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Social and generalized anxiety symptoms and alcohol and cigarette use in early adolescence: The moderating role of perceived peer norms[☆]

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Abstract

This study prospectively examines the association between social and generalized anxiety symptoms and alcohol and cigarette use in early adolescence and how injunctive (perceived peer approval of use) and descriptive (perceived peer use) norms may moderate the association. Sex differences were also examined. Data were taken from a longitudinal study investigating problem behavior and adolescent substance use. The community sample (N=387) was assessed annually, and data from the first two waves of assessment were used for this study. Early adolescents were between the ages of 11 and 13 at the first assessment (mean age=11.05, SD=0.55, 55% female). Peer norms moderated the association between both social and generalized anxiety symptoms and the likelihood of alcohol and cigarette use for girls, but not for boys. Specifically, girls with elevated levels of generalized anxiety symptoms were at risk for use when perceived peer use was low, and protected from use when perceived peer use was high. Girls with elevated levels of social anxiety symptoms were at risk for use when perceived peer approval of use was high, and protected from use when perceived peer approval of use was low. Past studies have found inconsistent support for an association between anxiety and adolescent substance use, and our findings provide some clarity regarding for whom and when anxiety operates as a risk/protective factor. Social context and sex are critical for understanding the role of different forms of anxiety in the etiology of adolescent alcohol and cigarette use.

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Contributors Jennifer Zehe conducted literature searches, conducted statistical analyses, co-wrote the manuscript, and developed the manuscript's figures and tables. Craig Colder designed the study, wrote the protocol, assisted in conducting statistical analyses, and co-wrote the manuscript. Jennifer Read provided literature to incorporate into the manuscript and provided revisions to draft versions. William Wieczorek assisted in subject recruitment and provided revisions to draft versions. Liliana Lengua provided guidance on assessment of anxiety and provided revisions to draft versions. All authors have approved this manuscript.

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Keywords

Alcohol and cigarette use; Early adolescents; Social anxiety; Generalized anxiety; Perceived peer approval; Perceived peer use

1. Introduction

Alcohol and cigarette use are initiated and escalate during adolescence (Colder, Campbell, Ruel, Richardson, & Flay, 2002; Colder et al., 2001; Johnston, O'Malley, Bachman, & Schulenberg, 2011), and both are associated with a variety of negative outcomes (Aung, Hickman, & Moolchan, 2003; Cooper, Pierce, & Huselid, 1994; Ellickson, Tucker, & Klein, 2001; Hill, White, Chung, Hawkins, & Catalano, 2000; Patten, Choi, Gillin, & Pierce, 2000; Spirito, Rasile, Vinnick, Jelalian, & Arrigan, 1997). Investigating the etiology of alcohol and cigarette use in early adolescence is important because such research may inform interventions. Some studies suggest that high levels of anxiety symptoms are associated with adolescent alcohol and cigarette use, and hence, anxiety has been considered an important risk factor (e.g., Clark & Sayette, 1993; Deas-Nesmith, Brady, & Campbell, 1998; DiFranza et al., 2004; Kessler et al., 2005; Rohde, Lewinsohn, & Seeley, 1996). The mechanism often purported to account for this association is self-medication (Kassel, Stroud, & Paronis, 2003; Wills & Hirky, 1996). That is, substance use is motivated by a desire to reduce emotional distress. Indeed, negative reinforcement is frequently endorsed as a motive for adolescent alcohol use and cigarette smoking (Cooper, 1994; Lewis-Esquerre, Rodrigue, & Kahler, 2004).

Although there is evidence for anxiety as a risk factor, there is also evidence that anxiety is protective (e.g., Costello, Erkanli, Federman, & Angold, 1999) or not associated with adolescent substance use (e.g., Woodward & Fergusson, 2001). Unmeasured moderators may account for these inconsistencies. The epigenetic theory suggests that individual differences affect liability for substance use depending on the characteristics of the environment (Tarter et al., 1999; Zucker, Heitzeg, & Nigg, 2011). According to this perspective, it would be important to consider potential person $\times$ environment interactions when examining associations between anxiety symptoms and substance use. A notable dearth of studies has considered potential moderators of the impact of anxiety symptoms on adolescent cigarette and alcohol use.

