



Unpacking Social Avoidance and Substance Use in Social Anxiety: Does Extraversion Explain Behavior Variability?

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Abstract

Social anxiety is characterized by heightened fear and anxiety associated with social situations, resulting in the use of avoidance behaviors. Contemporary models suggest that some individuals with social anxiety may choose to completely avoid social situations, while others may seek social connections and interactions and utilize avoidance behaviors such as substance use as a means of distress tolerance, while engaging in these situations. Our aim is to test a theoretical model whereby extraversion could help to explain the heterogeneous nature of social anxiety in relation to these behaviors. Lower levels of extraversion have been commonly associated with withdrawal behaviors and higher levels of extraversion have been associated with behaviors commonly enacted in social situations. Understanding factors which predict the use of one behavior over another is imperative to the conceptualization and successful treatment of patients with social anxiety. A sample of 195 college students completed self-report measures and a 10-day experience sampling diary with five diary signals each day. Participants were asked to rate their current negative emotions and behaviors during each diary signal. Using a multilevel modeling approach, we tested the association between social anxiety symptoms and negative affect predicting engagement in substance use or social avoidance and tested whether extraversion moderated this association. Negative affect was included as a covariate given the established associations between elevations in negative affect predicting both behaviors. Results indicated that higher levels of social anxiety symptoms and negative affectivity increased the probability of social avoidance and substance use, and extraversion was a significant predictor for only substance use. Moderation analysis indicated that extraversion moderated the relationship between social anxiety and substance use, suggesting a stronger positive relationship between substance use and social anxiety for individuals higher in extraversion. However, extraversion was not a significant moderator between social anxiety and social avoidance. Overall, the findings suggest that extraversion could be a key factor predicting the use of substances amongst individuals with social anxiety and may need further consideration in treatment.

Keywords Social avoidance · Substance use · Social anxiety · Extraversion · Experience sampling

Social anxiety is characterized by a marked fear and anxiety of negative evaluation in social situations (APA 2013; Rapee 1995). This fear is problematic because individuals with social anxiety have a general desire to form and develop relationships, yet this fear often motivates individuals to avoid social interactions altogether to escape possible negative outcomes (Clark and Wells 1995; Rapee and Heimberg 1997; Heimberg et al. 2010). The extant literature on social anxiety disorder has revealed that “avoidance” in this disorder manifests in a

variety of ways, most notably in behaviors that facilitate actual removal of the self from proximity to others (social avoidance) as well as behaviors that facilitate distress-tolerance when the self is still in the presence of others (e.g., substance use; Carrigan and Randall 2003). Indeed, elevations in negative affect are associated with increased use of both types of avoidance behaviors, (Rapee and Heimberg 1997; Clark and Wells 1995) however, what is unclear is the understanding of why one individual chooses to avoid social situations and why another individual may choose to attend social situations. Contemporary views of social anxiety suggest (Kashdan et al. 2008; Kashdan and Hofmann 2008) that variability in factors associated with a drive to seek social interactions might help elucidate our understanding. Specifically, one factor worth consideration is extraversion, a dispositional trait representing a strong tendency to seek social rewards

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(McCrae and Costa 1997; McCrae and John 1992). Lower levels of extraversion might account for behaviors associated with complete avoidance of a social situation and higher levels of extraversion might account for behaviors commonly enacted in the presence of others. Understanding variability among individuals with social anxiety may shed some light on distinct subgroups and assist with tailoring treatments.

The traditional assumption has largely been that socially anxious individuals are low in extraversion and sociability (Kotov et al. 2010; Watson et al. 1988; Brown et al. 2007; Gainey-Naragon et al. 2014; Watson et al. 2005), and utilize avoidance behaviors resulting in the removal from social situations (Rapee and Heimberg 1997; Clark and Wells 1995). However, considerable theory and research suggests this may not always be the case (Nikitin and Freund 2015; Kashdan and Hofmann 2008; Nicholls et al. 2014). Current views suggest that although individuals with social anxiety may be more inclined to withdraw or avoid social situations, there are individuals with social anxiety who desire to be social, and utilize behaviors (e.g., substance use) to manage discomfort while engaging in social situations (Kashdan et al. 2008; Nicholls et al. 2014). Given, the current study sought to explore processes that underlie why an individual might choose behaviors consistent with avoidance or withdrawal of a social situation (social avoidance) or behaviors more consistent with engagement in a social situation (substance use) by examining the relationship among negative affective experiences, social anxiety symptoms and personality factors (extraversion). We applied experience sampling methods to capture within-person and between-person variability in key variables, as well as reduce retrospective bias in responses, by capturing the enactment of behaviors as they manifest in daily life, in a sample of college students, where increased social pressures could facilitate both increases in social anxiety and the use of both behaviors.

Avoidance Behaviors in Social Anxiety

Social avoidance is characterized by withdrawal or complete avoidance of a social situation (e.g., staying home instead of attending a social event) (Rapee and Heimberg 1997). Theory argues that social avoidance is a means of regulating negative emotions by decreasing the likelihood of a negative outcome or reducing anticipatory distress associated with a social context (Lovibond et al. 2008; Stevens et al. 2014). For example, individuals with social anxiety experience worry before a social event. To manage their discomfort, they often choose to avoid the social situation by staying home. The subsequent feeling of relief serves to maintain the use of social avoidance by reinforcing the belief of a potential negative outcome and emphasizing the comfort associated with staying home.

