Published in final edited form as:
J Exp Psychopathol. 2011 ; 2(3): 318–353. doi:10.5127/jep.012810.

Anxiety Psychopathology and Alcohol Use among Adolescents: A Critical Review of the Empirical Literature and Recommendations for Future Research

Heidemarie Blumenthal[a], **Ellen W. Leen-Feldner**[a], **Christal L. Badour**[a], and **Kimberly A. Babson**[b]

[a]University of Arkansas, Department of Psychology, Fayetteville, AR 72701, United States

[b]University of Washington, Department of Psychiatry and Behavioral Sciences, Seattle, WA 98195, United States

Abstract

Adolescent alcohol use is a critical public health concern; accordingly, a considerable body of work exists identifying developmentally salient risk and protective factors. One area receiving increasing attention among adults is the linkage between specific constellations of anxiety psychopathology and alcohol use problems. Relatively less is known about such linkages among adolescents, despite the onset of both anxiety-type problems and alcohol use during this developmental period. The current review presents a detailed summary and analysis of the empirical literature focused on specific forms of anxiety psychopathology as they relate to alcohol use among adolescents, and provides a number of specific recommendations for future work with an emphasis on the utility of experimental psychopathology techniques for clarifying basic questions and forwarding this body of work.

Keywords

Alcohol; Anxiety; Adolescence; Comorbidity; Youth

Introduction

Co-morbidity across clinical disorders is common (Kessler, Chiu, Demler, & Walters, 2005; Mineka, Watson, & Clark, 1998), and the co-occurrence of anxiety and problematic alcohol use (e.g., excessive intake, abuse, coping-related use) is receiving increasing recognition as researchers begin to understand how each condition exacerbates the other (e.g., Merikangas et al., 1998). One area that has received empirical attention is the association between alcohol use behaviors and specific constellations of anxiety psychopathology (e.g., generalized anxiety, social anxiety; Kushner, Sher, & Beitman, 1990), although relatively little work has been conducted among adolescents. Three primary objectives guide the current manuscript. The first is to outline developmental considerations related to the association between specific clusters of anxiety symptomatology and alcohol use behaviors among adolescents. The second goal is to comprehensively review the relevant extant literature. Finally, drawing from these sections, a number of research suggestions are offered

Correspondence to: Heidemarie Blumenthal, University of Arkansas, Department of Psychology, 216 Memorial Hall, Fayetteville, AR 72701, hblumen@uark.edu.

with a particular emphasis on the utility of experimental psychopathology techniques for clarifying basic questions and forwarding this body of work.

Adolescent Alcohol Use and Anxiety: Background and Developmental Considerations

Alcohol use among adolescents is a critical public health concern, with linkages to an array of negative consequences including poor academic performance, risky sexual behavior, increased delinquency (e.g., vandalism; Hingson & Kenkel, 2004), other substance use (e.g., marijuana use; Yamaguchi, & Kandel, 1984a), as well as an increased risk of unintentional (e.g., traffic accidents; National Highway Traffic Safety Administration, 2002) and intentional (e.g., suicide; Levy, Miller, & Lox, 1999) death. Despite concerted efforts aimed at reducing adolescent alcohol use (Stewart, Conrad, Marlatt, Comeau, Thrush, & Krank, 2005), initiation and experimentation with alcohol is relatively normative during this developmental phase. For example, large scale cross-sectional (Johnston, O'Malley, Bachman, & Schulenberg, 2008) and prospective work (Kandel & Logan, 1984; Wittchen et al., 2008) suggests that by age 18 years, 75–90% of adolescents have experimented with alcohol, and a significant proportion of adolescents report alcohol use initiation prior to age 14 years (38.5%; Wittchen et al., 2008). Indeed, alcohol is the most commonly used substance among adolescents (cf. nicotine, marijuana), and the initiation of alcohol use most often occurs prior to the initiation of other substances (e.g., Johnston et al., 2008; Kandel & Logan, 1984). Importantly, although early initiation of alcohol use is linked to an elevated risk for the development of alcohol use problems later in life (e.g., alcohol abuse; Nelson & Wittchen, 1998), there is still considerable variation in subsequent patterns and trajectories of use, and the majority of adolescents, including those who begin use early in adolescence, do not progress to problematic use behaviors (Kandel & Logan, 1984; Labouvie & White, 2002; Wittchen et al., 2008). Researchers are therefore increasingly concerned with distinguishing “normal” and “problem-prone” alcohol use behaviors among adolescents (Labouvie & White, 2002; Weber, Graham, Hansen, Flay, & Johnson, 1989), including the identification of subgroups of adolescents who not only evidence early initiation, but also progress toward elevated use (i.e., frequency, amount), alcohol-related problems (e.g., missing school/work, driving under the influence), and the development of alcohol abuse and dependence. Indeed, a considerable body of work exists examining developmentally salient risk and protective factors related to the onset and course of alcohol consumption among adolescents, including biological (e.g., genetic influences; Schuckit et al., 1999), cognitive (e.g., executive function; Deckel, 1999), social (e.g., familial alcohol use; Alati et al., 2005), and psychological (e.g., externalizing problems; Dobkin, Tremblay, Masse, & Vitaro, 1995) factors; the reader is directed to several excellent reviews of these literatures (e.g., Brown et al., 2008; Marsh & Dale, 2005; Saraceno, Munafó, Heron, Craddock, & van den Bree, 2009; Windle et al., 2008).

