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An α-synuclein gene (*SNCA*) polymorphism moderates the association of PTSD symptomatology with hazardous alcohol use, but not with aggression-related measures

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Abstract

Posttraumatic stress disorder (PTSD) often precedes comorbid substance use disorder and has been associated with aggression. Prior research has evidenced that alcohol use and other externalizing behaviors share genetic factors with PTSD; however, few studies have examined if specific genes are associated with externalizing behaviors in PTSD. The purpose of the current study was to investigate whether an α-synuclein gene polymorphism (*SNCA* rs356195) moderates the association of PTSD symptomatology with externalizing behaviors. We examined the separate and combined effects of PTSD symptomatology and *SNCA* rs356195 on alcohol- and aggression-related measures in nonclinical participants (N = 138 European Americans; 15 diagnosed with probable PTSD). Probable PTSD status and *SNCA* were both associated with externalizing measures. *SNCA* also moderated the association of PTSD symptomatology with hazardous alcohol use, but not with aggression-related measures. Current findings suggest that variations in *SNCA* may increase the likelihood that PTSD symptomatology results in excessive alcohol use.

Keywords

posttraumatic stress disorder; alpha-synuclein; alcohol use; impulsivity; aggression

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1. Introduction

Posttraumatic stress disorder (PTSD) is a common psychiatric disorder that develops following a traumatic event and is estimated to affect approximately 9% of individuals in their lifetime.[1] The range of responses that can follow exposure to a traumatic event is broad and includes emotional numbing, hypervigilance, irritability, recklessness, and unwanted re-experiencing of the event through intrusive memories and flashbacks.[2] Notably, PTSD frequently co-occurs with substance use disorders.[3,4] For instance, estimated rates of lifetime alcohol use disorder range from about 22 to 52% in individuals with PTSD,[4–6] compared to 8 to 21% in individuals without PTSD.[5,6] Where temporal data are available, PTSD usually precedes comorbid substance use disorder.[3,4,7,8] PTSD has also been associated with interpersonal aggression,[9–12] and the robustness of this association has been supported by a meta-analysis of 39 studies.[13] Other studies have reported elevated rates of thrill-seeking behavior, risky sexual behavior, and unsafe driving associated with PTSD,[14,15] and these risky and impulsive behaviors frequently co-occur.[11,14,15]

Importantly, cluster analytic studies have revealed distinct patterns of personality and behavior among individuals who have been exposed to trauma.[16–19] One pattern is characterized by *externalizing* psychopathology, including high negative emotionality, low constraint, high levels of aggression, and elevated comorbidity with substance use disorders and antisocial personality disorder. This contrasts with an *internalizing* pattern characterized by low positive emotionality and high negative emotionality. The nature of the genetic and environmental influences on these outcomes is an area of ongoing research.

Twin studies using the Vietnam Era Twin Registry have revealed that PTSD and alcohol use disorder share common genetic influences.[20,21] However, examination of individual genes is better suited to determining which individuals with PTSD tend to display externalizing psychopathology following traumatic exposure.[22] The *ANKK1/DRD2* A1 allele, which is associated with alcohol expectancies[23,24] and risk for alcohol dependence in general,[25] has been shown to be more frequent in combat veterans with PTSD who were harmful drinkers compared to those who were not harmful drinkers.[26] The ankyrin 3 gene (*ANK3*) has also been studied for its possible influence on externalizing behavior and PTSD: Logue and colleagues[27] reported that a single-nucleotide polymorphism (SNP; rs9801490 T allele) was associated with a reduced likelihood of PTSD and externalizing behavior, suggesting that it may reflect a common genetic factor underlying the development of both PTSD and externalizing behavior. Finally, variations in *5-HTTLPR* have been found to interact with early life and family stress to predict alcohol use in maltreated children and adolescents.[28,29] Overall though, little is known about specific genes that are associated with externalizing behaviors in PTSD.