Although social avoidance could serve as a viable strategy for some circumstances, many social situations are unavoidable, even for individuals with social anxiety. Moreover, some individuals with social anxiety might also seek social interactions. Hence, when placed in social situations, individuals with social anxiety often use in-situation avoidance behaviors (e.g., substance use, avoiding eye contact; using a cell phone; talking to specific individuals) to attenuate distress (Wells et al. 1995; Kashdan et al. 2008; Piccirillo et al. 2016; Clark and Wells 1995; Stevens et al. 2014). Substance use has been the most commonly examined in-situation avoidance behavior associated with social anxiety, (Carrigan and Randall 2003; Kushner et al. 1990; Buckner et al. 2013) with commonly examined substances including alcohol and cannabis (Buckner et al. 2008; Grant et al. 2005; Agosti et al. 2002). The use of substances provides the sensation of safety through a reduction in negative emotions as well as the dampening of physiological responses associated with heightened anxiety or discomfort (Buckner and Heimberg 2010). Additionally, extant research has established high comorbidity rates between social anxiety disorder and alcohol and cannabis use disorders (Kessler and Berglund 2005; Buckner et al. 2008), supporting the hypothesis that individuals with social anxiety disorder use substances to manage discomfort, thereby increasing risk for addiction.

Indeed, dominant theories of social anxiety posit that elevations in negative affect are associated with an increased use of *both* avoidance behaviors (Rapee and Heimberg 1997; Clark and Wells 1995). Empirical evidence from laboratory and experience sampling studies suggest that trait and state negative affect precede and predict the use of substance use (Clark and Wells 1995; Simons et al. 2005a; Cooper et al. 1995; Weiss et al. 2015) and social avoidance (Hayes et al. 1996; Clark and Wells 1995; Kashdan et al. 2014). The use of these behaviors, to down-regulate negative affect, provides short-term relief and thus reinforces the use of the behavior in the future. Given, it is clear that negative affective experiences are central to enactment of avoidance behaviors and maintenance of disease. Yet, what is still unclear are dispositional factors which might predict why an individual with social anxiety may opt to either completely avoid a social situation or opt to attend and use in-situation avoidance behaviors to manage their discomfort in the moment. One factor associated with social anxiety which could drive this behavioral enactment is the personality dimension of extraversion.

Extraversion as a Moderating Factor Influencing Behavioral Choice

Extraversion is defined as a relatively enduring trait that is predictive of the consistent drive to engage in social action (McCrae and Costa 1987; McCrae and John 1992). Traits such as sociability, excitability and assertiveness are frequently used to

describe individuals who are characterized as extroverts (McCrae and Costa 1987). Interestingly, variability in extraversion has been associated with different behaviors (McCabe and Fleeson 2012; Nikitin and Freund 2015). Specifically, lower levels of extraversion have been associated with avoidance or withdrawal behaviors (e.g., social avoidance) (Engeser and Langens 2010; Nikitin and Freund 2010, Study 2) and higher levels of extraversion have been associated with behaviors commonly enacted in social situations, in college samples (e.g., gambling, substance use; Acton 2003; Nikitin and Freund 2015; Engeser and Langens 2010; Knyazev 2004; Walton and Roberts 2004). Thus, it may be that individuals with heightened social anxiety and extraversion may be more likely to engage in social activities to accommodate their need for sociability, compared to individuals with heightened social anxiety and low extraversion.

In a study examining the association between personality characteristics and social outcomes in young adults, results suggest that social avoidance motives (characterized as a need to avoid negative social outcomes) were indeed associated with lower levels of extraversion and social approach motives (characterized as a dispositional drive to seek social relationships) were associated with higher levels of extraversion (Nikitin and Freund 2015). These findings suggest that dispositional drives to seek social connection might assist in our understanding of why individuals with social anxiety may utilize different avoidance behaviors. Furthermore, empirical evidence examining dispositional tendencies within a sample of socially anxious individuals, suggests there might be distinct subtypes or subsets of individuals with social anxiety. These subtypes distinguish between individuals who may use substances to facilitate social behaviors or individuals who use social avoidance to manage their symptoms (Tillfors et al. 2013; Kashdan et al. 2008; Kashdan and Hofmann 2008; Nicholls et al. 2014). Findings from Kashdan et al. (2008) indicate multiple subsets of individuals with social anxiety. Their findings suggest the following subtypes: 1) low anxiety and low avoidance and approach oriented behaviors 2) moderate social anxiety and high approach oriented behaviors associated with increased social activity and 3) moderate social anxiety and high avoidance of social situations. Specifically, this research suggests heterogeneity among individuals with social anxiety. Taken together we were interested in examining the underlying factors which might drive the use of substance use and social avoidance in college students to better understand the heterogeneity of social anxiety and the associated avoidance behaviors. Social anxiety is a prevalent disorder associated with several consequences. Indeed, avoidance behaviors have been shown to assist in the maintenance of disease, however what is still unclear are why some individuals choose one avoidance behavior over another. Understanding the heterogeneity within social anxiety and the variability may assist in facilitating tailored treatments focused on specific behavioral interventions, as well as improve assessment for patients at risk.

Current Investigation

The current study sought to investigate factors which might predict engagement in social avoidance and substance use, in daily life in a sample of college students reporting higher than average symptoms of social anxiety. College is a critical developmental period for adolescents with high rates of first-time diagnosis of psychopathology, where approximately 75% of individuals experience their first onset before the age of 25 (Kessler et al. 2007; Pedrelli et al. 2015), and prevalence rates of up to 9.0% for social anxiety in college aged samples (e.g., 18–29 years old; Kessler and Berglund 2005). Traditional college experiences are accompanied with elevated stressors and thus college students may begin to rely on maladaptive behaviors, to mitigate the emotional and cognitive discomforts, resulting in the development of problematic habits (Clark 2001; Wells et al. 1995).