The goal of the current study was to clarify the role of anxiety in the development of early adolescent alcohol and cigarette use by considering how the peer context in the form of descriptive and injunctive norms and sex might moderate these associations. Some forms of anxiety may be more germane to adolescent alcohol and cigarette use than others (Colder, Chassin, Lee, & Villalta, 2010; Hussong, Jones, Stein, Baucom, & Boeding, 2011). Moderators may be particularly relevant for social and generalized anxiety as the literature has been equivocal on links between these domains of anxiety and early adolescent alcohol and cigarette use. Accordingly, we focus on social and generalized anxiety in this study.

1.1. Social anxiety

Socially anxious individuals avoid social situations and have excessive concerns about negative evaluation and interpersonal rejection (Kearney, 2005). Although high levels of social anxiety are associated with adult alcohol and cigarette use (for reviews, see Morissette, Tull, Gulliver, Kamholz, & Zimering, 2007; Morris, Stewart, & Ham, 2005), there is evidence to support social anxiety as a risk (Buckner et al., 2008; Deas-Nesmith et al., 1998; Zimmermann et al., 2003) and a protective factor (e.g., Fröjd, Ranta, Kaltiala-Heino, & Marttunen, 2011; Myers, Aarons, Tomlinson, & Stein, 2003; Stewart, Morris,

Mellings, & Komar, 2006) in adolescence. Adolescent alcohol and cigarette use largely takes place with peers (Verkooijen, de Vries, & Nielsen, 2007), and alcohol and cigarette use may serve as a way to self-medicate worries about social evaluation and make it easier to join with peers for socially anxious youth (Blumenthal, Leen-Feldner, Frala, Badour, & Ham, 2010). On the other hand, socially anxious youth are likely to be avoidant of social situations and may be protected from peer contexts where alcohol and cigarette use typically take place. Thus, social anxiety may operate as a both a protective and risk factor.

1.2. Generalized anxiety

Generalized anxiety is characterized by excessive worry across a variety of domains (e.g., athletic performance, schoolwork, health) that is difficult to control (Wilmschurst, 2005), and often accompanied by a physical symptoms (e.g., restlessness or feeling keyed up or on edge, being easily fatigued, and muscle tension) (Merrell, 2008). Generalized anxiety symptoms are associated with adult alcohol and cigarette use (Bolton, Cox, Clara, & Sareen, 2006; Covey, Hughes, Glassman, Blazer, & George, 1994; Robinson, Sareen, Cox, & Bolton, 2009). However, the empirical support for a link between generalized anxiety symptoms and adolescent alcohol and cigarette use has been equivocal (Kaplow, Curran, Angold, & Costello, 2001; Wu et al., 2010). Generalized anxiety symptoms may increase risk for early adolescent alcohol and cigarette use via a self-medication pathway. This is consistent with evidence suggesting that self-medication is a prominent motive for a subgroup of youth characterized by high levels of anxiety sensitivity (Buckner, Eggleston, & Schmidt, 2006; Morissette et al., 2007; Stewart & Zeitlin, 1995). On the other hand, early adolescents who are inclined to worry may be concerned about the consequences of engaging in an illicit and dangerous behavior like substance use, and such concerns may serve a protective function. Accordingly, generalized anxiety symptoms, like social anxiety symptoms, may plausibly increase or decrease liability for substance use.

1.3. Peer norms

Peers become particularly influential (Brown, Dolcini, & Leventhal, 1997) as youth spend more time with their peers and distance themselves from their parents during early adolescence (Larson & Richards, 1991). Changing peer dynamics may have implications for the role of anxiety in the development of substance use. Adolescents may become especially susceptible to social norms that convey information about what behaviors and attitudes are generally valued and accepted (Ward, 2011).

Descriptive norms refer to the prevalence of a particular behavior (e.g., the frequency and quantity of cigarette and alcohol use) while injunctive norms refer to peers' attitudes or beliefs surrounding a particular behavior (e.g., approval or disapproval) (Borsari & Carey, 2003). Both types of norms are considered theoretically important for adolescent substance use (Petratis, Flay, & Miller, 1995). Descriptive norms may provide naïve early adolescents with the knowledge required to successfully adopt substance use behaviors and injunctive norms may provide expectations for positive substance use-related outcomes, leading to behavioral modeling (Borsari & Carey, 2001). Indeed, prospective research has demonstrated that peer substance use (descriptive norms) and peer approval of use (injunctive norms) predict later substance involvement (Ennett & Bauman, 1994; Larimer, Turner, Mallett, & Geisner, 2004; Perkins, 2002; Schulenberg et al., 1999; Urberg, Degirmencioglu, & Pilgrim, 1997; Wills & Cleary, 1999).

