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Social Anxiety and Alexithymia in Relation to Problematic Drinking and Theory of Mind

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Abstract

Cognitive models of social anxiety posit inaccurate appraisal of emotional states as a core feature. Such inaccurate appraisal also characterizes alexithymia, a trait defined by difficulties in identifying and describing emotional feelings and an externally oriented thinking style. As both social anxiety and alexithymia have been linked to alcohol misuse and deficient theory of mind, the degree to which alexithymia might account for these associations with social anxiety merits investigation. The current study explored relationships between social anxiety (specifically social interaction anxiety), alexithymia, problematic drinking, and theory of mind after controlling for comorbid depression in a non-clinical sample of 242 participants (93 males) ranging in age from 18 to 35 years ($M = 23.22$ years, $SD = 4.48$). They completed an online questionnaire battery that included well-known measures of social anxiety (Social Interaction Anxiety Scale), alexithymia (Toronto Alexithymia Scale 20), theory of mind (Reading the Mind in the Eyes Test Revised), depression (Depression Anxiety Stress Scales - Depression Scale), and problematic drinking (Alcohol Use Disorders Identification Test). In hierarchical regression models, social anxiety predicted alexithymia even after controlling for depression and demographic factors; alexithymia mediated relationships between social anxiety and both problematic drinking and deficient theory of mind. Assessment of alexithymia in those with social anxiety may potentially offer insight and directions for treatment.

Keywords: Social Anxiety, Alexithymia, Alcohol Abuse, Theory of Mind

As a group, anxiety disorders comprise the most common mental health problems (Baxter, Patton, Scott, Degenhardt, & Whiteford, 2013). Of the anxiety disorders, Social Anxiety Disorder (SAD) affects the greatest proportion of the general population and is recognized as the fourth most common psychiatric disorder worldwide (Ruscio et al., 2008). It is a chronic and pervasive disorder with an estimated lifetime prevalence of 12% (Kessler et al., 2005). SAD is characterized by intense fear and avoidance of social and performance situations that leads to clinically significant interference with an individual's life, often impacting on career and interpersonal relationships (American Psychiatric Association, 2013; Schlenker & Leary, 1982). Subclinical social anxiety is even more common and can also be highly problematic for sufferers. A large-scale German study (Fehm, Beesdo, Jacobi & Fiedler, 2008) found that subclinical social anxiety was associated with a similar pattern of disruption across diverse aspects of life to SAD, including satisfaction with familial and other social relationships, job and financial status, and satisfaction with life overall. Subclinical social anxiety is also a known risk factor for alcohol misuse in young adults (Kairouz, Kliksman, Demers & Adlaf, 2002; Schry & White, 2013; Thomas, Randall & Carrigan, 2003), presumably because alcohol acts as a "social lubricant" due to its anxiolytic and disinhibiting effects (Abrams, Kushner, Medina & Voight, 2001, 2002; Thomas et al., 2007).

A recent large-scale Norwegian twin study (Torvik et al., 2016) indicated that although genetic factors substantially influence vulnerability to SAD, experiential factors play a critical role in its manifestation. The condition thus typically develops in adolescence during a time when social and peer relationships are extremely important (Iverach & Rapee, 2014). Individuals with social anxiety can experience considerable subjective and somatic distress during social interactions, often marked by increased heart rate, sweating and trembling (Stemberger et al., 1995). Given the adverse impacts of both

clinical and subclinical social anxiety on an individual's functioning and overall quality of life, and on alcohol-related risk in young adults as described earlier, elucidation of factors likely to promote and maintain social anxiety is warranted. This is especially the case for young adults, as their pursuits of fulfilling social relationships and careers are often adversely affected by the condition (Fehm et al., 2008).

Social Anxiety and Alexithymia

Alexithymia, a term first coined by Sifneos (1973), is a subclinical personality trait (Thorberg et al., 2016a) that involves a cognitive-affective disturbance with markedly reduced symbolic thinking, limited ability in identifying and verbalizing emotions and an impoverished fantasy life. Salient features of alexithymia include poor ability to identify and describe feelings, an externally oriented thinking style and difficulties differentiating feelings and somatic sensations of emotional arousal (Nemiah, Freyberger & Sifneos, 1976). Highly alexithymic individuals are often preoccupied with external events and tend not to solicit help or comfort from others due to their interpersonal difficulties, which are often reflected in self-reports of loneliness (Qualter, Quinton, Wagner & Brown, 2009). The etiology of alexithymia is unknown; a large-scale twin study indicated low to moderate heritability (Jorgensen, Zachariae, Skytthe & Kyvik, 2007), suggesting that developmental influences such as parental neglect and inadequate parental bonding in childhood may be crucial (Aust, Alkan Härtwig, Heuser & Bajbouj, 2013; Evren et al., 2009; Thorberg et al., 2011b).