Within this broad framework, one area of increasing empirical attention is the relation between adolescent alcohol use behaviors and anxiety problems (e.g., Clark et al., 1995; Zimmerman et al., 2003). Indeed, there is a substantial literature focused on linkages between anxiety and alcohol use problems among adults (i.e., over 18 years of age; see Allan, 1995; Brady, & Lydiard, 1993; Kushner et al., 1990; Schuckit, & Hesselbrock, 1994; Wilson, 1988 for reviews), and, importantly, research suggests that anxiety-alcohol use disorder (AUD) comorbidity predicts poorer treatment outcomes and an increased risk of relapse as compared to outcomes among non-comorbid individuals (e.g., Bruce et al., 2005; Kushner et al., 2005). As with other substances characterized by anxiolytic properties (e.g., marijuana, heroin; Stewart & Conrod, 2008; Tull, Schulzinger, Schmidt, Zvolensky, & Lejuez, 2007), theoretical accounts of this association typically center on the use of alcohol in the context of affect regulation/anxiety reduction among individuals with co-morbid

anxiety and alcohol use problems (e.g., self-medication; Carrigan & Randall, 2003; Robinson, Sareen, Cox, & Bolton, 2009; Sayette, 1999). Importantly, this body of work suggests variability in the association between anxiety psychopathology and alcohol use outcomes when specific anxiety diagnoses are considered (e.g., Allan, 1995; Brady, & Lydiard, 1993; Kushner et al., 1990). For example, contemporary research suggests variability in terms of rates of co-occurrence (Kessler et al., 2005), as well as the use of alcohol to "self-medicate" (Robinson et al., 2009) as a function of anxiety diagnosis. Post-traumatic stress disorder (please see Stewart, 1996 for a review), and social anxiety disorder (see Morris, Stewart, & Ham, 2005), have been the most widely studied as research consistently indicates positive relations between problematic alcohol use and these two diagnoses; however, a growing body of work suggests that generalized anxiety disorder (e.g., Smith & Book, 2010), obsessive compulsive disorder (e.g., Manacebo, Grant, Pinto, Eisen, & Rasmussen, 2009), and panic disorder (e.g., Bunaciu et al., 2010; Seguí et al., 2001) also are important clusters of anxiety psychopathology to consider in relation to alcohol use problems among adults, even after variance associated with other commonly comorbid conditions (e.g., depression, illicit substance use disorders) are taken into account.