Socially anxious early adolescents might be particularly vigilant of descriptive and injunctive norms so that they can tailor their own attitudes and behaviors to gain acceptance and affirmation from peers. Indeed, studies of college drinking have found that socially anxious youth who perceived high levels of peer use and peer approval of use were at

increased risk for alcohol use and problem drinking (Buckner, Ecker, & Proctor, 2011; Neighbors et al., 2007). Such moderational effects of norms have not been tested in early-adolescence, but peer norms may be important moderators during this period given the emergent importance of peers. We propose that high levels of social anxiety symptoms may decrease early adolescent alcohol and cigarette use when peer approval of use and peer use is perceived to be low, and may increase use when peer approval or peer use is perceived to be high.

The association between generalized anxiety symptoms and substance use may also depend on norms. To our knowledge, no studies have tested these potential interactions in adult or adolescent samples. Early adolescents with high levels of generalized anxiety symptoms may model peer use in order to alleviate distress, and perceived peer approval may provide reinforcement for coping motivated use. However, in the absence of a peer context supportive of substance use, anxious early adolescents may fear potential negative outcomes of use (e.g., health or legal consequences), and thus high levels generalized anxiety symptoms in this social context may be associated low levels of use.

1.1. Sex differences

Although adult studies suggest that anxiety symptoms in general, and social anxiety in particular, may be more strongly linked to alcohol and cigarette use outcomes for females (Buckner & Turner, 2009; Merikangas, Stevens, & Fenton, 1996; Norberg, Olivier, Alperstein, Zvolensky, & Norton, 2011), it is unclear if such sex differences generalize to early adolescence. Most studies examining adolescent substance use combine anxiety symptoms or disorders into one category. For example, reviews of psychiatric co-morbidity suggest no consistent pattern of association between an anxiety disorder and adolescent substance use/abuse (Armstrong & Costello, 2002; Roberts, Roberts, & Xing, 2007). Sung, Erkanli, Angold, and Costello (2004) found that anxiety symptoms increased risk for substance use disorders more strongly for girls than boys, but only after age 16.

Studies that have examined specific domains of anxiety suggest a similarly mixed picture regarding sex differences. For example, Zimmermann et al. (2003) examined prospective associations between several anxiety disorders and adolescent alcohol use and dependence, and findings suggested few sex differences with the exception of Phobia Not Otherwise Specified, which was more strongly linked to alcohol outcomes for females. Wu et al. (2010) found social phobia to be related to cigarette smoking in boys, but not girls, and reported a positive association between generalized anxiety and cigarette smoking in girls, but not boys. Kaplow et al. (2001) did not find sex differences in the association between generalized anxiety and alcohol use. Overall, these studies present a mixed picture regarding sex differences in the association between generalized and social anxiety symptoms and adolescent substance use. When sex differences emerge, they most often suggest that anxiety symptoms are more strongly associated with substance use for girls. The equivocal nature of sex differences suggests that it may be important to consider sex along with other moderators to clarify the role of anxiety in the etiology of early adolescent substance use.

1.2. Present study

The present study examines whether social and generalized anxiety symptoms will interact with perceived peer use (descriptive norms) and perceived approval of use (injunctive norms) to predict early adolescent alcohol and cigarette use. We offer the following hypotheses: (a) High levels of social and generalized anxiety symptoms will be associated with an increased likelihood of alcohol/cigarette use when perceived peer approval/use are high; and (b) high levels of social and generalized anxiety symptoms will be associated with decreased likelihood of use when perceived peer approval/use are low. We also examine sex

as a potential moderator, and test 3-way norms $\times$ anxiety $\times$ sex interactions given some evidence for sex differences in associations between anxiety symptoms and early adolescent substance use. The proposed norm $\times$ anxiety interactions are hypothesized to be stronger for females than males, but this is a tentative hypothesis given the equivocal nature of sex differences in the literature. These hypotheses are tested using a prospective design to minimize potential interpretative difficulties regarding direction of the effects between anxiety and substance use. We also statistically controlled for depressive symptoms given the known overlap between anxiety and depression (Brady & Kendall, 1992).

