCutcheon, V, Anokhin, AP, Hesselbrock, V, Hesselbrock, M, Bucholz, K (2017) A Prospective Comparison of How the Level of Response to Alcohol and Impulsivity Relate to Future DSM-IV Alcohol Problems in the COGA Youth Panel. *Alcohol Clin Exp Res*, 41(7):1329-1339.

Schuckit, MA, Smith, TL, Rana, BK, Mendoza, LA, Clarke, D, Kawamura M (2019b) Performance of the Self-Report of the Effects of Alcohol Questionnaire Across Sexes and Generations. *Alcohol Clin Exp Res*, 43(7):1384-1390.

Schuckit, MA, Smith, TL, Tipp, JE (1997) The self-rating of the effects of alcohol (SRE) form as a retrospective measure of the risk for alcoholism. *Addiction*, 92:979-988.

Schuckit, MA, Smith, TL, Trim, R, Fukukura, T, Allan R (2009) The Overlap of Predicting Alcohol Outcome for Two Measures of the Level of Response to Alcohol. *Alcohol Clin Exp Res*, 33(3):563-569.

Schuckit, MA, Smith, TL, Trim, RS, Heron, J, Horwood, J, Davis, J, Hibbeln, J, ALSPAC Study Team (2008b) The Self-Rating of the Effects of Alcohol Questionnaire as a Predictor of Alcohol-Related Outcomes in 12-Year-Old Subjects. *Alcohol Alcohol*, 43(6):641-646.

Sher, KJ, Grekin, ER and Williams, NA (2005) The development of alcohol use disorders. *Annu Rev Clin Psychol*, 1(1), pp.493-523.

Sher, KJ, Bartholow, BD and Wood, MD (2000) Personality and substance use disorders: a prospective study. *J Consult Clin Psychol*, 68(5), p.818.

Accepted Article

Slutske, WS, Heath, AC, Madden, PA, Bucholz, KK, Statham, DJ and Martin, NG (2002) Personality and the genetic risk for alcohol dependence. *J Abnorm Psychol*, 111(1), p.124.

Stanford, MS, Mathias, CW, Dougherty, DM, Lake, SL, Anderson, NE and Patton, JH (2009) Fifty years of the Barratt Impulsiveness Scale: An update and review. *Personality and individual differences*, 47(5), pp.385-395.

Turiano, NA, Whiteman, SD, Hampson, SE, Roberts, BW, Mroczek, DK (2012b) Personality and substance use in midlife: Conscientiousness as a moderator and the effects of trait change. *J Res Pers*, 46(3):295-305.

Waddell, JT, Jager, J and Chassin, L (2022) Maturing out of alcohol and cannabis co-use: A test of patterns and personality predictors. *Alcohol Clin Exp Res*, 46(8), pp.1603-1615.

Wennberg, P (2002) The development of alcohol habits in a Swedish male birth cohort. In SP Shohov (Ed), *Advances in psychology research*, Vol. 15, pp. 121–155.

Zuckerman, M (1978) Sensation seeking and psychopathy. In RD Hare & D Schilling (Eds), *Psychopathic behavior: Approaches to research* (pp 165-186). London, England: Wiley. pp 165-186.

Table 1

Baseline (Time 1) Characteristics and Their Correlations with Follow-up Maximum Number of DSM-IV AUD Criteria Items Endorsed for 414 Participants in the COGA Prospective Study