Alpha-synuclein is a presynaptic protein that attenuates dopamine (DA) biosynthesis and release,[30] and DA neurotransmission is known to play an important role in reward and addiction.[31,32] With regard to addictive behavior, the α-synuclein gene (*SNCA*) has been shown to be more highly expressed in the hippocampus and nucleus accumbens of alcohol-naïve rats bred to prefer alcohol compared to alcohol-naïve rats bred to not prefer

alcohol.[33,34] In humans, blood α-synuclein levels have been positively correlated with alcohol and cocaine craving,[35,36] and several SNPs of *SNCA* have been associated with alcohol craving[37,38] and alcohol use disorder.[39] Recent studies have also linked *SNCA* to impulsivity in mice[40,41] and humans.[42] In regard to specific SNPs of *SNCA*, the C-allele of *SNCA* rs356195 has been associated with negative history of alcohol craving,[38] and *SNCA* rs356195 T-allele carriers have displayed greater impulsivity than individuals with the CC genotype.[42] Given the involvement of DA and impulsivity in aggressive behavior,[43,44] it is possible that *SNCA* is also associated with aggression. However, no study to date has examined this relationship.

Externalizing symptoms (e.g., aggression), characterized by behavioral disconstraint, have been prospectively associated with alcohol problems in individuals with PTSD.[45,46] The purpose of the current study was to investigate whether the *SNCA* rs356195 polymorphism, which has previously been associated with impulsivity, moderates the association of PTSD symptomatology with externalizing behaviors. To this end, we examined the separate and combined effects of PTSD symptomatology and *SNCA* rs356195 on alcohol- and aggression-related measures in a nonclinical sample. We hypothesized that *SNCA* T-allele carriers would display evidence of greater impairment in behavioral control in domains related to alcohol use and aggression relative to C homozygotes. Based on past research, we expected that probable PTSD status would be associated with more severe alcohol use and greater aggression and alcohol-related aggression expectancies. We also hypothesized that *SNCA* would moderate these relationships, such that PTSD symptomatology would be more strongly related to higher levels of hazardous alcohol use, aggression, and alcohol-related aggression expectancies in T-allele carriers.

2. Method

2.1. Participants and Procedures

Using the same methodology as a prior study,[47] a total of 222 participants were recruited from the university and community through university-based e-mail announcements, on- and off-campus fliers, and newspaper and online advertisements and were genotyped for *SNCA* rs356195. Blood samples for genotyping were obtained by puncturing the index finger with an automatic fingerstick lancet device and then storing three small blots of blood with 3MM chromatography paper (Whatman, Inc., Florham Park, NJ). Dried blood samples were analyzed at the Indiana Alcohol Research Center. DNA was isolated using the HotSHOT method,[48] after which TaqMan probes were used for allelic discrimination (Applied BioSystems, Inc., Foster City, CA). Thermocycling was carried out in MJ Research PTC-200 thermocyclers, and the PCR products were analyzed in an ABI PRISM® 7300 Sequence Detection System (SDS) instrument.

In order to limit the potentially confounding effects of population stratification, only participants who self-identified as “Caucasian” were retained. Of the remaining 145 participants, 7 were excluded because of incomplete self-report data, leaving a total sample of 138 European Americans (77 men and 61 women) between the ages of 21 and 55 (M = 25.96, SD = 7.48). The project was approved by The University of Southern Mississippi

Human Subjects Protection Review Committee. Written informed consent was obtained prior to participation.

2.2. Measures

2.2.1. PTSD Checklist Civilian Version (PCL-C)—The PCL-C was used to diagnose probable PTSD.[49] The self-report instrument consists of 17 items corresponding to symptoms from PTSD Criterion B (trauma re-experiencing), Criterion C (trauma-related avoidance and general numbing), and Criterion D (increased arousal) of the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV*).[50] Test-takers are asked to respond to each symptom consistent with how much they have been bothered by that problem during the past month, and items are answered on a 5-point severity scale scored from 1 (*not at all*) to 5 (*extremely*). Using the symptom cluster method, individuals are given a presumptive diagnosis of PTSD if they score 3 (*moderately*) or higher on at least one Criterion B item, three Criterion C items, and two Criterion D items (thus meeting Criterion B, C, and D, respectively). The symptom cluster method has yielded a sensitivity of 39–100% and a specificity of 79–94% in relation to interviewer-diagnosed PTSD.[49] In addition, PCL-C Criterion B, C, and D subscale scores and Total Scale scores were also computed.