Alexithymia has been linked to a variety of psychological disorders including depression (Li, Zhang, Guo, & Zhang, 2015), anxiety (De Gucht, Fischler, & Heiser, 2004; de Timary, Luts, Hers & Luminet, Filee, 2008), obsessive-compulsive disorder (Roh, Kim, & Kim, 2011), schizophrenia (O'Driscoll, Laing, & Mason, 2014), autism spectrum disorder (Berthoz & Hill, 2005), post-traumatic stress disorder (Frewen, Dozois, Neufeld,

& Lanius, 2008), and eating disorders (Pinaquy, Chabrol, Simon, Louvet & Barbe, 2003). Approximately 28% (Cox, Swinson, Shulman, & Bourdeau, 1995) to 58% (Fukunishi et al., 1997) of patients diagnosed with SAD have been reported to be highly alexithymic. Emotion suppression has been reported to characterize both social anxiety (Spokas, Luterek, & Heimberg, 2009) and alexithymia (e.g., Swart, Kortekaas & Aleman, 2009). Difficulties identifying and communicating one's feelings can present major impediments to social interaction (Edel et al., 2010), hence trait alexithymia might promote social anxiety starting in adolescence or earlier; however, there are other plausible explanations of the relationship as well. A highly alexithymic child or adolescent is likely to have deficient social skills and suffer interpersonal difficulties due to their poor ability to interpret and appropriately respond to the emotions of others (Lyvers, McCann, Coundouris, Edwards & Thorberg, 2018; Vanheule, Desmet, Meganck & Bogaerts, 2006), which would presumably promote anxiety in social interactions. Alternatively, given that the onset of social anxiety most often occurs in early adolescence, learned avoidance of social situations that would normally aid in developing knowledge of complex emotional states could plausibly lead to poor emotion knowledge and alexithymia. As a result, socially anxious individuals may be less likely to learn about and fully understand their own emotions (O'Toole et al., 2013) as well as those of others.

Yet another possibility is that alexithymia may in some cases be a reaction to intense anxiety, as so-called secondary alexithymia (Evren & Evren, 2007; Freyberger, 1977). Freyberger distinguished between primary and secondary alexithymia. Primary alexithymia is regarded as a personality trait that is presumably genetic or biological in origin, whereas secondary alexithymia is a reaction to intense or chronic negative affect or psychological stress (Grabe et al., 2000; Summerfeldt et al., 2010). Some studies have supported this primary-secondary distinction (e.g., Dalbudak et al., 2013; Fukunishi et al.,

1997; Haviland et al., 1994), whereas others have not (Mikolajczak & Luminet, 2006). In any case, as cognitive models of social anxiety posit the perpetuating role played by inaccurate appraisals of emotional states (Clark & Wells, 1997; Wells, 1997) - which is also characteristic of alexithymia – in the present study social anxiety was anticipated to be positively associated with alexithymia in a nonclinical sample of young adults, as was found in a recent study by Dalbudak et al. (2013) in a nonclinical sample of university students.

Dalbudak et al. (2013) also reported that social anxiety was positively associated with depression in their nonclinical sample of young adults. Other evidence suggests that the association between social anxiety and alexithymia may reflect the high comorbidity of both with depression (Ertekin, Koyuncu, Ertekin, & Ozyildirim, 2015). Erekin et al. reported that the positive association of social anxiety with alexithymia in a clinical sample was diminished after controlling for comorbid depression. In contrast, Evren and Evren (2007) found that the association of social anxiety with alexithymia in a sample of dermatological patients was independent of depression. Given inconsistent findings, the present study assessed whether depression could account for the relationship between social anxiety and alexithymia, or if the relationship persists even after controlling for depression.

Social Anxiety, Alexithymia, and Theory of Mind

Cognitive processing biases have been theorized to contribute to the maintenance of social anxiety, including attentional (Amin, Foa, & Coles, 1998), memory (Foa, Gilboa-Schechtman, Amir, & Freshman, 2000), and interpretative biases (Amin et al., 1998) for socially relevant information. Socially anxious individuals may lack an accurate view of how others perceive them due to deficits in comprehending the mental and emotional states of others in social situations (Hezel & McNally, 2014; Washburn et al., 2016),

which is also characteristic of alexithymia (Lyvers, Kohlsdorf, Edwards & Thorberg, 2017; Lyvers, McCann, Coundouris, Edwards & Thorberg, 2018). The ability to understand, identify and reason about the subjective states of others is known as theory of mind (Frith & Frith, 2003; Moriguchi et al., 2006; Premack & Woodruff, 1978; Onuoha, Quintana, Lyvers, & Guastella, 2016). Theory of mind reasoning involves two component processes: detecting or deciphering others' states based on the immediate observable evidence, and reasoning about those states to predict or understand others' behavior (Sabbagh, 2004). If an individual has difficulty decoding and reasoning about others' emotions, thoughts, and intentions, they are likely to find social situations especially challenging (Hezel & McNally, 2014). Further, their failure to understand and predict the behaviors of others, and to comprehend how others view them, would seem likely to promote and maintain anxiety in the context of social interaction.

Theory of mind deficits, such as difficulties evaluating others' thoughts and feelings, may thus pose a significant risk for impaired interpersonal functioning and social anxiety (Hezel & McNally, 2014; Washburn et al., 2016). Washburn et al. examined performance on the Reading the Mind in the Eyes Test (RMET; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), a widely used index of theory of mind, in patients with SAD, depression, comorbid SAD and depression, and a community control sample. Those with pure SAD demonstrated the poorest emotion recognition performance. Hezel and McNally administered two theory of mind tasks to 80 university students, with 40 meeting criteria for SAD. Their results indicated that participants with SAD performed significantly worse on both theory of mind tasks in comparison to controls. Those with SAD appeared to over-interpret the mental and emotional states of others, potentially leading to misunderstandings in social interactions.