Although theoretically promising, the empirical literature focused on the anxiety-alcohol use linkage among adolescents has produced mixed results (Alati et al., 2005; Fidalgo, da Silveira, & da Silveira, 2008; Marmorstein, White, Loeber, & Stouthamer-Loeber, 2010; Pardini, White, & Stouthamer-Loeber, 2007; Shedler & Block, 1990). For instance, in a sample of 400 urban adolescents in the United States, Schwinn, Schinke, and Trent (2010) found that elevated anxiety, as measured by the Brief Symptom Inventory (Derogatis, 1993), was associated with increased frequency of alcohol consumption over the past 30 days. Similarly, Fidalgo and colleagues (2008) found that adolescents who reported heavy alcohol consumption (i.e., at least once every day over the past 30 days) also presented with elevated anxiety as measured by the Beck Anxiety Inventory (Beck, Epstein, Brown, & Street, 1988). Indeed, the level of anxiety reported by heavy users was almost twice as high as those reported by mild and non-users. Conversely, in a sample of almost 500 boys participating in the Pittsburgh Youth Study (Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998), elevated anxiety, as indicated by the Achenbach rating system (Achenbach & Edelbrock, 1986, 1987; Achenbach, 1991) was unrelated to the development of alcohol abuse, and *negatively* associated with subsequent symptoms and diagnoses of alcohol dependence (Pardini et al., 2007). Finally, Lewinsohn, Shankman, Gau, and Klein (2004) examined relations among anxiety and AUDs in a sample drawn from the Oregon Adolescent Depression Project (OADP; Lewinsohn, Hops, Roberts, Seeley, & Andrews, 1993). Employing a structured clinical interview, the authors found that while subthreshold anxiety was positively associated with the subthreshhold and threshold AUDs, the diagnosis of a full-symptom anxiety disorder (i.e., all diagnoses combined into a single group, "anxiety") was unrelated to the presence of an AUD. Taken together, findings such as these suggest that anxiety psychopathology may be an important variable to consider in terms of alcohol use problems among adolescents, although the precise nature and direction of the relation remains unclear.

One significant limitation of this body of work is the use of varied definitions of "anxiety" (e.g., trait anxiety, anxious/withdrawn behavior), as well as the treatment of anxiety as a unitary construct (e.g., the presence of any anxiety disorder) as opposed to examining specific constellations of symptoms. Such concerns have culminated in a call for more refined analyses of the relation between anxiety psychopathology and alcohol use behaviors among adolescents, including the differentiation of associations across the anxiety disorders (Cicchetti & Rogosch 1999; Clark, Smith, Neighbors, Skerlec, & Randall, 1994; Falk, Yi, & Hilton, 2008). Drawing upon work conducted with adults, there is reason to hypothesize that specific clusters of anxiety psychopathology may evidence distinct relations with alcohol

use behaviors (Falk et al., 2008; Kessler et al., 2005; Robinson et al., 2009), and thus non-specific indicators of anxiety (e.g., trait anxiety) and related risk factors (e.g., behavioral inhibition; Fox, Henderson, Marshall, Nichols, & Ghera, 2005) may not capture important variability in terms of specific relations across the anxiety disorders (e.g., Buckner et al., 2008; Marmorstein et al., 2010). To illustrate, Buckner and colleagues (2008) examined data collected in the OADP discussed above, from which Lewinsohn and colleagues (2004) reported no association between the presence of an anxiety disorder and AUDs. However, when adolescent social anxiety disorder was isolated as the primary predictor, findings indicated a significant association with alcohol dependence at age 30 years (after controlling for gender, conduct disorder, as well as additional anxiety and mood disorders; Buckner et al., 2008). Importantly, in contrast to the rather well-developed adult literature that includes a number of integrative reviews (e.g., Allan, 1995; Brady, & Lydiard, 1993; Kushner et al., 1990), a synthesis of the extant literature focused on patterns of comorbidity among adolescents remains absent, limiting conclusions that may be drawn in this domain.