2.2.2. Alcohol Use Disorders Identification Test (AUDIT)—The AUDIT is a self-report measure of hazardous and harmful alcohol use.[51] The first 3 items pertain to alcohol use frequency, typical drinking amount, and frequency of binge drinking, and the remaining 7 items inquire about alcohol-related difficulties and symptoms of alcohol dependence. Item responses are scored from 0 to 4, except for responses to the last two items, which are scored 0, 2, or 4, and higher scores indicate greater levels of hazardous drinking.

2.2.3. Alcohol Effects Questionnaire (AEQ) Aggression and Power Subscale—The AEQ Aggression and Power subscale is a 6-item self-report measure that assesses beliefs regarding the likelihood of engaging in aggressive behavior after consuming a few alcoholic drinks.[52] “True” and “False” item responses are scored 1 and 0, respectively, and higher scores are indicative of greater alcohol-related aggression expectancies.

2.2.4. Life History of Aggression (LHA) Aggression Subscale—The LHA Aggression subscale is a 5-item self-report measure that assesses history of aggressive behavior.[53] Items are answered on a 6-point frequency scale ranging from 0 (*never happened*) to 5 (*happened so many times I couldn’t give a number*), and higher scores are indicative of greater levels of past aggression. LHA Aggression scores have been shown to be highly correlated with other measures of aggression.[53]

2.3. Data Analysis

Alpha (two-tailed) was set at .05 for all analyses. We first obtained descriptive statistics and genotype frequencies and compared PTSD and *SNCA* groups on demographic variables. Hardy-Weinberg equilibrium was tested using an online Hardy-Weinberg equilibrium calculator.[54] Two-way between-subjects ANOVAs were used to evaluate the main and interactive effects of PTSD symptomatology and *SNCA* on continuous variables (i.e.,

AUDIT, AEQ Aggression and Power, and LHA Aggression scores). If there was a significant interaction between PTSD symptomatology and *SNCA* on a particular variable, then the interactive effects of PTSD Criterion (B, C, and D) and *SNCA* on that particular variable were also examined. For significant interactions, simple effects analyses were conducted with separate one-way between-subjects ANOVAs. Due to group size considerations (less than 5 TT participants per cell), *SNCA* group comparisons were limited to comparisons between C homozygotes (CC participants) and T-allele carriers (CT/TT participants), consistent with a prior *SNCA* study that used nearly the same (overlapping) sample.[42]

3. Results

3.1. Sample Characteristics

Using the PCL-C symptom cluster method, 47 participants met PTSD Criterion B; 35 participants met Criterion C; 25 participants met Criterion D; and 15 participants (3 men and 12 women) were diagnosed with probable PTSD. Fisher's exact tests and one-way analyses of variance revealed that participants with and without a presumptive diagnosis of PTSD did not differ significantly in respect to age, years of education, or marital status (all *p*s > .18); however, women were significantly more likely to be diagnosed with probable PTSD ($p = .005$, RR = 5.0). Men and women did not differ significantly in regard to AUDIT or LHA Aggression scores (*p*s > .15), but women did score higher on AEQ Aggression and Power ($t_{136} = 2.02$, $p = .046$, $d = .35$. The genotypic frequency distribution for *SNCA* rs356195 in the total sample did not deviate significantly from expected Hardy-Weinberg equilibrium (78 CC, 49 CT, and 11 TT; $\chi^2 = .69$, $p = .41$). Fisher's exact tests and one-way analyses of variance revealed that *SNCA* C homozygotes and T-allele carriers did not differ significantly in respect to sex, age, years of education, marital status, or probable PTSD diagnosis (all *p*s > .75). Descriptive statistics and Cronbach's alphas for study measures are displayed in Table 1.