We examined social anxiety as it relates to substance use and social avoidance in daily life for 10 days using experience sampling methods and tested whether extraversion moderated specific behavioral choices. Because research has also clearly established a relationship between negative emotion and social avoidance and substance use (Clark and Wells 1995; Hayes et al. 1996; Simons et al. 2005b; Cooper et al. 1995), we also accounted for emotion factors that could drive either behavior. Specifically, we examined negative emotions at the trait and state level during experience sampling. Mean negative emotions across the diary, or negative affectivity, is strongly aligned with neuroticism (Watson and Clark 1984; Myers et al. 2003), increased social anxiety symptoms (Watson et al. 1988; Myers et al. 2003) and related behaviors (Kotov et al. 2010). In addition, state level deviations in negative emotion are theorized to drive both social avoidance and substance use behaviors (Watson et al. 1988; Simons et al. 2005a, 2005b). Based on previous research, it was hypothesized that individuals with higher levels of social anxiety symptoms and elevations in negative affect would be likely to engage in both substance use and social avoidance behaviors. Importantly, we hypothesized that extraversion would moderate this association, such that higher levels of extraversion will be contributing to a stronger relationship between social anxiety and substance use, and lower levels of extraversion will contribute to a stronger relationship between social anxiety and social avoidance.

Method

Participants

Two-hundred and sixteen, Native English speakers (76.9% female, 78.7% Caucasian, mean age = 20.07) were recruited through the psychology department subject pool at Kent State University (see Table 1 for a summary of demographic

Table 1 Demographic characteristics of study participants ($n = 195$)

Demographic Characteristics		
	M	SD
Age	20.05	2.38
	N	%
Sex		
Female	154	79
Male	41	21
Race		
White/European	158	81.0
Black/African	19	9.7
Asian	5	2.6
American Indian/Alaska Native	1	0.5
Biracial/Multiracial	10	5.1
Other	2	1.0
Ethnicity		
Non-Hispanic or Latino	187	95.9%
Hispanic or Latino	8	4.1%
Undergraduate Status		
Freshman	69	35.4
Sophomore	42	21.5
Junior	48	24.6
Senior	35	17.9
	M	SD
LSAS	50.88	25.77
Extraversion	3.18	0.79
Mean Negative Affect	4.40	14.08

information of this sample). Participants consisted of college students 18 years of age and older ($M = 20.07$, $SD = 2.36$). However, data from $n = 21$ ¹ participants were invalid, resulting in a final sample of $n = 195$. Utilizing independent samples *t*-tests, no significant differences emerged between participants who were included versus excluded in the final analysis on key demographic and theoretical variables (age, sex, race, social anxiety symptoms, substance use, social avoidance, affect). Participants were compensated with course credit.

Procedure

All individuals who responded to recruitment materials were prompted to an online survey platform and provided with an informed consent form. Following consent, participants

¹ $n = 13$ participants were excluded due to insufficient diary data only; $n = 4$ were excluded due to failure to adequately complete accuracy checks only, however, $n = 7$ participants were excluded due to insufficient diary data and failure to adequately complete accuracy checks; $n = 4$ were excluded due to insufficient responding and completion of questionnaires (LSAS and extraversion scale). Therefore, a total of 21 participants were excluded from final analysis, resulting in a final sample of 195 participants.

completed a demographics questionnaire, the Liebowitz Social Anxiety Scale and the Big Five Inventory extraversion subscale. Additional questionnaires were administered, unrelated to the current study. Following completion of the questionnaires, participants were instructed to complete a 10-day experience sampling diary. Participants were prompted to complete a diary entry, five times a day, for 10 consecutive days. Based on a pseudorandom schedule, diary prompts were scheduled during a 12-h time frame, with one diary scheduled between each of the following time frames: 9 am–12 pm, 11 am–2 pm, 1 pm–4 pm, 4 pm–7 pm, and 6 pm–9 pm. Each diary prompt was scheduled at least 30 min apart, with a maximum gap of 5 h between each diary prompt. Participants were able to complete up to 50 total diary entries during the 10-day period. Participants could delay responding to each diary prompt for up to 2 h if they were otherwise occupied (e.g., attending class). Each diary entry expired two hours after participants received the prompt. After completion of the experience sampling diary, participants were debriefed and compensated with course credit. All parts of the study were approved by the Kent State University IRB prior to data collection.

Measures

Social Anxiety The Liebowitz Social Anxiety Scale – Self Report Version (LSAS; Fresco et al. 2001) was used to index social anxiety symptoms. The LSAS consists of 24 items assessing fear/anxiety and avoidance in 11 social interaction situations (e.g., talking to people in authority) and 13 performance-based situations (e.g., taking a test). Using a 4-point Likert style scale (ranging from 0 to 3), participants rated their fear/anxiety and avoidance for each item. Social anxiety symptoms were indexed by summing fear and avoidance ratings together, for all items. The current sample's mean ($M = 50.88$) and standard deviation ($SD = 25.77$) was higher compared to other college samples (e.g., $M = 34.70$, $SD = 20.40$; Russell and Shaw 2009). However, it was just below clinical cutoffs for moderate social phobia (55 or higher) (Liebowitz 1987). Internal consistency in this sample was excellent ($\alpha = .94$).