Correctly inferring the emotions of others based on external cues logically requires an ability to recognize one's own emotional feeling states (Lombardo et al., 2011). Recent research has thus documented negative relationships between alexithymia and facial recognition of emotions as assessed by tasks such as the RMET (Demers & Koven, 2015; Grynberg et al., 2013; Lyvers et al., 2017; Lyvers, McCann et al., 2018). Highly alexithymic individuals are not only impaired in their ability to recognize their own feelings but also in their ability to recognize the feelings of others. The relationship between alexithymia and deficient theory of mind is regarded as an increasingly important issue in clinical work (Lane et al., 2015), especially given the impact of interpersonal relationships on psychological health. The ability of highly alexithymic individuals to understand and deal with subtleties of social interaction tends to be poor, and their predictions of others' responses and actions are often inaccurate (Wastell & Taylor, 2002). Given such evidence, alexithymia would seem likely to account for at least part of the relationship between social anxiety and deficient theory of mind, another hypothesis examined in the present investigation.

Social Anxiety, Alexithymia, and Problematic Drinking

Between 24% (Magee et al., 1996) and 48% (Buckner et al., 2008) of individuals with a lifetime diagnosis of SAD additionally meet the criteria for a lifetime alcohol use disorder (AUD) diagnosis, compared to a lifetime prevalence rate of 15% for AUD in the general population (Kessler et al., 2005). Comorbidity of social anxiety and problematic drinking has been reported in both clinical and nonclinical samples, including university students (Gilles, Turk, & Fresco, 2006; Kairouz, Kliksman, Demers, & Adlaf, 2002; Thomas, Randall, & Carrigan, 2003). Alcohol abuse and dependence often precede development of full-blown SAD, suggesting that heavy drinking may be a learned response to subclinical social anxiety in such cases (Gilles et al., 2006). Experimental

research indicates that alcohol consumption can decrease performance anxiety in those with SAD (Abrams et al., 2001), and that they increase alcohol intake following a performance task (Abrams et al., 2002).

A continued reliance on anxiolytic substances such as alcohol to self-medicate is likely to increase the risk of problematic use and dependence. A longitudinal study by Buckner et al. (2008), who assessed 1709 adolescents over 14 years, found that social anxiety was a unique risk factor for the later development of alcohol dependence. Buckner et al. concluded that the relationship between social anxiety and alcohol dependence was relatively specific, as no such relationship was evident for other mood or anxiety disorders in their sample.

Interestingly, the use of alcohol to cope with negative emotions such as anxiety and stress has been reported to increase the risk of alcohol-related problems regardless of the quantity of alcohol use (Cooper et al., 1995). For example, Gilles et al. (2006) assessed 188 undergraduate students and found that social anxiety was a significant predictor of alcohol dependence and problems caused by alcohol, but not alcohol consumption. Given that their university student sample showed high levels of alcohol consumption overall, social anxiety may not necessarily be associated with higher alcohol consumption – especially in heavy social drinking samples, such as young adults at university - but nevertheless may remain a risk factor for problematic drinking including dependence. The present study thus examined problematic drinking in relation to social anxiety in a nonclinical sample of young adults, independent of consumption levels.

High levels of alexithymia are common in those diagnosed with AUD (Thorberg et al., 2009). The disinhibiting and anxiolytic effects of alcohol may help those with alexithymia improve poor interpersonal functioning, relieve social anxiety (Lyvers et al., 2012, 2018) and aid in overcoming their inability to express or experience emotions

(Thorberg et al., 2016b). Considering that social anxiety, like alexithymia, is also a potential risk factor for AUD, exploring the role of alexithymia in such relationships may provide considerable insight. Individuals with high levels of alexithymia may use substances such as alcohol to compensate for their inability to modulate affect (Speranza et al., 2004). Lyvers et al. (2012) reported an association in university students between difficulties identifying feelings and drinking to cope with negative emotions, suggesting that deficiencies of emotional self-regulation can lead to self-medication with alcohol. Thorberg et al. (2011a) reported that the relationship between alexithymia and alcohol dependence in a clinical sample was mediated by the expectation that alcohol would cause affective changes. Alexithymia may thus play a mediating role in the relationship between social anxiety and problematic drinking, an idea examined in the current study.

The Present Study

As previous studies have indicated associations of social anxiety with alexithymia in both clinical and nonclinical samples (e.g., Cox et al., 1995; Dalbudak et al., 2013; Fukunishi et al., 1997) as well as problematic drinking (Kairouz et al., 2002; Schry & White, 2013; Thomas et al., 2003) and deficient theory of mind (Hezel & McNally, 2014; Washburn et al., 2016), the potential role of alexithymia in the links between social anxiety and problematic drinking or deficient theory of mind merits investigation, as does the related question as to whether the association between social anxiety and alexithymia is independent of depression. The present study explored these issues in a nonclinical sample with the aim of elucidating possible perpetuating factors in both social anxiety and problematic drinking. The role of alexithymia is important as this trait is a likely risk factor for both types of problems and has been reported to respond to cognitive therapy (Thorberg et al., 2016a). Based on the evidence and theory discussed earlier, the present study thus tested three hypotheses: (1) self-reported anxiety regarding social interaction

would predict alexithymia even after controlling for depression; (2) alexithymia would mediate the expected relationship between social anxiety and problematic drinking; and (3) alexithymia would mediate the expected relationship between social anxiety and deficient theory of mind.