Baseline (T1) Variables	Time 1 Mean (SD) or %	Maximum Average AUD Criteria Endorsed at Follow-up
Demography		
Age	19.7 (1.40)	-.19 ^c
Male %	43.7	.22 ^c
Years Follow-Up (FU)	8.9 (3.75)	.16 ^c
European-American %	62.3	-.09
Education Years	12.4 (1.43)	-.07
Alcohol Related		
SRE-5	3.3 (1.77)	.21 ^c
SRE-H	5.0 (2.84)	.29 ^c
Usual Drinks/Drinking Day/6 month	2.5 (2.99)	.11 ^a
Usual Frequency/Week/6 month	0.9 (0.96)	.10 ^a
AUD Items Endorsed in Past 2 Years	0.4 (0.66)	.26 ^c
Family AUD History (FH) %	70.0	.14 ^b
Drug Use		
Ever Smoked 100 Cigarettes %	32.6	.09
Cannabis Use Past Year%	31.9	.20 ^c
Psychiatric Diagnoses		
Ever Mood or Anxiety Disorder %	12.6	.07
Personality		
Barratt Impulsivity	62.5 (10.64)	.17 ^c
Zuckerman Sensation Seeking	18.1 (6.47)	.30 ^c
NEO Conscientious	45.8 (11.37)	-.23 ^c
NEO Neuroticism	50.6 (10.15)	.16 ^b
NEO Extraversion	53.2 (9.86)	.03
NEO Openness	50.5 (10.49)	.10 ^a
NEO Agreeableness	45.7 (11.28)	-.13 ^b

DSM-IV = Fourth Diagnostic and Statistical Manual; AUD = alcohol use disorder; COGA = Collaborative Study on the Genetics of Alcoholism; SRE-5 = Self Report of the Effects of Alcohol first 5-times drinking; SRE-H Self Report of the Effects of Alcohol during the heaviest drinking period; Barratt = Barratt Impulsiveness Scale; Zuckerman = Zuckerman Sensation Seeking Scale; NEO = NEO 5-Factor Personality Scale.

Table 2

Correlation Matrix of Time 1 Variables Significantly Related to Maximum Future DSM-IV AUD Criteria Items for 414 Participants in the COGA Prospective Study

Time 1 variable	Age	Male	FU Years	SRE-5	SRE-H	Usual Quantity	Usual Freq	AUD Items	Family AUD	Cannabis Use	Impulsivity	Sensation Seeking	NeoC	NeoN	NeoO
Male	-.09														
Years Follow-Ups (FU)	.00	-.13 ^b													
SRE-5	-.01	.24 ^c	-.02												
SRE-H	.04	.25 ^c	-.01	.68 ^c											
Usual Drinks/Drinking Day/6 mon	-.15 ^b	.13 ^b	-.03	.16 ^c	.17 ^c										
Usual Frequency/Week/6 mon	-.07	-.12 ^b	-.02	.11 ^a	.11 ^a	.91 ^c									
AUD Items Endorsed prior 2 years	-.01	.11 ^a	-.03	.12 ^a	.32 ^c	.15 ^b	.17 ^c								
Family AUD History (FH)	-.07	.04	.02	.08	.11 ^a	.05	-.01	.05							
Cannabis Use Past Year	.01	.11 ^a	-.02	.03	.10 ^a	-.03	.01	.21 ^c	.11 ^a						
Barratt Impulsivity	-.06	.06	-.04	.12 ^a	.16 ^c	.00	-.03	.12 ^a	.08	.13 ^b					
Zuckerman Sensation Seeking	-.13 ^b	.29 ^c	.00	.26 ^c	.31 ^c	.09	.09	.15 ^b	.14 ^b	.04	.28 ^c				
Neo Conscientiousness	.11 ^a	-.10 ^a	-.02	-.12 ^a	-.14 ^b	-.04	-.05	-.10 ^a	-.03	-.13 ^b	-.50 ^c	-.20 ^c			
Neo Neuroticism	-.02	-.01	.01	.06	.05	.00	.01	.07	.09	.11 ^a	.40 ^c	.04	-.39 ^c		
Neo Openness	-.01	.09	.04	.03	.02	.09	.10 ^a	.01	.04	-.01	-.02	.38 ^c	-.12 ^a	.06	
Neo Agreeableness	.04	-.00	-.01	-.05	-.06	.06	.07	-.01	-.05	-.04	-.31 ^c	-.08	.30 ^c	-.37 ^c	.07

COGA= Collaborative Study on the Genetics of Alcoholism; DSM-IV = Fourth Diagnostic and Statistical Manual; AUD = alcohol use disorder; SRE-5 = Self Report of the Effects of Alcohol first 5-times drinking; SRE-H Self Report of the Effects of Alcohol during the heaviest drinking period; Barratt = Barratt Impulsiveness Scale; Zuckerman = Zuckerman Sensation Seeking Scale; NEO = NEO 5-Factor Personality Scale; NeoC = conscientiousness; NeoN = neuroticism; NeoO = openness; NeoA = agreeableness; Freq = frequency; superscript a = p<.05; b = p<.01; c = p<.001.