2. Methods

2.1. Participants

The sample for this study was taken from a longitudinal study investigating adolescent substance use (Trucco, Colder, Bowker, & Wieczorek, 2011; Trucco, Colder, & Wieczorek, 2011). The sample included 387 families from Erie County, NY, recruited by trained interviewers through random digit dialing (RDD) and computer-assisted telephone interviewing (CATI). The study was described as an investigation of behaviors that would allow researchers gain an understanding of how youth make healthy transitions into adolescence. Inclusion criteria were an adolescent between 11 and 12 years and one caregiver. Participants were required to have no physical or mental disabilities or language barriers that would prevent them from completing the assessments. The sample was roughly evenly split on sex ($N=213$ females, 55%), and the majority was White/non-Hispanic (83%) or Black (9%). At the first assessment, the mean age was 12.1 years (range 11–13 years because some youth had a birthday between recruitment and the first assessment) and most were in the 6th or 7th grade (85%). The data for this study were collected during the first and second waves of assessment. Families were contacted to participate in the second wave of assessment two months prior to the anniversary of their first assessment. Families completed the second wave of assessment $\pm$ two months of the one-year anniversary of their first assessment. At Time 2, 96% of the sample was retained. There were no significant differences between those who did and did not participate on social anxiety symptoms [$t(385)=0.36$, $p=0.72$], generalized anxiety symptoms [$t(385)=-1.84$, $p=0.07$], perceived peer approval [$t(385)=-0.41$, $p=0.68$], perceived peer use [$t(385)=-0.41$, $p=0.68$], age [$t(385)=-0.16$, $p=0.87$], sex [$\chi^2(1, N=387)=0.03$, $p=.87$], lifetime substance use [$\chi^2(1, N=387)=0.08$, $p=.77$], or minority status [$\chi^2(1, N=387)=0.22$, $p=.64$].

2.2. Procedures

All interviews were conducted in university-based research offices. Informed consent and assent forms were read out loud by the interviewer and signed by the caregiver and early adolescent. To maintain participants' privacy, the early adolescent and caregiver were interviewed in separate rooms. Interviewers read instructions from detailed protocols and inputted participants' responses into the computer. Early adolescents inputted their responses to sensitive questions (e.g., questions regarding substance use) to enhance privacy. Interviews took approximately two and a half hours to complete. Participants were compensated \$75 at Time 1 and \$85 at Time 2, and early adolescents selected a toy or gift card upon completion of the interview.

2.2.1. Substance use (Times 1 & 2)—Given the age of our sample, we focus on alcohol and cigarette use because adolescents typically experiment with these substances before progressing to other illicit drugs (Kandel, 1975). At Time 1, early adolescents were asked to self-report whether or not they had ever used alcohol and cigarettes without their parents' permission.¹ At Time 1, the prevalence of alcohol and cigarette use was 6.46% and 2.58%, respectively. During the second wave of assessment, early adolescents were asked to report

on past year use of cigarettes and alcohol, and the prevalence of alcohol and cigarette use was 14.47% and 6.2%, respectively. Cigarette and alcohol use were combined to create dichotomous substance use variable (0=Neither cigarette or alcohol use; 1=Either cigarette or alcohol use) to increase variability of the outcome. At Time 2, 80 participants (20.67%) reported using either alcohol or cigarettes in the past year. Lifetime alcohol/cigarette use at time 1 (N=35, 9.04%) was included as a statistical control variable in our models.

2.2.2. Substance use-related descriptive and injunctive norms (Time 1)—Items that measured descriptive and injunctive norms of substance use were adapted from the Monitoring the Future Study (Johnston, O'Malley, & Bachman, 2003). To measure injunctive norms, participants were asked to use a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree) to rate how their three closest friends would feel about them smoking cigarettes occasionally and regularly, drinking alcohol occasionally and regularly, and having five or more drinks of alcohol at one time. Items were averaged for analysis. To measure descriptive norms, participants were asked to estimate how many of their friends engaged in the aforementioned behaviors using a 6-point response scale (1=None, 3=Some, 6=All). Items were averaged for analysis. The alphas for injunctive and descriptive norms were .89 and .86, respectively. Perceived approval and use were highly correlated across substances (r s=.83 and .80, respectively), suggesting that it was appropriate to combine items across substances.