Extraversion Extraversion was measured using an 8-item subscale from the Big Five Inventory (BFI; John et al. 1991). Participants rated the extent to which they agreed or disagreed with each item (e.g., is talkative) on a 5-point Likert scale (1 = disagree strongly, and 5 = agree strongly). The mean and standard deviation for this sample ($M = 3.18$, $SD = 0.79$) was comparable to other similarly aged college samples (John and Srivastava 1999). Additionally, the internal consistency for the extraversion subscale was good ($\alpha = .84$).

Experience Sampling Diary

A 10-day experience-sampling diary was used to measure current emotional experiences and the frequency of substance use and social avoidance behaviors. Additional behaviors (e.g., exercise) and constructs (e.g., rumination) were measured as part of the parent project but were unrelated to this investigation resulting in a total of 6 additional total questions. Experience-sampling data was collected using *Qualtrics*, a secure online survey platform (Qualtrics, Provo, UT; www.qualtrics.com). Diary entries could be completed using a computer, smartphone, or another electronic device and took approximately 3–5 min to complete. Diary compliance (i.e., percentage of completed diaries) was 60%, with participants completing a mean of 30.22 ($SD = 13.51$) diaries. Following standard experience sampling conventions, participants whose mean diary compliance was two standard deviations below the mean were excluded ($n = 10$; Bolger et al. 2003).

Current Self-Reported Emotion During each diary prompt, participants reported their current emotional state by rating on a Likert scale, the magnitude to which they currently felt on 26 emotion words, including six negative emotion words (fear, sadness, distress, guilt, anger, disgust) used to index negative affect. The order of presentation of emotion words was randomized within each diary prompt. Two negative affect scores were derived for each participant. A mean negative affect score was derived for each participant across the sampling period to index trait negative affectivity, by averaging ratings across each of the six negative emotion words ($M = 4.40$, $SD = 14.08$). Additionally, to understand within-person variability or state deviations in negative affect in the moment, a person-centered negative affect score was also derived by subtracting each participant's mean negative affect score from their negative affect rating, for each diary prompt. Using procedures outlined by Cranford et al. (Cranford et al. 2006; see also Shrout and Lane 2012) the affect rating scales' between-person reliability (R_{kf} , estimating measurement precision for between-person differences across days between) and within-person reliability (R_c , estimating measurement precision for within-person changes from day to day) were computed, indicating good reliability ($R_{kf} = 0.92$; $R_c = 0.94$).

Reported Behaviors During each diary prompt, participants were provided with a randomized list of twenty-three behaviors. Behaviors used for the current study included: social avoidance and substance use. Participants were asked “please indicate whether you performed any of the following actions or behaviors since the last diary response” on a three-point scale “yes”, and “no” and “no, but I thought about it a lot/had a strong urge. No responses were combined, resulting in a dichotomous indicator at each diary signal for each behavior. To ensure consistent

responding across participants, each behavior was supported with a brief description. The description provided for social avoidance stated, “this refers to avoiding social activities that involve in-person contact with friends or others and/or engaging in solitary activities” and the description for substance use stated “this refers to stimulants and/or intoxicating substances or drugs including alcohol.” Behaviors assessed for this study included only “yes” responses for social avoidance and substance use. Descriptively we examined the rate of occurrence for each behavior, a proportion score was calculated by dividing the number of “yes” responses by the total number of diaries completed, for each participant. The mean rate of engaging in substance use for this sample was $M = 0.07$ ($SD = 0.12$), and the mean rate of engaging in social avoidance was $M = 0.05$ ($SD = 0.08$). However, in our analysis we were only interested in the signal-level, or momentary, report of the presence or absence of a given behavior.

Accuracy Checks Similar to previous online experience sampling studies, accuracy checks were embedded into each diary prompt to measure participant engagement (Gilman et al. 2017). Accuracy check questions were placed throughout the diary and prompted participants to respond in a specific manner. For example, participants were asked to “Please type in the number 7” and “Please mark ‘yes.’” Accuracy checks were randomized within each diary to adequately measure participant engagement. The frequency of missed accuracy checks was calculated by dividing the number of failed accuracy checks by diaries completed ($M = 0.04$, $SD = 0.14$). Participants were excluded if the number of failed accuracy checks were more than 2 standard deviations above the sample's mean frequency of missed accuracy checks (.31 or higher). Seven participants were excluded from analysis due to a failure to adequately complete accuracy checks.

Results

Data Analytic Strategy

Due to the multilevel structure of the data (signals nested within individuals) and dichotomous nature of the dependent variables (yes/no responses), the *ProcGLIMMIX* procedure (SAS, 9.4) with a lagged framework was identified as an appropriate procedure to examine the study aims (Bolger and Laurenceau 2013). A lagged framework was employed to account for negative emotion ratings from the previous diary predicting engagement in social avoidance and substance use in the next diary signal. We take this approach so as to be able to account for momentary or state fluctuations in negative emotion which have been shown to predict both substance use and social avoidance. Further, to account for over-dispersion and count data associated with responses of substance use and social avoidance, a

negative binomial distribution was employed, assuming variability among participants with the same predicted score for social avoidance and substance use behaviors (Atkins et al. 2013; Coxé et al. 2009). Together, this approach was used to examine the role of social anxiety symptoms (*LSAS*), between-person negative affect, or negative affectivity (*MeanNA*), and extraversion (*Extraversion*) when predicting social avoidance (*NextSocial*) or substance use (*NextSubstance*), while also considering the role of moment level negative affect (*PCNA*). Sex was included as a covariate to account for gender differences associated with the frequency of engagement in substance use and social avoidance behaviors. Additionally, to account for variability in diaries completed, number of diaries was included as a covariate. The following equation was consistent for both dependent variables, social avoidance (*NextSocial*), and substance use (*NextSubstance*) when examining the role of extraversion, above and beyond the effect of negative affectivity when predicting social avoidance and substance use.