Method

Participants

A total of 301 individuals volunteered to participate in this study. After removal of cases outside the desired age range of 18-35 years in order to minimize cohort and other age-related factors (note that the legal drinking age in Australia is 18), those who were not at least occasional consumers of alcohol (as the study examined predictors of alcohol-related risk among social drinkers), and multivariate outliers (identified by Mahalanobis Distance, $p < .001$), the final sample consisted of 242 volunteers (93 males) from two universities in southeast Queensland, Australia ($n = 178$) and from the local community ($n = 64$). Participants ranged in age between 18 and 35 years ($M = 23.22$, $SD = 4.48$). Participants reported having completed education to the level of undergraduate or trade school (44%), grade 12 (43%), postgraduate (11%), and before grade 12 (2%). Most participants identified as Australian (72%), with the remainder including American (7%), British (5%), New Zealander (4%), South African (2%) and Other (10%). In line with previous findings on the population prevalence of definite or high alexithymia as indicated by Toronto Alexithymia Scale cut-off score (Bagby, Taylor, & Parker, 1994), 18% of the sample met this criterion. The Alcohol Use Disorders Identification Test (Saunders et al., 1993) identified 46% of the sample as low-risk drinkers, 43% as risky or hazardous drinkers, and 12% as harmful or dependent drinkers. Although not diagnostic of SAD, the suggested Social Interaction Anxiety Scale cut-off score (Mattick & Clarke, 1998)

identified 13.2% of the sample as likely having SAD, very close to the 13.6% prevalence of SAD in young adults reported by Kessler et al. (2005).

Materials

Demographic Questionnaire. The 12-item self-report questionnaire assessed participants' age, gender, country of origin, student status, and highest level of education attained, as well as information on alcohol and other substance use.

Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998). The SIAS is a 20-item self-report measure that assesses distress associated with ordinary social interactions. Items are self-statements describing one's characteristic reaction to situations involving social interaction such as "I have difficulty talking with other people" and "I feel I'll say something embarrassing when talking." Items are rated on a five-point Likert scale ranging from 0 *Not at all characteristic of me* to 4 *Extremely characteristic of me*.

Summation of item responses yields a total score that can range from 0 to 80. Higher scores indicate higher levels of social anxiety, with a score of 43 or more suggestive (though not diagnostic) of SAD. The SIAS has been reported to detect differences between socially anxious patients and those with other anxiety disorders in an anxiety disorder unit (Peters, 2000). Peters also reported evidence for construct validity as the SIAS converged with other measures of social anxiety such as the Social Phobia Scale ($r = .73$) and the Social Phobia and Anxiety Inventory ($r = .85$). The Cronbach's alpha reliability coefficient for the SIAS in the current study was high ($\alpha = .91$).

Toronto Alexithymia Scale 20 (TAS-20; Bagby, Parker & Taylor, 1994). The TAS-20 is an empirically derived self-report index of alexithymia consisting of 20 items that assess the three facets of this trait: difficulty identifying feelings (DIF; 7 items, e.g., "I am often confused about what emotions I am feeling"), difficulty describing feeling (DDF; 5 items, e.g., "It is difficult for me to find the right words for my feelings"), and externally

oriented thinking (EOT; 8 items, e.g., “I prefer to talk to people about their daily activities rather than their feelings”). Items are rated on a five-point Likert scale ranging from 1 *Strongly Disagree* to 5 *Strongly Agree*. Summation of responses generates a total score signifying the severity of alexithymia ranging between 20 and 100. Based on empirically derived cut-offs, a total score greater than 61 indicates definite or high alexithymia, a score between 51 and 60 indicates borderline alexithymia, and a score less than 51 indicates low or no alexithymia (Bagby, Taylor & Parker, 1994). The TAS-20 has been shown to be a psychometrically sound index of alexithymia (Taylor, Bagby & Parker, 2003; Thorberg et al., 2010). The TAS-20 showed an acceptable Cronbach’s alpha reliability coefficient in the current study ($\alpha = .79$).

Depression Anxiety Stress Scales-21 (DASS-21) Depression Scale (Lovibond & Lovibond, 1995). The DASS-21 is a self-report measure used to assess negative emotional states experienced over the past week. It contains 21 items assessing three factors, Depression, Anxiety, and Stress, with 7 items for each. The Depression Scale was used in the current study. Items such as “I felt that life was meaningless” are rated on a four-point Likert scale ranging from 0 *Did not apply to me at all* to 3 *Applied to me very much, or most of the time*. Higher scores on this scale indicate higher levels of depression. Concurrent validity of the Depression Scale was demonstrated by high positive correlations with the Beck Depression Inventory (Antony et al., 1998). Cronbach’s alpha reliability coefficient of the Depression Scale in the current study was very high ($\alpha = .92$).