Systematic examination of associations among specific constellations of anxiety symptoms and the onset, maintenance, and progression of alcohol use behaviors (e.g., initiation, regular, hazardous, and symptomatic use) among adolescents is important for at least two reasons. First, efforts aimed at delineating temporal and potentially causal relations among alcohol use behaviors and anxiety psychopathology requires research examining incidence and progression *as they occur* (cf. retrospective report) before strong conclusions may be drawn with regard to how these relations play out in adolescence. Alcohol use typically begins during adolescence (Johnston et al., 2008; Newes-Adeyi, Chiung, Williams, & Faden, 2005; Wittchen et al., 2008), adolescents progress more rapidly from initial use to problematic outcomes as compared to adults (e.g., alcohol dependence; Deas, Riggs, Langenbucher, Goldman, & Brown, 2000), and the onset of many anxiety disorders/ symptomatology (e.g., simple/specific phobias, panic attacks/disorder, social anxiety disorder; Last, Perrin, Hersen, & Kazdin, 1992) often occurs during adolescence, highlighting adolescence as a key period in which to better understand the etiology of anxiety, alcohol use behaviors, and their co-occurrence. Second, adolescence itself is a unique developmental phase, characterized by profound biopsychosocial development (e.g., puberty; Hayward, 2003; Rogol, Roemmich, & Clark, 2002) combined with distinct socioemotional and demographic characteristics (e.g., living with a parent/guardian; Arnett, 2000, 2007). Researchers and theorists therefore argue that adolescent anxiety psychopathology and alcohol use behaviors must be considered in the context of this developmental phase (Cicchetti & Rogosch, 1999; Deas et al., 2000). For example, research suggests that, as compared to adults, adolescents evidence attenuated sensitivity to many of the negative effects of alcohol (e.g., motor impairment, dysphoria), along with heightened sensitivity to some of the positive effects (e.g., social facilitation; please see Windle et al., 2008 for a review). Further, adolescent alcohol consumption also may have particular effects on neurological, physiological, cognitive, and social development that are not evidenced by adult alcohol users by virtue of the rapid development occurring during this period (please see Brown et al., 2008 for a review). For these reasons, “downward extension” of risk-factor models defined by work with adults without direct evaluation of the nature and extent to which these relations exist among adolescents can be misleading, particularly in terms of alcohol use (Deas et al., 2000; Dunn & Mezzich, 2007).

Collectively, there is a need to better understand the linkage between adolescent anxiety psychopathology and alcohol use behaviors. The goal of the next section is therefore to critically review and synthesize the relevant empirical literature. Here, key constructs are defined and a detailed description of the extant literature is provided (also, please see Table 1).

Anxiety and Alcohol Use among Adolescents: Extant Literature

Definitions of Key Constructs

Anxiety—Research suggests that anxiety disorder diagnoses (e.g., generalized anxiety, social anxiety) represent unique dimensions of psychopathology among adolescents, and despite some overlap in symptoms specific diagnoses should be treated as distinct diagnostic constructs (e.g., Ferdinand, Dieleman, Ormel, & Verhulst, 2007). Accordingly, all studies utilizing criteria defined in the Diagnostic and Statistical Manual for Mental Disorders-IV-Text Revision [DSM-IV-TR; American Psychiatric Association (APA), 2000] for specific constellations of anxiety symptoms or diagnostic status were included (i.e., agoraphobia, generalized anxiety/overanxious disorder, obsessive-compulsive disorder, panic attacks/ panic disorder, separation anxiety disorder, social anxiety disorder/social phobia, and simple/specific phobias). Research on traumatic event exposure or posttraumatic stress disorder was excluded from the current manuscript as these data have been comprehensively reviewed elsewhere (Blumenthal et al., 2008); however, general findings from this review are included to facilitate comparison across the anxiety disorders.

Alcohol use and use-related problems—All stages of alcohol use were considered relevant to the current review, including alcohol use history (i.e., ever having used, frequency of use, standard quantity consumed), age of onset, hazardous use/binge drinking (i.e., ≥ 5 drinks in a single sitting), as well as alcohol abuse/dependence diagnostic status (APA, 2000). Finally, consistent with extant work underscoring the importance of patterns of use (e.g., irregular, recurrent) as well as progressive trajectories (Kandel & Logan, 1984; Windle et al., 2008; Yamaguchi & Kandel, 1984a; 1984b), research focused on these dimensions of alcohol use also was evaluated for inclusion.

Age range—As outlined above, the current review targets research with youth (i.e., under 18 years of age) in order to uniquely extend the extant literature on alcohol use and anxiety psychopathology. All studies focused on children (below age 10) and adolescents (ages 10 to 17) were included; studies were excluded if a wide study age range primarily reflected adulthood (e.g., National Comorbidity Survey; Kessler, 1994), if they focused solely on participants age 18 years and older, or if they relied solely on adult reports of childhood experiences, which may be more susceptible to reporting and memory biases associated with retrospective reporting across long periods of time (Nisbett & Ross, 1980). Importantly, no studies were found examining youth below age 10 years, and thus the current manuscript focuses solely on adolescents.