Table 3

Results of Linear Hierarchical Regression Analysis Predicting Maximum Number of DSM-IV AUD Items Endorsed On Follow-Up

Variables at Time 1	Standardized Beta and R ² Change			
	Step 1	Step 2	Step 3	Step 4
Demography				
Age	-.17 ^c	-.17 ^c	-.17 ^c	-.14 ^b
Sex (Male)	.24 ^c	.17 ^c	.16 ^b	.12 ^b
Years Follow-Up	.19 ^c	.19 ^c	.19 ^c	.18 ^c
	R²=.12^c			
Alcohol Related				
SRE-5		.14 ^b	.14 ^b	.10 ^a
Usual Quantity/Drinking Day/6 month		-.06	-.03	.00
AUD Items Endorsed 2 years		.22 ^c	.19 ^c	.17 ^c
Family AUD History (FH)		.10 ^a	.08	.06
		R²=.08^c		
Drug Use				
Cannabis Use Past Year			.13 ^b	.12 ^b
			R²=.02^b	
Personality				
Barratt Impulsivity				-.02
Zuckerman Sensation Seeking				.16 ^b
NEO Conscientious				-.09
NEO Neuroticism				.06
NEO Openness				.00
NEO Agreeableness				-.05
				R²=.05^c

DSM-IV = Fourth Diagnostic and Statistical Manual; AUD = alcohol use disorder; SRE-5 = Self Report of the Effects of Alcohol first 5-times drinking; SRE-H Self Report of the Effects of Alcohol during the heaviest drinking period; Barratt = Barratt Impulsiveness Scale; Zuckerman = Zuckerman Sensation Seeking Scale; NEO = NEO 5-Factor Personality Scale; R² =proportion of the variance explained by each step; superscript a = p<.05; b = p<.01; c = p<.001.

Table 4

Results of Step 4 for Linear Hierarchical Regression Analyses Predicting Maximum Number of DSM-IV AUD Items Endorsed On Follow-Up for Each Single Personality Assessment at a Time

Variables at Time 1	Standardized Beta and R ² Change					
	Barratt Impulsivity	Zuckerman Sensation Seeking	NeoC	NeoN	NeoO	NeoA
Demography						
Age	-.16 ^c	-.15 ^c	-.15 ^c	-.16 ^b	-.17 ^b	-.16 ^c
Sex (Male)	.16 ^c	.12 ^a	.15 ^c	.16 ^c	.15 ^c	.16 ^c
Years Follow-Up	.20 ^c	.19 ^c	.19 ^c	.19 ^c	.19 ^c	.19 ^c
Alcohol Related						
SRE-5	.13 ^b	.11 ^a	.12 ^b	.13 ^a	.14 ^b	.13 ^b
Usual Quantity/Drinking Day/6 month	.02	.02	.02	.02	.01	.02
AUD Items Endorsed 2 years	.18 ^c	.17 ^c	.18 ^c	.19 ^c	.19 ^c	.19 ^c
Family AUD History	.07	.06	.08	.07	.08	.08
Drug Use						
Cannabis Use Past Year	.12 ^b	.14 ^b	.12 ^b	.12 ^b	.14 ^b	.13 ^b
Specific Personality Measure	.10 ^a	.17 ^c	-.14 ^c	.11 ^a	.07	-.10 ^a
	R² = .01^a	R² = .02^c	R² = .02^c	R² = .01^a	R² = .00	R² = .01^a

DSM-IV = Fourth Diagnostic and Statistical Manual; AUD = alcohol use disorder; SRE-5 = Self Report of the Effects of Alcohol first 5-times drinking; Barratt = Barratt Impulsiveness Scale; Zuckerman = Zuckerman Sensation Seeking Scale; NEO = NEO 5-Factor Personality Scale; NeoC = conscientiousness; NeoN = neuroticism; NeoO = openness; NeoA = agreeableness;
R² = proportion of the variance explained by Step 4; superscript a = p<.05; b = p<.01; c = p<.001.