Reading the Mind in the Eyes Test - Revised (RMET-R; Baron-Cohen et al., 2001). The RMET-R is a theory of mind measure that assesses emotion recognition via pictures of men’s and women’s eyes. It consists of 36 grey-scale photographs of human eyes (18 males) expressing a complex mental state. The photographs are presented individually with four mental state adjectives (one target word and three foils) displayed

around the photo, e.g., “cautious,” “insisting,” “bored,” “aghast.” Where possible, the foils have similar valence to the target word. Participants were asked to indicate the adjective that best describes what the person in the photograph was feeling. One point is assigned per correct response and summation of correct responses provides a total score. Scores can range from 0 to 36, with higher scores indicating more accurate theory of mind. Test retest reliability has been found to be moderate to high over a 30-day period ($r = .83$; Vallante et al., 2012). The RMET-R has been shown to differentiate among groups that theoretically differ in their theory of mind abilities, such as groups with and without Autism Spectrum Disorder or Asperger’s syndrome (Olderbak et al., 2015). The Cronbach’s alpha reliability coefficient for the RMET-R in the current study was high ($\alpha = .90$).

Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993). The AUDIT is a self-report screening tool to indicate hazardous or harmful alcohol use. It was created over two decades in collaboration with the World Health Organization (Babor, Higgins-Biddle, Saunders & Monteiro, 2001). Responses are selections from a three-point (2 items) or five-point (8 items) Likert scale scored from 0 to 4, with anchors depending on the question. Items assess three factors: alcohol consumption, measured by three items (e.g., “How often do you have a drink containing alcohol?”); alcohol dependence, measured by three items (e.g., “How often during the last year have you found that you were not able to stop drinking once you had started?”); and alcohol-related problems, measured by four items (e.g., “Have you or someone else been injured because of your drinking?”). Summation of the subscale items provides a score for each subscale. Summation of all items provides a total score, with scores of 8-15 indicating hazardous drinking and scores of 16 and above indicating harmful drinking (Saunders et al., 1993). The AUDIT has demonstrated concurrent validity with the Michigan Alcoholism Screening Test (Bohn, Babor, & Kranzler, 1995; Conley, 2001). Given previous evidence

that SAD may be associated with problematic drinking independently of consumption levels in heavy drinking samples of young adults (Gilles et al., 2006), the current study used a composite index combining the alcohol dependence and alcohol-related problems subscales. This index showed good reliability in the present sample ($\alpha = .81$).

Procedure

The ethics committees of both universities granted approval of the study protocol prior to data collection. Questionnaires were administered via Qualtrics, a research software website. The hyperlink to the study was emailed to students at the two universities and also shared via a dedicated Facebook page. The link directed prospective participants to an explanatory statement that contained general information about the study, specified that responses would be anonymous, and provided contact details of the researchers. Prospective participants were also informed that their participation would require 25-30 minutes of their time. Incentives included course credit in a psychology subject for those recruited from one university, and entrance into a raffle for a \$50 gift voucher for the remainder. In order to receive the incentive, participants had to provide a screen-shot of the final page to send to the researcher's email address upon completion.

Results

The data were analyzed using SPSS Version 23. Missing values analysis showed that well less than 5% of data were missing, thus mean substitution was used for the missing data. G* Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2009) indicated that the sample yielded adequate power for detecting a medium effect size.

Correlations

Pearson's correlations as well as means and standard deviations for all variables are displayed in Table 1. As predicted, SIAS social anxiety scores displayed significant positive correlations with TAS-20 total alexithymia scores, as well as with subscale scores

for DDF and DIF, but not EOT, consistent with previous reports (Dalbudak et al., 2013). Also as predicted, SIAS scores were significantly positively correlated with both the AUDIT alcohol dependence and alcohol-related problems subscales, which were combined to form a single index of problematic drinking. In line with previous findings (Gilles et al., 2006), SIAS did not correlate with the alcohol consumption subscale in this young adult sample. Further, as predicted both SIAS and TAS-20 scores displayed significant negative correlations with the theory of mind index (RMET-R scores). TAS-20 was significantly positively correlated with the AUDIT and its subscales as in previous work cited earlier. A highly significant association was found between likely SAD and definite or high alexithymia based on suggested cut-off scores of the SIAS and TAS-20 respectively, such that 41% of participants with likely SAD were highly alexithymic, compared to only 15% of those without likely SAD, $\chi^2(1) = 12.49, p < .0001$.

<INSERT TABLE 1 NEAR HERE>

Social Anxiety Predicts Alexithymia After Controlling for Depression

To test the hypothesis that social anxiety would be positively associated with alexithymia even after controlling for depression, a hierarchical regression was conducted with alexithymia (TAS-20 scores) as the criterion variable. Age, gender and DASS-21 Depression scores were entered at step 1 as covariates, and SIAS scores were entered at step 2. Step 1 accounted for 28% of the variance in alexithymia, $F(3, 238) = 30.04, p < .0001$, with depression the only significant predictor (see Table 2). Addition of the SIAS index of social anxiety at step 2 explained an additional 14% of variance in alexithymia, $\Delta F(1, 237) = 57.62, p < .0001$, and the model remained significant, accounting for 42% of the variance in alexithymia, $F(4, 237) = 42.29, p < .0001$. Social anxiety was the strongest predictor of alexithymia in the final model, followed by depression (see Table 2).