Level 1: Equations for the signal level within-person

$$\text{DependentVariable}_{ij} = \beta_{0j} + \beta_{1j}\text{PCNA} + \beta_{2j} \text{Time}_{ij} + \varepsilon_{ij}$$

In the Level 1 equations, social avoidance (*NextSocial*), or substance use (*NextSubstance*) in the next diary signal are the predicted outcomes for a person (*i*) on signal (*j*), β_{0j} is the intercept for the specific person, β_{1j} is the slope for the effect of person-centered negative affect (*PCNA*) for this person, β_{2j} is the slope for the effect of time for this person, and ε_{ij} is the residual component for this person.

In the Level 2 equations, the between-person effects of negative affect (*MeanNA*), extraversion and social anxiety symptoms (*LSAS*) were accounted for. The following equation was consistent for both dependent variables. Grand mean centering was employed for both extraversion and *LSAS* scores for both dependent variables, social avoidance (*NextSocial*), and substance use (*NextSubstance*).

Level 2: Equation for the person-level between-person

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\text{MeanNA} + \gamma_{02}\text{Extraversion} + \gamma_{03}\text{LSAS} + \mu_{ij}$$

$$\begin{aligned} \beta_{1j} &= \gamma_{10} + \mu_{1j} \\ \beta_{2j} &= \gamma_{20} + \mu_{2j} \\ \beta_{3j} &= \gamma_{30} + \mu_{3j} \end{aligned}$$

In this equation β_{0j} , the intercept, of person (*i*) is predicted by the average outcome, γ_{00} (fixed effects), mean negative affect (γ_{01}), extraversion (γ_{02}), social anxiety symptoms (γ_{03}) and the persons’ random effects (μ_{ij}) for social avoidance and substance use behaviors.

Finally, we tested moderation via an interaction term to examine the relationship between social anxiety symptoms (*LSAS*) and extraversion (*Extraversion*) when predicting substance use (*NextSubstance*) and social avoidance (*NextSocial*) in the next diary signal. In this equation β_{0j} , the intercept, of person (*i*) is predicted by the average outcome, γ_{00} (fixed effects), mean negative affectivity (γ_{01}), extraversion (γ_{02}), social anxiety symptoms (γ_{03}), and (γ_{04}) interaction between social anxiety (*LSAS*)* extraversion (*Extraversion*) and the persons’ random effects (μ_{ij}) for social avoidance and substance use. Dependent variables in this equation are social avoidance (*NextSocial*), or substance use (*NextSubstance*).

Level 1: Equations for the signal level within-person

$$\text{DependentVariable}_{ij} = \beta_{0j} + \beta_{1j}\text{PCNA} + \beta_{2j} \text{Time}_{ij} + \varepsilon_{ij}$$

Level 2: Equation for moderation analysis

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\text{MeanNA} + \gamma_{02}\text{Extraversion} + \gamma_{03}\text{LSAS} + \gamma_{04}\text{LSAS}$$

$$\begin{aligned} & * \text{Extraversion} + \mu_{ij} \\ \beta_{1j} &= \gamma_{10} + \mu_{1j} \\ \beta_{2j} &= \gamma_{20} + \mu_{2j} \\ \beta_{3j} &= \gamma_{30} + \mu_{3j} \\ \beta_{4j} &= \gamma_{40} + \mu_{4j} \end{aligned}$$

Preliminary Analysis

Bivariate correlation analysis of all variables of interest (including mean negative affect, social anxiety symptoms (*LSAS*), extraversion, frequency of engaging in substance use and frequency of engaging in social avoidance) were conducted (Table 2). Results yielded a significant positive association between the frequency of engaging in social

Table 2 Summary of bivariate correlations for key variables

Variables	1	2	3	4	5
1. Mean Negative Affect	–				
2. Extraversion	-.086	–			
3. Social Anxiety Symptoms	.188*	-.435*	–		
4. Frequency of Substance Use	.009	-.022	.020	–	
5. Frequency of Social Avoidance	.290*	-.108	.195*	-.068	–

**p* < .01

avoidance and social anxiety symptoms, $r = 0.19, p < 0.01$ and mean negative affect, $r = 0.29, p < 0.01$. Results also indicated a positive association between social anxiety symptoms and mean negative affect, $r = 0.19, p < 0.01$ and an inverse association between social anxiety symptoms and extraversion, $r = -0.44, p < 0.01$. There were no other significant findings.

Main Analysis

Using a lagged framework and *ProcGLIMMIX* procedure, we first analyzed the influence of social anxiety symptoms, extraversion and negative affect predicting the probability of social avoidance in the next diary signal while controlling for sex and number of diaries completed (Table 3). As predicted, the results indicated that higher levels of social anxiety symptoms increased the probability of social avoidance ($B = 0.02, SE = 0.01, p = 0.02$). Results also indicated that elevated mean negative affect across the diary increased the probability of social avoidance ($B = 0.11, SE = 0.02, p < 0.01$). Surprisingly, there was no effect of extraversion and moment level negative affect on social avoidance. Additionally, there was no significant interaction between extraversion and social anxiety symptoms with social avoidance, therefore

suggesting that individuals with elevated levels of social anxiety symptoms and mean negative affect were more likely to engage in social avoidance, with extraversion having no effect on predicting social avoidance. Examination of gender differences indicated that sex was not a significant predictor of social avoidance.