2.2.3. Social anxiety symptoms (Time 1)—Social anxiety symptoms were assessed with the *Social Anxiety Scale For Children – Revised* (SASC-R; La Greca & Stone, 1993). This is an 18-item self-report scale of symptoms experienced during peer interactions or group situations. The items assess fear of negative evaluation from peers, general social avoidance/distress, and social avoidance and distress in novel situations. Participants self-reported the frequency of each item using a five-point Likert scale (0=Not at all, 3=Sometimes, 5=All the time). Items were combined to form a social anxiety score by summing together all of the items that comprise the three subscales. Cronbach's α for this scale was .90.

2.2.4. Generalized anxiety and depression symptoms (Time 1)—Items taken from the internalizing scale of the *Youth Self-Report Survey* (YSR; Achenbach & McConaughy, 2001) were used to assess generalized anxiety and depression symptoms. Early adolescents responded to items with the responses Not True (0), Somewhat or Sometimes True (1), and Very True or Often True (2). Lengua, Sadowski, Friedrich, and Fisher (2001) created a scoring procedure for the Achenbach scales that maps onto DSM-based symptom categories. A combination of expert ratings and factor analyses were used to create scales that distinguished clinical and nonclinical samples. In the present study, the items from Lengua et al. (2001) scoring procedure were used to form generalized anxiety and depression symptoms scales scores by taking the average of the items. The seven generalized anxiety items reflect being afraid of certain animals, situations, or places other than school; being afraid of going to school; being afraid of doing or thinking something bad; being nervous or tense; having body parts that twitch or make nervous movements; being too fearful or anxious; and worrying a lot. The 11 depression items reflect crying a lot, feeling lonely, unloved, worthless, overtired, or unhappy/sad, or having sleep difficulties or low energy.

¹Some prior research has assessed alcohol use with and without parental permission (e.g., King, Iacono, & McGue, 2004). In early adolescence, alcohol use with parental permission often reflects use in structured settings (e.g., as part of religious ceremonies). Our data suggests that the prevalence of drinking with parents' permission (26% at Time 1) is much higher than drinking without parents' permission (4% at Time 1). Use without parental permission is more likely to reflect an adolescent drinking by his/her own volition. Although we asked about cigarette use with parental permission, no adolescents reported such use. Thus, the distinguishing with and without permission is less important for cigarette use.

The item “I think about killing myself” was excluded due to low variability. Polychoric correlations were used to estimate the internal consistencies, and results suggested acceptable reliability for both scales (.79 and .85 for depression and generalized anxiety symptoms, respectively).

2.3. Data analytic plan

The hypotheses were tested with logistic regression analyses in SAS 9.2 (SAS Institute Inc., 2008). The odds of substance use were modeled. Separate models were run for perceived peer use and perceived peer approval to reduce the number of interaction terms tested in one model. The independent variables included sex, perceived peer approval (or perceived peer use), social anxiety, and generalized anxiety. Age, lifetime substance use at Time 1, and Time 1 depression were included as statistical control variables. Of interest were four three-way interactions: Social Anxiety×Perceived Peer Approval×Sex, Social Anxiety×Perceived Peer Use×Sex, Generalized Anxiety×Perceived Peer Approval×Sex, and Generalized Anxiety×Perceived Peer Use×Sex. Independent variables were standardized to eliminate non-essential collinearity (Aiken & West, 1991). Finally, to prevent extreme cases from having an undue influence on the results, observations that were beyond ± 3 SD units from the sample mean on continuous variables were set to a value of $+3$ SD above the sample mean (Tabachnick & Fidell, 2007). This resulted in 1% of data values being reset for social and generalized anxiety symptoms and 2% for perceived peer use and perceived peer approval.²

In the case where sex entered into a statistically significant interaction term, the simple slopes were probed by recoding sex so that in one model males were coded as the reference group and in the other, females were the reference group. In the case where one of the peer variables entered into a statistically significant interaction term, simple slopes of anxiety were tested at high (1 SD above the mean) and low (1 SD below) levels of the peer variables. Before testing our moderational models, we examined sex differences on study variables as well as marijuana and other drug use. No sex differences were found.