<INSERT TABLE 2 NEAR HERE>

To test the hypotheses that, after controlling for the covariates of age, gender and depression, alexithymia would mediate the associations of social anxiety with (1) problematic drinking and (2) theory of mind, mediation was tested via regression following the conservative Baron and Kenny (1986) steps approach. According to Baron and Kenny, a mediated relationship is indicated when certain criteria are met. Firstly, the independent variable predicts the dependent variable. Secondly, the independent variable predicts the mediator variable. Thirdly, the mediator variable predicts the dependent variable. Finally, the relationship between the independent variable and the dependent variable is significantly reduced after including the mediator (partial mediation) or becomes non-significant in the presence of the mediator (full mediation).

Social Anxiety and Problematic Drinking: Full Mediation by Alexithymia

In a hierarchical regression, after controlling for age, gender and depression at step 1, social anxiety at step 2 predicted problematic drinking (AUDIT dependence + alcohol-related problems), $\Delta F(1, 237) = 4.49, p = .03$, accounting for 2% of the variance. As expected, social anxiety was a significant positive predictor (see Table 3). As reported earlier, social anxiety also predicted alexithymia even after controlling for depression (see Table 2). Thus, in a three-step hierarchical regression predicting problematic drinking, the covariates age, gender and depression were entered at step 1, social anxiety was entered at step 2, and alexithymia was entered at step 3. Social anxiety was a significant predictor at step 2 (see Table 3), however it became nonsignificant at step 3 after adding alexithymia to the model. Alexithymia accounted for an additional 5% of variance in problematic drinking, $\Delta F(1, 236) = 13.75, p < .0001$. The final model was significant, $F(5, 236) = 6.81, p < .0001$, accounting for 13% of the variance in problematic drinking. Sobel test (Sobel, 1982) was significant, $z = 3.33, p = .001$, indicating full mediation (see Figure 1).

<INSERT TABLE 3 NEAR HERE>

<INSERT FIGURE 1 NEAR HERE>

Social Anxiety and Deficient Theory of Mind: Partial Mediation by Alexithymia

In a hierarchical regression, after controlling for age, gender and depression at step 1, social anxiety at step 2 predicted performance on the theory of mind task, $\Delta F(1, 237) = 12.44, p < .0001$, accounting for 5% of additional variance over and above the 5% of variance explained in step 1. As expected, social anxiety was a negative predictor of theory of mind (see Table 4). Male gender was also associated with worse performance. At step 3, addition of alexithymia to the model explained an additional 2% of variance in theory of mind, $\Delta F(1, 236) = 5.38, p = .02$, and the final model was significant, $F(5, 236) = 6.03, p < .0001$, accounting for 11% of the variance in theory of mind task performance. Gender was the strongest predictor, followed by alexithymia (see Table 4). Both social anxiety and alexithymia were significant in the final model, however the influence of social anxiety was substantially reduced; Sobel test (Sobel, 1982) was significant, $z = 2.22, p = .03$, indicating partial mediation (see Figure 2).

<INSERT TABLE 4 NEAR HERE>

<INSERT FIGURE 2 NEAR HERE>

Discussion

Relationships among variables were consistent with expectations, such that social anxiety was significantly correlated with alexithymia, theory of mind, problematic drinking and depression in expected directions. Furthermore, social anxiety predicted alexithymia even after controlling for depression, indicating that the relationship between social anxiety and alexithymia does not simply reflect their comorbidity with depression as has been previously suggested (Ertekin et al., 2015; Evren & Evren, 2007). In the present sample, 41% of individuals with SIAS scores that were suggestive (though not diagnostic) of SAD also had TAS-20 scores above the cut-off for definite or high alexithymia, compared to only 15% of those whose SIAS scores did not suggest SAD. This association is consistent with the hypotheses discussed earlier on how social anxiety could be an

outcome of alexithymia, or vice-versa. Social anxiety scores were specifically correlated with the DIF and DDF components of alexithymia as indexed by the corresponding TAS-20 subscales, but not with EOT, which was consistent with previous work (Cox et al., 1995; Dalbudak et al., 2013; Fukunishi et al., 1997).

The present study also provided support for a mediating role of alexithymia in the relationship between social anxiety and problematic drinking, the latter operationally defined by combining the alcohol dependence and alcohol related problems subscales of the AUDIT. This result was consistent with previous reports of positive relationships between social anxiety and both alcohol dependence and alcohol-related problems (Buckner et al., 2008; Morris, Stewart & Ham, 2005), and between alexithymia and both alcohol dependence and alcohol-related problems (Lyvers et al., 2012; Speranza et al., 2004; Thorberg et al., 2009, 2010). Interestingly, social anxiety was unrelated to alcohol consumption in the present study, consistent with previous findings in young adults (Gilles et al., 2006). Use of alcohol to cope with negative emotions - a drinking motive that has been reported to characterize both social anxiety and alexithymia, as described earlier - has specifically been linked to an increased risk of alcohol dependence (Kuntsche, Knibbe, Gmel & Engels, 2005).