Next, using the same framework as above, we analyzed the influence of social anxiety symptoms, extraversion and negative affect predicting substance use in the next diary signal while controlling for sex and number of diaries completed (Table 3). Sex was a significant predictor of substance use ($B = -8.72, SE = 1.21, p < 0.01$), such that males reported more substance use than females. Results also indicated that sex did not moderate the effects of social anxiety and extraversion and there was no significant three-way interaction between sex, social anxiety and extraversion. As expected, higher levels of social anxiety symptoms increased the probability of substance use ($B = 0.03, SE = 0.00, p < 0.01$), this was also true for mean negative affect, where higher levels of mean negative affect, across the diary, increased the probability of substance use ($B = 0.35, SE = 0.05, p < 0.01$). Results also indicated that extraversion was relevant for predicting substance use ($B = 0.87, SE = 0.00, p < 0.01$), where increased extraversion predicted greater substance use. There was no effect of moment level negative affect.

Table 3 Parameter Estimates indicating an interaction between social anxiety and extraversion as a predictor of substance use and social avoidance

Fixed effects (intercept, slopes)	Estimate (SE)	t-value	p value	CI ₉₅	
				Lower	Upper
Social anxiety and extraversion interaction predicting social avoidance					
Intercept	-3.64 (0.33)	-11.00	<.0001	-4.29	-2.99
Sex	-0.28 (0.54)	-0.53	0.60	-1.34	0.77
Total Diaries	0.01 (0.01)	1.57	0.12	-0.004	0.03
Momentary negative affect	0.003 (0.002)	1.05	0.30	-0.002	0.01
Mean negative affectivity	0.11 (0.02)	5.90	<.0001	0.07	0.15
Extraversion	0.32 (0.29)	1.11	0.27	-0.25	0.90
LSAS	0.02 (0.01)	2.29	0.023	0.003	0.04
Extraversion * LSAS	-0.01 (0.01)	-0.62	0.538	-0.03	0.01
Signal (time)	-0.05 (0.07)	-0.64	0.519	-0.20	0.10
Social anxiety and extraversion interaction predicting substance use					
Intercept	-16.31 (1.81)	-9.00	<.0001	-19.89	-12.71
Sex	-8.720 (1.21)	-7.18	<.0001	-11.12	-6.32
Total Diaries	0.349 (0.04)	9.60	<.0001	0.28	0.42
Momentary negative affect	0.000 (0.001)	0.08	0.933	-0.01	0.01
Mean negative affectivity	0.218 (0.03)	6.69	<.0001	0.15	0.28
Extraversion	0.912 (0.00)	Inf	<.0001	-	-
LSAS	0.08 (0.00)	Inf	<.0001	-	-
Extraversion * LSAS	0.08 (0.04)	2.14	0.032	0.01	0.14
Signal (time)	-0.15 (0.24)	-0.64	0.525	-0.62	0.31

Moderation analysis indicated that there was a significant interaction between extraversion and social anxiety symptoms ($B = 0.08$, $SE = 0.04$, $p = 0.03$).² To represent the possible effects of this interaction between extraversion and social anxiety symptoms, we plotted participants reported substance use behaviors in four possible quadrants (± 1 SD of extraversion and LSAS scores) (see Fig. 1) based on conventions outlined by Bolger and Laurenceau (2013). As expected, examination of descriptive statistics for the interaction plots revealed that individuals higher in extraversion and higher in social anxiety symptoms reported using substances more frequently ($M = 0.10$, $SD = .08$), followed by participants lower in social anxiety symptoms and higher in extraversion ($M = 0.08$, $SD = 0.11$), followed by participants low in extraversion and high in social anxiety symptoms ($M = 0.06$, $SD = 0.09$), with individuals low in extraversion and social anxiety symptoms using the least ($M = 0.05$, $SD = 0.07$). Post-hoc tests of the interaction revealed a significant difference between individuals higher in extraversion (1 standard deviation above the mean) and individuals lower on extraversion (1 standard deviation below the mean), where individuals higher in extraversion were more likely to endorse using substances compared to individuals lower in extraversion ($t(113) = 2.87$, $p = 0.01$).

Discussion

Avoidance behaviors are central to the maintenance of social anxiety (Clark and Wells 1995). Thus, it is important to understand factors which might predict why some individuals engage in one avoidance behavior over the other. The current study sought to fill this gap in the literature by examining the association between social anxiety and substance use and social avoidance in college students, while considering the moderating role of the personality trait of extraversion. First we tested the association between social anxiety, affect and both behaviors. Results indicated that higher levels of social anxiety and elevated mean negative affect, or negative affectivity, increased the probability of both social avoidance and substance use in participant reports over ten days of experience sampling. Next, we tested the moderating role of extraversion. Results indicated that extraversion did moderate the association between social anxiety and substance use, suggesting that individuals higher in extraversion with higher levels of social anxiety were most likely to engage in substance use when assessed in daily life. However, there was no significant moderation by extraversion on the association between social

anxiety and social avoidance. Overall, the present findings increase our understanding of avoidance behaviors in social anxiety and shed important light on the personality and affective processes that drive behavioral selection in social anxious individuals, with clear implications for treatment.