3.2. Hazardous Alcohol Use

PTSD symptomatology ($F_{(1, 134)} = 7.52$, $p = .007$, $\eta_p^2 = .053$) and *SNCA* ($F_{(1, 134)} = 13.28$, $p = .0004$, $\eta_p^2 = .090$) were both related to AUDIT scores: Participants with probable PTSD ($M = 8.2$, $SD = 5.2$) displayed higher AUDIT scores than participants without probable PTSD ($M = 6.2$, $SD = 3.2$, $d = .58$), and T-allele carriers ($M = 7.2$, $SD = 3.7$) displayed higher AUDIT scores than C homozygotes ($M = 5.8$, $SD = 3.2$, $d = .41$). As displayed in Fig. 1, a significant interaction between PTSD symptomatology and *SNCA* ($F_{(1, 134)} = 6.82$, $p = .01$, $\eta_p^2 = .048$) was also found. Simple effects analyses showed that T-allele carriers with probable PTSD ($M = 11.7$, $SD = 5.8$) displayed higher AUDIT scores than T-allele carriers without probable PTSD ($M = 6.7$, $SD = 3.1$, $p = .001$, $d = 1.46$), whereas C homozygotes with probable PTSD ($M = 5.9$, $SD = 3.3$) scored nearly the same on the AUDIT as C homozygotes without probable PTSD ($M = 5.8$, $SD = 3.2$, $p = .92$).

Follow-up analyses were conducted to examine if meeting a specific PTSD criterion was primarily responsible for the significant interactive effect of PTSD symptomatology and *SNCA* on AUDIT scores. There was a significant interaction between *SNCA* and PTSD

Criterion D (increased arousal), $F_{(1, 134)} = 7.82$, $p = .006$, $\eta_p^2 = .055$. Simple effects analyses revealed that T-allele carriers who met Criterion D ($M = 9.9$, $SD = 5.3$) displayed higher AUDIT scores than T-allele carriers who did not meet Criterion D ($M = 6.6$, $SD = 3.0$, $p = .007$, $d = .94$), whereas C homozygotes who met Criterion D ($M = 5.1$, $SD = 3.1$) scored about the same on the AUDIT as C homozygotes who did not meet Criterion D ($M = 5.9$, $SD = 3.2$, $p = .36$). Neither Criterion B ($p = .79$) nor C ($p = .58$) significantly interacted with *SNCA* in relation to AUDIT scores.

3.3. Alcohol-Related Aggression Expectancies

PTSD symptomatology ($F_{(1,134)} = 10.38$, $p = .002$, $\eta_p^2 = .072$) and *SNCA* ($F_{(1,134)} = 13.95$, $p = .0003$, $\eta_p^2 = .094$) were both related to AEQ Aggression and Power scores: Participants with probable PTSD ($M = 3.1$, $SD = 1.9$) displayed higher AEQ Aggression and Power scores than participants without probable PTSD ($M = 1.9$, $SD = 1.5$, $d = .78$), and T-allele carriers ($M = 2.6$, $SD = 1.7$) displayed higher AEQ Aggression and Power scores than C homozygotes ($M = 1.6$, $SD = 1.3$, $d = .67$). However, the interaction of PTSD symptomatology and *SNCA* on AEQ Aggression and Power scores did not reach significance ($p = .12$). Therefore, no follow-up PTSD criterion analyses were conducted in regard to alcohol-related aggression expectancies.

3.4. History of Aggression

PTSD symptomatology ($F_{(1,134)} = 5.38$, $p = .022$, $\eta_p^2 = .039$) was related to LHA Aggression scores: Participants with probable PTSD ($M = 13.0$, $SD = 4.9$) displayed higher LHA Aggression scores than participants without probable PTSD ($M = 9.9$, $SD = 4.6$, $d = .67$). However, *SNCA* was not related to LHA Aggression scores ($p = .96$), and the interaction of PTSD symptomatology and *SNCA* on LHA Aggression scores did not reach significance ($p = .63$). Therefore, no follow-up PTSD criterion analyses were conducted in regard to aggression.

3.5 Supplemental Analyses

Although we chose to conduct primary analyses using ANOVA models with probable PTSD status as a predictor (for ease of interpretation and to be consistent with traditional categorical conceptualizations of PTSD[2,50]), taxometric studies have consistently revealed that the PTSD construct is optimally represented through the use of continuous (or dimensional) measures.[55–57] Therefore, we decided to conduct supplemental moderated regression analyses instead using PTSD severity (PCL-C Total Scale score) as a predictor. Because sex (female coded as 0; male coded as 1) was significantly correlated with PTSD severity ($r = .21$, $p = .013$) and AEQ Aggression and Power scores ($p = .046$, $r_{pb} = -.17$), we also reran regression analyses controlling for gender. These moderated regression analyses were conducted with PROCESS for SPSS Version 2.13[58].