A recent study (Lyvers, Hanigan & Thorberg, 2018) found that both social anxiety (as indexed by SIAS) and alexithymia (as indexed by TAS-20) were positive predictors of coping motives for drinking, and that alexithymia fully mediated the relationship between social anxiety and coping motives. However, those who experience high levels of anxiety during social interactions may not only learn to use alcohol to alleviate their anxiety; the difficulties identifying and expressing feelings in those with high levels of alexithymia may further promote reliance on drinking as a means to induce affective changes via disinhibition and (at least subjectively) improve interpersonal functioning and emotional

expression (Lyvers et al., 2012; Thorberg et al., 2011a, 2016b). Highly alexithymic individuals have been reported to show significantly earlier onset and longer duration of problematic drinking compared to those with low or no alexithymia (see review by Thorberg et al., 2009). Alexithymia associated with social anxiety may thus encourage a dependence on the anxiolytic and disinhibiting effects of alcohol to reduce anxiety, encourage emotional expression and make social interactions easier to deal with.

The present study also supported a mediating role of alexithymia in the relationship between social anxiety and deficient theory of mind, implying that the latter relationship (Hezel & McNally, 2013; Washburn et al., 2016) may be partially explained by high levels of alexithymia as reported in SAD samples. Theory of mind reasoning errors would seem likely to lead to negative interpersonal outcomes, thereby promoting and maintaining social anxiety. Likewise, the difficulties identifying and describing one's own feelings in alexithymia are clearly linked to difficulties in correctly identifying the emotions of others, potentially leading to social difficulties (e.g., Demers & Koven, 2015; Lyvers et al., 2017). Clinician efforts to improve interpersonal functioning in those who suffer from social anxiety may thus benefit from targeting alexithymia in a relevant subset of such clients. Note however that the present study's finding of partial mediation suggests that deficient theory of mind in social anxiety cannot entirely be accounted for by alexithymia. Gender was the strongest predictor of theory of mind performance in this sample.

The present study had several limitations that necessarily temper its conclusions. As noted earlier, the SIAS specifically assesses anxiety experienced in the context of social interactions and cannot be considered diagnostic of SAD. A review of social anxiety measures (Letamendi & Stein, 2009) cited the absence of items assessing avoidance of social situations – a crucial feature of SAD - as a limitation of the SIAS. Although the SIAS has been reported to reliably distinguish socially anxious from non-socially anxious

individuals, and to detect differences between clinic patients with social anxiety and those with other forms of anxiety (Peters, 2000), the SIAS by itself was not regarded by its developers as diagnostic of SAD (Mattick & Clarke, 1989). However, the current study was not intended to target those with SAD, but rather sought to assess subclinical social anxiety as a continuous variable in relation to alexithymia, with the aim of clarifying conceptual understanding of this relationship in the context of the known links between social anxiety and problematic drinking as well as deficient theory of mind.

As the data gathered in the present study were cross-sectional, the observed relationships among variables - including the evidence supporting mediation – cannot be interpreted to elucidate the nature or direction of causation; appropriately designed longitudinal research is required to address such issues. As noted earlier, there is evidence to suggest that social anxiety may, in at least some cases, have a causal relationship to both alexithymia and problematic drinking (Fukunishi et al., 1997; O’Toole et al., 2013). On the other hand, a highly alexithymic child or adolescent is likely to experience persistent interpersonal difficulties due to their poor ability to interpret and appropriately respond to the emotional states of others (Lyvers, McCann et al., 2018; Vanheule et al., 2006), which in turn would seem likely to promote anxiety in social interactions. Such a deficiency in theory of mind has been suggested to precede or at least help maintain social anxiety (Hezel & McNally, 2014; Washburn et al., 2016). A final limitation of the present study was the reliance on self-report instruments for operationalization of variables. Such instruments are of course very widely used as they can provide quick and low-cost indices of psychological constructs, however their validity is reliant on (among other things) the participant’s awareness and knowledge of themselves. This may be particularly problematic in the context of alexithymia, where there are evident difficulties in identifying and describing feelings. On the other hand, Thorberg et al. (2010) found that

self-report and observer measures of alexithymia yielded similar results, so this issue may not present a major impediment to interpretation.

Despite the present study's limitations, the findings do support and to some extent clarify a potentially important relationship between social anxiety and alexithymia, as they suggest how alexithymic features and related theory of mind deficits are likely to impact those with social anxiety – including problematic drinking as a common outcome. As the study used a nonclinical sample, the results indicate that alexithymic characteristics are prominent not only among those diagnosed with SAD as found in previous work cited earlier, but also in non-diagnosed young adults who report experiencing anxiety in the context of social interactions.

In conclusion, the present study has provided support for alexithymia as a notable feature in social anxiety. Difficulties experienced by such individuals in identifying and describing their emotions have the potential to perpetuate and maintain social anxiety by interfering with social interactions and normal processes of developing emotional and interpersonal insight. Further, as alexithymia may not only promote and maintain social anxiety but can also increase the risk of additional problems such as AUD, assessment of alexithymia in those with social anxiety may offer fruitful directions for clinical treatment.

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Table 1

Pearson's Product Moment Correlations, Means and Standard Deviations for all variables of interest.