Overall, our findings are highly consistent with new research suggesting that social anxiety could be characterized as two distinct subtypes, an avoidance subtype or an impulsive/approach oriented subtype (Tillfors et al. 2013; Kashdan et al. 2008; Kashdan and Hofmann 2008; Nicholls et al. 2014). In particular, our findings indicate clearly that for socially anxious individuals lower in extraversion, social anxiety is the primary driver of social avoidance in daily life, regardless of the level of extraversion. However, for individuals higher in extraversion, social anxiety is more likely to predict greater substance use. This fits well into contemporary models of social anxiety and may be driven also by variable appraisals of social contexts. For example, when examining the role of moderate social anxiety associated with avoidance and risk-taking behaviors in college students, Kashdan et al. (2008) found two distinct groups unique on appraisal patterns. Specifically, they found an avoidance oriented group associated with increased threat appraisals and an increased report of likelihood to engage in risk-averse behaviors (e.g., stay home), and an approach oriented group associated with increased social enhancement appraisals and an increased report of likelihood to engage in social and risky behaviors (e.g., substance use). Moreover, their findings also indicated that the approach-oriented group was more likely to engage in social activity compared to the avoidance group, which may be accounted for by the contrasting appraisals of social contexts. These findings suggest that specific appraisals of social situations might contribute to behavioral variability, such that individuals with social anxiety in the approach oriented group may be more likely to seek out social interactions (similar to individuals higher on extraversion) compared to those in the avoidance orientation group. Thus, factors influencing appraisals, such as personality characteristics, may account for specific subtypes within social anxiety and should continue to be explored to better understand this important clinical phenomena.

Our findings also may have important clinical implications. Established treatments of social anxiety do not account for personality characteristics or affect as factors associated with avoidance behaviors. However, there has been an increase in calls to incorporate personality and affect into models of disease and treatment (Spinoven et al. 2014; Kotov et al. 2017). Overall, the findings of this study suggest that in the context of social anxiety, extraversion could be an important factor associated with understanding why individuals choose one avoidance behavior over another. Indeed, the understanding of why someone might use either substances or social avoidance could have significant implications for treatment. For example, extant research has established high comorbidity between

² We tested to examine whether the interaction effect held without the inclusion of covariates, specifically excluding mean negative affect and moment level negative affect. Results indicated that the significant interaction between social anxiety symptoms and extraversion was relatively unchanged ($B = 0.05$, $SE = 0.00$ $p < .01$).

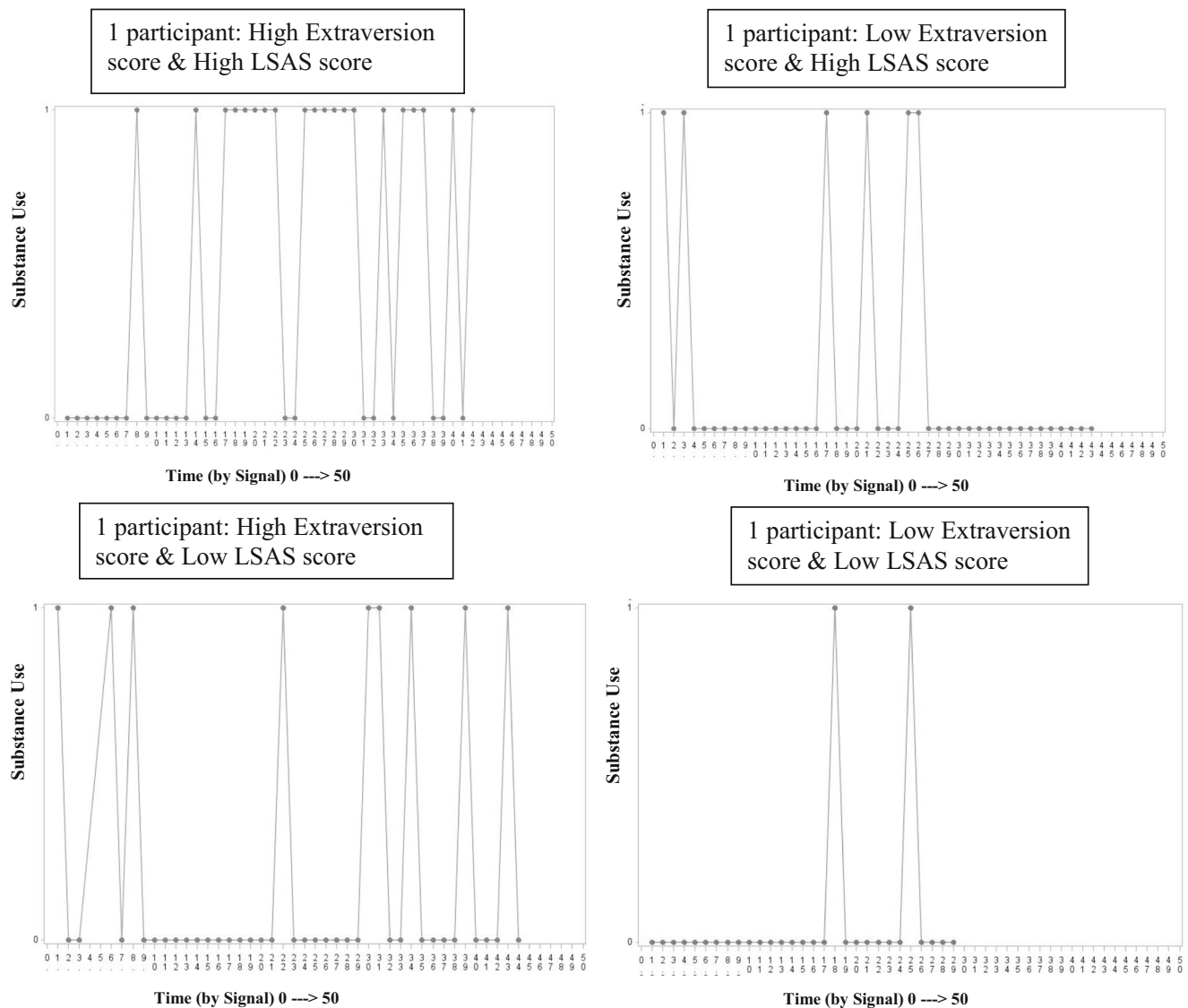


Fig. 1 Frequency of substance use by ± 1 SD of extraversion and social anxiety symptoms (LSAS). This figure depicts four prototypical participant responses across diary signals