Results are reported as standardized regression coefficients (βs).

Moderated regression analyses revealed that the association between *SNCA* and AUDIT scores was significant ($\beta = .21$, $p = .014$), whereas the association between PTSD severity and AUDIT scores was not significant ($p = .89$). Moderated regression analyses also

revealed that the interaction of PTSD severity and *SNCA* on AUDIT scores was significant (β = .17, *p* = .043). Follow-up analyses indicated that neither PTSD Criterion B scores (*p* = .10) nor C scores (*p* = .16) significantly interacted with *SNCA* in relation to AUDIT scores, but the interaction of *SNCA* and Criterion D scores (increased arousal) on AUDIT scores was significant (β = .24, *p* = .007), indicating that Criterion D scores were positively associated with AUDIT scores to a greater degree in T-allele carriers relative to C homozygotes. The significance of AUDIT-related regression results was not altered by controlling for gender.

Moderated regression analyses revealed that the association between PTSD severity and AEQ Aggression and Power scores (β = .22, *p* = .007) and the association between *SNCA* and AEQ Aggression and Power scores (β = .32, *p* = .0001) were both significant; however, the interaction of *SNCA* and PTSD severity on AEQ Aggression and Power scores was not significant (*p* = .20). Therefore, no follow-up PTSD criterion score analyses were conducted in regard to AEQ Aggression and Power scores. The significance of AEQ-related regression results was not altered by controlling for gender.

Moderated regression analyses revealed that the association between PTSD severity and LHA Aggression scores was significant (β = .27, *p* = .001); however, neither the association between SNCA and LHA Aggression scores (*p* = .49) nor the interaction of PTSD severity and SNCA on LHA Aggression scores was significant (*p* = .62). Therefore, no follow-up PTSD criterion score analyses were conducted in regard to LHA Aggression scores. The significance of LHA-related regression results was not altered by controlling for gender.

In summary, rerunning analyses with a dimensional PTSD measure altered the significance of results in only one instance: Whereas probable PTSD status was significantly related to AUDIT scores, PTSD severity was not.

4. Discussion

We examined whether an α-synuclein gene polymorphism (*SNCA* rs356195) moderates the association of PTSD symptomatology with externalizing behaviors (i.e., alcohol- and aggression related measures) in nonclinical participants. Probable PTSD status and *SNCA* were both associated with externalizing measures, although *SNCA* was more specific to alcohol. *SNCA* moderated the association of PTSD symptomatology with hazardous alcohol use, but not with aggression-related measures. Rerunning analyses with PTSD as a continuous measure did not substantially alter results. This is the first study to examine the potential influence of *SNCA* on the expression of externalizing behaviors in individuals with significant PTSD symptomatology.

As expected, individuals with probable PTSD reported higher levels of hazardous alcohol use than those without probable PTSD, and *SNCA* T-allele carriers reported higher levels of hazardous alcohol use than C homozygotes (small-to-medium effect sizes). There was also a significant interaction between PTSD symptomatology and *SNCA*: T-allele carriers with probable PTSD displayed higher AUDIT scores than T-allele carriers without probable PTSD (a large effect size), whereas C homozygotes with probable PTSD scored nearly the same on the AUDIT as C homozygotes without probable PTSD. Notably, the average

AUDIT score for T-allele carriers with probable PTSD (which rounded to 12) was well above the cut-off score that has been recommended as indicating harmful or hazardous alcohol use (≥ 8),[51] suggesting that the moderating effect of *SNCA* on the relationship between PTSD symptomatology and hazardous alcohol use may be clinically significant. Further analysis indicated that this moderating effect was primarily due to the interaction of *SNCA* and *DSM-IV* PTSD Criterion D (analogous to *DSM-5* PTSD Criterion E), which is related to increased arousal and reactivity.[2,50] Thus, it appears that *SNCA* T-allele carriers with PTSD may be particularly vulnerable to the development of harmful or hazardous alcohol use largely because of heightened arousal and reactivity. One potential explanation for this interaction is that variations in *SNCA* may confer risk for deficient impulse control,[42] thereby increasing the likelihood that PTSD-related arousal and reactivity result in alcohol use.