Scale	2	3	4	5	6	7	8	9	10	11	12	<i>M</i>	<i>SD</i>
1. SIAS	.55***	.50***	.51***	.03	-.22**	.38***	.17**	.08	.20**	.21**	.21**	28.60	11.96
2. TAS-20	-	.76***	.88***	.21**	-.24***	.52***	.33***	.23***	.34***	.32***	.34***	49.13	13.05
3. TAS DDF		-	.66***	.25***	-.12	.39***	.12	.11	.10	.16*	.13*	14.15	3.33
4. TAS DIF			-	.22**	-.15*	.55***	.29***	.16*	.30***	.31***	.31***	16.43	6.57
5. TAS EOT				-	.03	-.00	.01	-.01	-.03	.05	.02	25.62	3.21
6. RMET-R					-	-.10	-.20**	-.17*	-.28***	-.19**	-.20**	24.74	6.27
7. DASS Depression						-	.21**	.11	.24***	.21**	.23***	5.55	5.22
8. AUDIT							-	.74***	.83***	.86***	.95***	9.21	5.85
9. AUDIT Consumption								-	.47***	.48***	.51***	5.25	2.16
10. AUDIT Dependence									-	.63***	.86***	1.07	1.79
11. AUDIT Problems										-	.92***	3.00	3.20
12. Problem Drinking											-	4.00	4.46

Note. * $p < .05$ ** $p < .01$ *** $p < .001$. SIAS = Social Interaction Anxiety Scale TAS-20 = Toronto Alexithymia Scale 20. TAS DDF = Difficulty Describing Feelings Subscale, TAS DIF = Difficulty Identifying Feelings Subscale. TAS EOT = Externally Oriented Thinking Subscale. RMET-R = Reading the Mind in the Eyes Test Revised. DASS Depression = Depression Anxiety Stress Scales Depression Scale. AUDIT = Alcohol Use Disorder Identification Test. AUDIT Consumption = Consumption subscale. AUDIT Dependence = Dependence subscale. AUDIT Related Problems = Alcohol-Related Problems subscale. Problem Drinking = combined Dependence and Alcohol-Related Problems subscales.

Table 2

Hierarchical regression coefficients for demographic variables, depression and social anxiety predicting alexithymia.

Predictors	R ²	ΔR ²	β	B	SE B	95% CI
Step 1	.28***					
Constant				46.19	4.78	[36.78, 55.60]
Age			-.08	-.24	.16	[-.56, .08]
Gender			.03	.83	1.48	[-2.09, 3.76]
Depression			.51***	1.29	.14	[1.01, 1.56]
Step 2	.42***	.14***				
Constant				34.07	4.55	[25.73, 43.67]
Age			-.04	-.12	.15	[-.41, .17]
Gender			-.02	-.38	1.34	[-3.03, 2.27]
Depression			.36***	.89	.14	[.62, 1.16]
Social Anxiety			.41***	.45	.06	[.33, .57]

Note. *** $p < .001$. SE = Standard Error. CI = Confidence Intervals.

Table 3

Hierarchical regression coefficients for age, gender, depression, social anxiety and alexithymia predicting problematic drinking.

Predictors	R ²	ΔR ²	β	B	SE B	95% CI
Step 1	.06**					
Constant				4.28	1.86	[.61, 7.94]
Age			-.02	-.02	.06	[-.15, .10]
Gender			-.06	-.53	.58	[-1.67, .61]
Depression			.23***	.20	.05	[.09, .30]
Step 2	.08**	.02*				
Constant				2.90	1.96	[-.96, 6.75]
Age			-.01	-.01	.06	[-.13, .12]
Gender			-.07	-.67	.58	[-1.81, .47]
Depression			.17*	.15	.06	[.03, .26]
Social Anxiety			.15*	.05	.03	[.00, .11]
Step 3	.13***	.05***				
Constant				-.61	2.13	[-4.80, 3.59]
Age			.00	.00	.06	[-.12, .13]
Gender			-.07	-.64	.56	[-1.75, .47]
Depression			.07	.06	.06	[-.06, .18]
Social Anxiety			.02	.01	.03	[-.05, .06]
Alexithymia			.30***	.10	.03	[.05, .16]

Note. * $p < .05$ ** $p < .01$ *** $p < .001$. SE = Standard Error. CI= Confidence Intervals.

Table 4

Hierarchical regression coefficients for age, gender, depression, social anxiety and alexithymia predicting theory of mind.

Predictors	R ²	ΔR ²	β	B	SE B	95% CI
Step 1	.05*					
Constant				20.49	2.63	[15.31, 25.67]
Age			.03	.04	.09	[-.13, .22]
Gender			.19**	2.41	.82	[.80, 4.02]
Depression			-.09	-.11	.08	[-.26, .04]
Step 2	.09***	.05**				
Constant				23.68	2.72	[18.31, 29.05]
Age			.01	.01	.09	[-.16, .18]
Gender			.21**	2.75	.80	[1.16, 4.33]
Depression			-.00	-.00	.08	[-.16, .16]
Social Anxiety			-.24**	-.13	.04	[-.20, -.06]
Step 3	.11***	.02*				
Constant				26.78	3.01	[20.85, 32.72]
Age			-.00	-.00	.09	[-.17, .17]
Gender			.21**	2.71	.80	[1.14, 4.28]
Depression			.07	.08	.09	[-.09, .25]
Social Anxiety			-.16*	-.09	.04	[-.16, -.01]
Alexithymia			-.19*	-.09	.04	[-.17, -.01]

Note. * $p < .05$ ** $p < .01$ *** $p < .001$. SE = Standard Error. CI= Confidence Intervals.