substance use and social anxiety. Thus, by determining whether an individual is likely to use substances might assist treatment providers in developing specific exposure treatment plans focused on reducing the use of in-situation avoidance behaviors, which might assist in reducing the development of comorbid substance use disorders. Moreover, research by Kashdan and Steger (2006) has established that individuals who avoid social situations might be more likely to experience fewer positive social experiences, consequently reinforcing their negative beliefs associated with social situations and maintaining the disease. Given, it is important to determine and understand how someone might choose to use social avoidance vs substance use to reduce the maintenance of the disorder, develop individualized exposure treatments, reduce the likelihood of developing a comorbid substance use disorder and improve social experiences.

Finally, although we did find the expected positive associations between mean or trait negative affect and both behaviors, we did not find similar associations for state-level increases in negative affect. This is inconsistent with previous research indicating a relationship between moment-level or state deviations in negative affect and avoidance behaviors (Armeli et al. 2008; Machell et al. 2014). This discrepancy could be related to the timing of assessments (between 1 and 3 h apart) but also highlights the importance of measuring and understanding both state and trait variables as they relate to behavioral variability in social anxiety.

The present investigation has several limitations worth examining. First, the sample was limited to social anxiety as it manifests in college students. It is possible that the nature or frequency of avoidance behaviors is different among other

groups (i.e., community sample diagnosed with social anxiety), therefore findings should be generalized with caution. Second, participants were asked to complete diaries for only 10 consecutive days, therefore it is possible that variability in behavioral and emotional changes were not fully captured. Moreover, it is also important to consider that continuous monitoring of specific behaviors could influence participant's reported rate of substance use and social avoidance (Bolger et al. 2003). Further, here substance use was characterized as a behavior commonly enacted in social situations. However, the current study was unable to measure whether individuals who reported using substances, engaged in this behavior during social contexts or in isolation as well as the underlying motives associated with substance use (e.g., enhancement motives, drinking to cope etc). It is most likely that substance use was engaged in social contexts, given the extant literature on substance use in college students (Johnston et al. 2009, 2013; Wechsler et al. 1994; Kassel et al. 2000) with a possible motivation to manage negative affect associated with social situations (Cooper 1994; Cox and Llinger 1988; Merrill et al. 2014). However, future studies should consider measuring social context and behaviors simultaneously to better understand this relationship as well as examining the motivations associated with behavioral enactment. Moreover, the current study was limited by not examining quantity of substance intake as well as the specified substance consumed. Future studies should consider examining quantity of the substance consumed to improve our ability to differentiate between individuals who may be engaging in excessive substance use (e.g., binge drinking) vs low to moderate consumption of a substance for symptom management. Furthermore, examination of specific substances consumed may provide additional information regarding commonly consumed substances used to mitigate discomfort. These additional findings may improve our understanding of risk factors associated with increased substance use in individual with symptoms of social anxiety as well as provide insight on possible implications for future interventions. Lastly, it is important to note that only self-report measures were used to index social anxiety symptoms and extraversion. Extant literature has examined the drawbacks of using only self-report measures to index traits and symptoms, therefore it is possible that state measures embedded in the daily diaries may provide different effects, accounting for momentary changes which could influence behavior.

Despite these limitations, the current study has several strengths. First, the study design is innovative by using both trait and state measures to understand behavioral enactment. Second, experience sampling methodology increases ecological validity by reducing response biases associated with self-report measures, therefore it is likely that the frequency of reported behaviors is more accurate compared to self-report questionnaires used to assess similar behaviors as has been

shown in prior research (e.g., Buckner and Heimberg 2010; Villarosa et al. 2014). Lastly, cautionary measures were employed using accuracy checks within each daily diary to increase accurate and reliable responding (Nelson et al. 1975; Aust et al. 2013). These strengths provide further support to our findings of extraversion as a key factor predicting behavioral choice.

In summary, in the current investigation, we tested the moderating role of extraversion in momentary reports of avoidance behaviors, specifically social avoidance and substance use, during 10 days of experience sampling in college students reporting elevated levels of social anxiety. We found evidence that social anxiety and trait-levels of negative emotion predicted both behaviors. However, extraversion moderated the association between social anxiety and substance use, such that individuals high on both dimensions, social anxiety and extraversion, were the most likely to endorse substance use in daily life. Together, these findings suggest the role of personality, specifically, extraversion, in behavioral variability in socially anxious individuals and suggests new avenues for research to better understand and treat patterns of disease maintaining behaviors in social anxiety.

“All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (Kent State Institutional Review Board; Index Number: 17-029) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.”

Compliance with Ethical Standards

Conflict of Interest Aurora, P and Coifman, K. G. declare that they have no conflict of interest.

Experiment Participants All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (Kent State Institutional Review Board; Index Number: 17-029) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Research Involving Human Participants All procedures were in accordance with the ethical standards of the Kent State Institutional Review Board (Index Number: 17–029).

Informed Consent Informed consent was obtained from all individual participants included in the study.

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