Also as expected, individuals with probable PTSD reported greater alcohol-related aggression expectancies than those without probable PTSD, and *SNCA* T-allele carriers reported greater alcohol-related aggression expectancies than C homozygotes (medium-to-large effect sizes). Hence, *SNCA* may influence the development of aggressive tendencies in the context of alcohol intoxication, which consequently may lead to greater expectations of aggressive behavior while under the influence of alcohol. In addition, individuals with probable PTSD reported a more severe history of aggression than those without probable PTSD (a medium effect size). Contrary to our hypotheses, however, *SNCA* was not related to history of aggression, and *SNCA* did not moderate the relationship between PTSD symptomatology and either of the aggression-related measures.

As stated previously, α-synuclein attenuates DA release,[30,40] and DA plays a key role in reward function.[31,32] Thus, one potential explanation for the presumed influence of *SNCA* on alcohol use and alcohol-related aggression in general is that α-synuclein may affect reward-related behaviors via regulation of DA neurotransmission.[34] Further backing this assertion, innately alcohol-preferring rats have displayed lower α-synuclein expression in the frontal cortex and caudate putamen compared to alcohol-nonpreferring rats;[59] mutant mice lacking α-synuclein have displayed increased reward-seeking behavior;[60] and human *SNCA* duplication carriers (who have enhanced levels of α-synuclein expression) have displayed impaired reward learning.[61] Although not tied to reward to the extent that addiction is, aggression in mice has been associated with DA activity in the nucleus accumbens, a region of the brain involved in the process of addiction,[62] and mice that were chronically victorious in aggressive encounters have displayed increased α-synuclein expression in the ventral tegmental area, a region of the brain involved in the process of reward.[63,64] As for *SNCA* being associated with expectations of aggression during alcohol intoxication but not aggression in general, it may be that the stimulant effects of alcohol tend to potentiate rewarding forms of aggression,[65] the susceptibility to which may be further increased by the effects of α-synuclein on DA and reward function.

In the current study, one unexpected finding was that women reported greater alcohol-related aggression expectancies than men. Notably, however, past studies that have used the AEQ Aggression and Power subscale to compare alcohol-related aggression expectancies between men and women have produced mixed results, with one study reporting that men

scored higher,[66] another study reporting no significant difference in scores,[52] and another study reporting that women scored higher.[67] Although one study that differed from the current study used a sample that was 45% Black[66] (compared to 0% Black in the current study), the other two studies did not provide data regarding race, making it difficult to speculate if differences in sample composition might account for these discrepancies.

This study has several limitations worth noting. First, the current study is limited by its cross-sectional design. Although we conceived of PTSD symptomatology as likely preceding and contributing to hazardous alcohol use via symptoms of hyperarousal and hyperreactivity, it is instead possible that chronically excessive alcohol use led to hyperarousal as a result of alcohol-induced changes in central and peripheral stress pathways.[68] Another concern is that the majority of participants with probable PTSD were women, which may have confounded PTSD-related results. However, past research has indicated that PTSD is more prevalent in women than in men;[4] of the three criterion variables studied, gender was only correlated with alcohol-related aggression expectancies; and the significance of supplemental regression analyses was not altered by controlling for gender. The inclusion of only European Americans limits the ability to generalize results to other racial/ethnic groups (though this was done to minimize the potentially confounding effects of population stratification). Another limitation is that we only tested one SNP of *SNCA* (rs356195) using a single model of genetic inheritance (the dominant model) because of sample/group size considerations. We also administered self-report measures of PTSD symptoms and alcohol use to nonclinical participants and did not formally diagnose PTSD or alcohol use disorder and further did not include biological markers of alcohol use. Lastly, we speculated that α-synuclein may affect alcohol use and alcohol-related aggression through its effect on DA neurotransmission and reward function; however, the current study did not include measures related to α-synuclein expression, DA activity, or reward. Therefore, future studies would benefit from utilizing longitudinal designs, including individuals from various racial/ethnic backgrounds, genotyping multiple SNPs of *SNCA*, using samples large enough to test for multiple models of genetic inheritance, using clinical interviews to diagnose PTSD and alcohol use disorder (perhaps as part of a case-control design), measuring blood α-synuclein levels and biological markers of alcohol consumption, using functional brain imaging techniques, and including measures related to reward (e.g., anhedonia and reward responsiveness).