Literature search method—First, a search of electronic databases (PsycINFO, PUBMed, Science Direct) was conducted. All combinations of the following key words were used: anxiety, separation anxiety, social anxiety, phobia, agoraphobia, social phobia, specific phobia, generalized anxiety disorder, GAD, worry, obsessive compulsive disorder, OCD, obsession, compulsion, panic, panic attack, and panic disorder; adolescents, adolescence, children, childhood, juvenile, and youth; and substance, alcohol, ethanol, beer, wine, liquor, and drinking. Second, all articles cited in these initially identified articles that were potentially relevant to the current review were collected (backwards literature search). Empirical studies written in English were included if they met the inclusion criteria outlined above. This search yielded 16 relevant empirical articles. Please see Table 1 for a synopsis of the study findings (i.e., analytic approach, sample, operational definitions, and relevant findings). Studies are organized first by the specific disorder/symptomatology examined. Within each category/symptom cluster studies are presented as a function of level of alcohol use examined (e.g., ever used, hazardous use, AUDs).

Agoraphobia

Two studies to date have focused on adolescent agoraphobia and alcohol use behaviors, using markedly different methodological approaches. First, Zimmerman and colleagues (2003) investigated relations among several different anxiety disorders, including agoraphobia, and problematic drinking across four years in the Munich Early Developmental Stages of Psychopathology study (EDSP). Specific drinking behaviors examined were: regular use (i.e., drinking at least three times per week at peak use), hazardous use [drinking at least 40 g/day (male participants) or 20 g/day (female participants) during peak use], any AUD diagnosis, alcohol abuse without dependence, and alcohol dependence. At baseline, a diagnosis of agoraphobia was significantly related to increased regular use, hazardous use, the diagnosis of any AUD, and alcohol dependence. Prospective analyses, controlling for several demographic and psychological variables (e.g., age, other anxiety disorders, depression, illegal drug use disorders; please see Table 1) demonstrated no further associations between baseline agoraphobia and the onset or persistence of evaluated alcohol use behaviors at follow-up. Second, Clark and colleagues (1995) examined the prevalence of anxiety disorders, including agoraphobia, among adolescents in an inpatient psychiatric unit; these authors found rates of the disorder to be much higher among adolescents presenting with an AUD (6.9%) than those found in the general community (e.g., 1–2%; Kessler at al., 2005).

The scarcity of studies currently precludes definitive conclusions regarding the association between agoraphobia and alcohol use behaviors among adolescents; concurrent relations with problematic use (e.g., regular use; AUD) were observed in both a clinical and a community-based sample, although there was no evidence that agoraphobia predicts subsequent alcohol use behaviors. Future research will be required to determine whether comorbidity is consistently evident across multiple studies, how symptoms and diagnosis relate to different stages of alcohol use (e.g., onset, hazardous use, AUD), and the specific role of agoraphobia as compared to co-occurring panic-like symptoms or panic disorder.

Overanxious/ Generalized Anxiety Disorder

Overanxious disorder no longer appears in the most recent addition of the DSM (i.e., DSM-IV-TR; APA, 2000); the associated cluster of symptoms (i.e., excessive worry accompanied by physiological response) has been re-conceptualized as generalized anxiety disorder (GAD) in this most recent addition. Nonetheless, it warrants mention that three independent studies suggest overanxious disorder does not predict consumption history (e.g., ever drank, binge drinking; King, Iacono, & McGue, 2004), or the presence of an AUD (Neighbors, Kempton, & Forehand, 1992), nor is it more frequent among adolescents diagnosed with an AUD (Clark et al., 1995).

With regard to GAD, two prospective examinations suggest that this condition may be related to particular alcohol use behaviors among adolescents. First, Kaplow, Curran, Angold, and Costello (2001) found a positive relation between symptoms of generalized anxiety among currently abstaining adolescents and the *initiation* of alcohol use across a four year period. This association was significant after controlling for age, gender, race, and depressive symptoms. Further, in the study discussed above, Zimmerman and colleagues (2003) found that the diagnosis of GAD at baseline was related to hazardous alcohol use; however, baseline GAD was not significantly associated with the onset or persistence of identified drinking behaviors across the four year period (e.g., regular use, hazardous use, AUD).

Taken together, the small extant literature suggests GAD symptoms and diagnosis may be related to increased experimentation, although the diagnosis does not uniquely predict

problematic use over time. These are necessarily tentative conclusions; additional work is needed to more firmly establish the nature and direction of the GAD-alcohol use behavior association.