3. Results

3.1. Perceived peer approval as a moderator

Generalized anxiety did not prospectively predict the likelihood of substance use as a first-order effect nor did it enter into a significant interaction with perceived peer approval. Social anxiety entered into a significant three-way interaction with perceived peer approval and sex (see Table 1). The simple slopes with the Y-axis converted to predicted probabilities are shown in Fig. 1. For males, social anxiety was not prospectively associated with the probability of substance use at high ($\beta = -0.27$, $p = .30$) or low ($\beta = -0.03$, $p = .94$) levels of perceived peer approval. For females, the conditional effect of social anxiety was statistically significant at low ($\beta = -0.68$, $p = .03$) levels of perceived peer approval and marginally significant at high levels of perceived peer approval ($\beta = 0.61$, $p = .06$). When we probed the three-way interaction social anxiety×perceived peer approval×sex with perceived peer approval set to 1.5 standard deviations above the mean, then the conditional effect of social anxiety became statistically significant at high levels of perceived peer approval for girls ($\beta = 0.93$, $p = .03$). In sum, at low levels of perceived peer approval, high levels of social

²We also conducted a sensitivity analysis to examine the impact of recoding extreme observations. In one set of models, extreme observations were excluded; in another set, we recoded the extreme values to missing and used full-information maximum likelihood estimation; and in a final set, we included extreme observations without any recoding. Across all three of these analyses, the three-way interaction between generalized anxiety, perceived peer use, and sex remained statistically significant, and the key three-way interaction between social anxiety, perceived peer approval, and sex were either significant ($p = .02$) or marginally significant ($p = .09$). Thus, recoding extreme observations did not have a strong influence on our findings.

anxiety were prospectively associated with a low probability of substance use, whereas at high levels of peer approval, high levels of social anxiety were associated with a high probability of use.

3.2. Perceived peer use as a moderator

Social anxiety did not predict substance use as a first-order effect or enter into a significant interaction with perceived peer use. However, generalized anxiety entered into a statistically significant 3-way interaction with perceived peer use and sex (see Table 2). The simple slopes for this interaction term are plotted in Fig. 2 with the Y-axis converted to predicted probabilities. The conditional effects of generalized anxiety were not statistically significant at high ($\beta=0.10$, $p=.70$) or low ($\beta=-0.20$, $p=.55$) values of perceived peer use for males. For females, the conditional effect of generalized anxiety was statistically significant at high levels of perceived peer use ($\beta=-1.04$, $p=.01$) and marginally statistically significant at low levels of perceived peer use ($\beta=0.64$, $p=.07$). When the three way interaction generalized anxiety $\times$ perceived peer use $\times$ sex was probed for girls with perceived peer use set to 1.5 standard deviations below the mean, then the conditional effect of generalized anxiety became statistically significant at low levels of use ($\beta=0.76$, $p=.05$). Generalized anxiety was negatively associated with the probability of substance use at high levels of peer use, and positively associated with the probability of substance use at low levels of peer use, although this latter association fell just short of conventional criteria for statistical significance. Also, notable is that the highest probability of use was observed for females who were low in anxiety and who perceived friends as using cigarettes and alcohol. Because the nature of the generalized anxiety $\times$ peer use $\times$ sex interaction was contrary to what was hypothesized, we also probed this interaction by conditioning the effect of perceived peer use across levels of generalized anxiety. For boys, the conditional effects of perceived peer use were not statistically significant at high ($\beta=-1.54$, $p=.19$) or low ($\beta=0.24$, $p=0.85$) levels of generalized anxiety. For girls, the conditional effect of perceived peer use was statistically significant at low ($\beta=6.30$, $p=0.01$) levels of generalized anxiety, but not statistically significant at high ($\beta=0.99$, $p=0.37$) levels of generalized anxiety. At low levels of generalized anxiety, high levels of perceived peer use were associated with a high probability of use.