5. Conclusion

Past and present research indicates that PTSD and *SNCA* influence alcohol use. The current study extends past research by reporting a relationship between *SNCA* and alcohol-related aggression expectancies. It also extends past research by reporting that the association between PTSD symptomatology and hazardous alcohol use is moderated by genotypic variation in *SNCA*. Although preliminary, current findings suggest that variations in *SNCA* may increase the likelihood that PTSD symptomatology results in excessive alcohol use.

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Highlights

- We genotyped the polymorphism SNCA rs356195 in 138 European Americans (EAs).
- EAs reported their alcohol use, alcohol-aggression expectancies, and aggression.
- We also diagnosed probable PTSD based on participant self-report.
- *SNCA* moderated the association of PTSD symptomatology with hazardous alcohol use.
- Variations in *SNCA* may increase risk of PTSD-related excessive drinking.

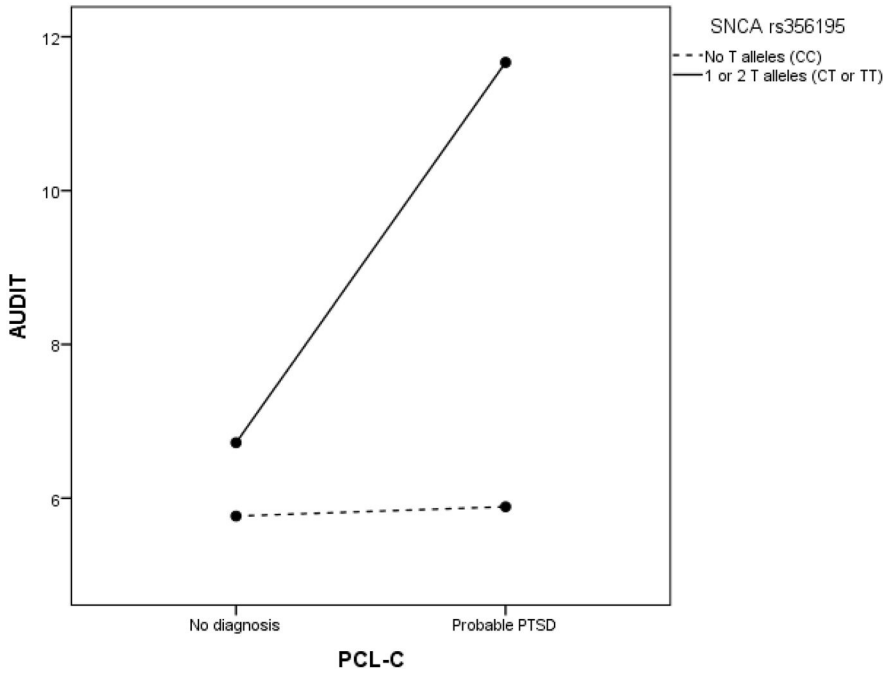

Fig. 1.

PTSD and *SNCA* interaction effects on hazardous alcohol use levels. AUDIT = Alcohol Use Disorders Identification Test; PCL-C = PTSD Checklist Civilian Version.

Table 1

Descriptive Statistics and Cronbach's Alphas for Self-Report Measures

	M (*SD*)	Cronbach's α
PCL-C Criterion B subscale	8.3 (4.0)	.89
PCL-C Criterion C subscale	12.7 (5.0)	.81
PCL-C Criterion D subscale	7.7 (3.4)	.82
PCL-C Total Scale	28.7 (11.3)	.93
AUDIT	6.4 (3.5)	.67
AEQ Aggression and Power subscale	2.1 (1.5)	.58
LHA Aggression subscale	10.2 (4.7)	.77

Note. PCL-C = PTSD Checklist Civilian Version; AUDIT = Alcohol Use Disorders Identification Test; AEQ = Alcohol Effects Questionnaire; LHA = Life History of Aggression.