4. Discussion

The purpose of this study was to clarify divergent findings in the literature by examining how descriptive and injunctive norms and sex might moderate the association between generalized and social anxiety symptoms and early adolescent alcohol/cigarette use. Findings suggested that socially anxious females were at an increased risk for alcohol/cigarette use when perceived injunctive norms were high, and deterred from use when injunctive norms were low. Findings regarding generalized anxiety also suggested stronger links to alcohol/cigarette use for females, but the nature of the association was opposite of what we hypothesized. These findings will be discussed in turn.

4.1. Social anxiety

For females, social anxiety symptoms serve as a protective factor for alcohol/cigarette use when perceived peer approval of use is low, and a risk factor when perceived peer approval is high. Early adolescents with social anxiety worry excessively about being judged or rejected (Kearney, 2005) and are likely to act in accordance with what they perceive as normative to avoid these outcomes. When perceived peer approval of substance use is low, female early adolescents with elevated social anxiety symptoms may come to believe that engaging in a non-normative behavior will result in loss of peer bonds. However, using

alcohol and cigarettes when peers approve of substance use decreases the likelihood that of appearing atypical.

It is notable that perceived peer use did not moderate the relation between social anxiety and alcohol/cigarette use. This is perhaps not surprising given that concerns and worry about social evaluation are core features of social anxiety (Kearney, 2005), and therefore, the degree to which peers approve of substance use would conceivably be more important to socially anxious early adolescents than their peers' substance use behaviors. Our findings align with prior research that also failed to detect significant interactions between social anxiety and descriptive norms when predicting college drinking frequency (Buckner et al., 2011).

Social anxiety symptoms were unrelated to alcohol/cigarette use in boys, regardless of perceived levels of peer approval or peer use. This sex difference may be attributable to differences in the characteristics of friendships in early adolescence. In early adolescence, girls report needing more emotional support and interpersonal security than do boys, and experience more negative emotionality from interpersonal stressors (Prinstein, Borelli, Cheah, Simon, & Aikins, 2005). Hence, girls may be motivated than boys to conform in order to avoid strains on social relationships.

4.2. Generalized anxiety

Contrary to expectations, the results for females indicated that generalized anxiety symptoms serve as a protective factor against alcohol/cigarette use when perceived peer use is high, but as a risk factor when perceived peer use is low. Female early adolescents with high levels of generalized anxiety may observe or hear about negative consequences that peers experience from alcohol and cigarette use. Such consequences may impact perceptions of use and may motivate early adolescents prone to worry to abstain from use. When perceived peer substance use is low, there may be low expectations for negative consequences, and thus, females with high levels of generalized anxiety symptoms may be less inclined to worry about use and may use cigarettes and alcohol to self-medicate physiological tension and psychological distress (Bolton et al., 2006; DiFranza et al., 2002). Some prior research has also found that generalized anxiety is a risk factor for adolescent substance use (de Dios et al., 2010; Kaplow et al., 2001) and that generalized anxiety is more strongly linked to adolescent substance use for females (Wu et al., 2010). However, our findings suggest an important qualification of these conclusions. That is, whether or not generalized anxiety symptoms are a risk factor depends on perceived peer substance use and attitudes. Another interpretation of this unexpected effect is suggested by conditioning the effect of perceived peer use across levels of generalized anxiety. The interaction probed in this way suggested that perceived peer use operated as a risk factor only at low levels of generalized anxiety for girls. Perhaps female early adolescents, unhampered by potential anxieties over engaging in a potentially harmful activity, may be inclined to model peer substance use, whereas high levels of anxiety and accompanying worry about potential negative consequences of use may buffer the inclination to model peer use.

It is notable that perceived peer use (descriptive norms), but not perceived peer approval of use (injunctive norms), moderated the association between generalized anxiety and substance use. Presumably peer use, but not peer approval of use, is associated with the perception of negative outcomes. Such perceptions may be particularly salient for females with generalized anxiety and impact their own substance use behavior.

Like social anxiety symptoms, generalized anxiety symptoms were unrelated to alcohol and cigarette use for males. This suggests that anxiety may not be an important correlate of early alcohol and cigarette use for males. In early adolescence, antisocial behavior may represent

a more prominent pathway to alcohol and cigarette use for males (Elkins, McGue, & Iacono, 2007; Whitmore et al., 1997). This may change with age, such that pathways to alcohol and cigarette use diversify for males. Indeed, some research suggests that anxiety is a more ubiquitous correlate of substance use in older samples (Robinson et al., 2009).

4.3. Limitations and conclusions

Some limitations of the current study should be noted. First, our sample included early adolescents in the early stages of alcohol and cigarette use, and our findings may not generalize to later stages of use (escalation, problem use). Second, early adolescence marks a period of heightened sensitivity to peer influence (Brown et al., 1997); however, as youth transition into middle and late adolescence, they become less concerned about peer attitudes and behavior, and are more likely to make autonomous decisions (Steinberg & Monahan, 2007). Thus, our moderational findings may not generalize to older samples. Peer norms may be less relevant to late adolescent or early adult alcohol/cigarette use, and accordingly, we might expect main effects of social and generalized anxiety symptoms if we followed our sample into late adolescence or young adulthood (e.g., Buckner & Turner, 2009). Third, we combined alcohol and cigarette use in our sample because of the low rates of use, and it is possible that each substance has unique properties and produces distinct physiological effects that may have different implications for associations with anxiety (Colder et al., 2010; Wu et al., 2010). An important direction for future research would be to consider if the proposed pathways differentially predict alcohol and cigarette initiation in older samples with higher rates of use.

Despite these limitations, our study helped clarify prior discrepant findings regarding the association between anxiety and adolescent substance use (e.g., Fröjd et al., 2011; Myers et al., 2003; Zimmermann et al., 2003), and suggests that inconsistencies are partly attributable to unmeasured moderators, namely sex and peer norms. Moreover, the relationship between anxiety and adolescent alcohol and cigarette use varies across specific forms of anxiety. Accordingly, it is important for future research to continue examining how unique domains of anxiety may influence substance use behavior, and to consider moderators that may plausibly affect the relationship. These are critical avenues for future research because the self-medication model of adolescent substance use endures, and this model appears to be germane to only some youth depending on the social context.

Profiles of anxiety symptoms and perceived peer approval and use may help identify girls that are potential targets for intervention, but the nature of these interventions remains unclear given that our study has not examined potential mechanisms of risk. Accordingly, clear intervention implications await future research. If, for example, conformity motives were established as a mechanism through which social anxiety operates for girls who perceive high levels of peer approval for use, then establishing and maintaining social relationships through means other than alcohol might be successful intervention approach (Clark & Beck, 2010).

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HIGHLIGHTS

- ▶ We examine pathways from social and generalized anxiety to substance use.
- ▶ Peer norms and sex were tested as moderators in a sample of early adolescents.
- ▶ Social anxiety is a risk factor for girls when perceived peer approval is high.
- ▶ Generalized anxiety is a risk factor for girls when perceived peer use is low.
- ▶ Distinguishing different forms of anxiety and norms clarifies sex-specific risk.

Fig. 1. Plot of the simple slopes of the association between social anxiety symptoms across sex and levels of injunctive norms.

Fig. 2. Plot of the simple slopes of the association between generalized anxiety symptoms across sex and levels of descriptive norms.

Table 1

Standardized regression coefficients model using injunctive norms to predict past year substance use.

Variable	β
Lifetime substance use	0.4544 *
Social anxiety	0.2226
Depression	0.1204
General anxiety	0.4963
Perceived peer approval	0.9730 *
Age	0.3120 *
Sex	-0.2052
Perceived peer approval*sex	0.2237
Social anxiety*sex	-2.2 142
General anxiety*sex	1.2622
Social anxiety*perceived peer approval	-0.3 082.
General anxiety*perceived peer approval	-0.3 528
Social anxiety*sex*perceived peer approval	1.9400 *
General anxiety*sex*perceived peer approval	-1.2775

*
p<.05.

Table 2

Standardized regression coefficients model using descriptive norms to predict past year substance use.

Variable	β
Lifetime substance use	0.4171 *
Depression	0.1519
Social anxiety	-0.7407
General anxiety	-0.7567
Perceived peer use	0.8890
Age	0.2852 *
Sex	-1.7569
Perceived peer use*sex	1.7676
Social anxiety*sex	-1.9009
General anxiety*sex	-0.5173
Social anxiety*perceived peer use	0.4484
General anxiety*perceived peer use	0.6493
Social anxiety*sex*perceived peer use	1.9301
General anxiety*sex*perceived peer use	4.2911 *

*
p<.05.