Obsessive Compulsive Disorder

Only one study to date has examined the relation between OCD and alcohol use behaviors among adolescents. Specifically, Clark and colleagues (1995) reported a diagnosis of OCD among 2.3% of their sample of inpatient adolescents with an AUD. Although comparable to rates found in the general community (i.e., 1–2%; Clark et al., 1994), additional research will be necessary to clarify potential associations among different stages of alcohol use (e.g., initiation, regular) and symptoms/diagnosis of OCD. Further, OCD is a heterogeneous diagnosis, encompassing symptom patterns related to a number of different target obsessions and/or compulsions (e.g., contamination, religiosity); thus, it also will be important to differentiate consumption patterns across varied manifestations of adolescent OCD.

Panic Attacks/Panic Disorder

Extending qualitative work suggesting a linkage between panic spectrum problems and problematic alcohol use among adolescents (i.e., binge drinking; Gardner & Kutcher, 1993), seven quantitative studies have employed a variety of techniques to further clarify the nature of this relation. First, Hayward and colleagues conducted a series of studies examining relations among panic and alcohol use history. These authors found no relation between a positive history of panic attacks and ever having used alcohol among 95 ninth-grade girls and boys (Hayward, Killen, & Taylor, 1989), or current alcohol consumption (i.e., at least 2–4 full beverages or "being drunk" over the past 30 days) within a group of 160 young adolescent girls (M_{age} = 11.8 years; Hayward et al., 1995). Conversely, among more than 1,000 adolescent girls (Hayward et al., 1997), participants reporting a history of both cued and uncued panic attacks evidenced significantly higher rates of current alcohol consumption (as described above) as compared to girls who had never had a panic attack.

Zimmerman and colleagues (2003) found that a positive history of panic attacks was associated with an increased likelihood of regular alcohol use, hazardous use, the diagnosis of any AUD, alcohol abuse, and alcohol dependence at baseline. Further, adolescents who had experienced a panic attack were more likely to report the onset of hazardous use and alcohol abuse, as well as the persistence of any AUD during the follow-up period. Finally, the diagnosis of panic *disorder* was associated with the diagnosis of any AUD, and alcohol dependence specifically, at the baseline assessment, as well as the persistence of any AUD during the follow-up period.

Similarly, Domalanta, Risser, Roberts, and Risser (2003) found that among incarcerated adolescents diagnosed with panic disorder, 61.4% presented with comorbid alcohol abuse symptoms; this rate of alcohol-related symptoms is much higher than typically observed in community-based samples (e.g., 0.4–9.7%; Chung, Martin, Armstrong, & Labouvie, 2002), although the ability to generalize from the results of this study are limited by the unique nature of the sample. Further, Goodwin and colleagues (2004) also analyzed data collected in the Munich EDSP discussed earlier, finding that AUDs were more prevalent among adolescents with a positive history of panic attacks as compared to those who had never experienced a panic attack at baseline, and the presence of panic attacks at baseline was significantly associated with the onset of an AUD during the four-year follow-up period (after controlling for age, gender, and all other diagnoses). Finally, Clark and colleagues (1995) approached this question from a different angle, finding that panic disorder was diagnosed among 2.3% of their sample of inpatient adolescents with a current AUD, a rate

that is comparable to that observed in community-based samples (e.g., 2.1%; Kessler et al., 2009).

Taken together, this growing body of work suggests that among older adolescents, particularly after controlling for comorbid psychopathology and additional related variables (e.g., gender, ethnicity), both panic attacks and panic disorder may confer specific risk for problematic alcohol consumption (e.g., regular use, hazardous use; AUD). Indeed, these data suggest that the diagnosis of panic *disorder* evidences a robust relation with problematic alcohol consumption among adolescents (i.e., odds ratios ≥ 3.0; Haddock, Rindskopf, & Shadish, 1998), and there is initial evidence to suggest that the onset of panic may predate the onset of problematic consumption (e.g, Goodwin et al., 2004; Zimmerman et al., 2003). A next step in this line of research will be to examine the temporal relations among panic (i.e., symptoms, full-symptom attacks, panic disorder diagnosis) and specific alcohol use behaviors among adolescents, including more refined analyses aimed at addressing potential moderators, mediators, and/or shared factors in these relations.

Separation Anxiety

Four studies extended initial qualitative data that suggested a potential linkage between separation anxiety and episodic binge drinking (Gardner & Kutcher, 1993). First, in the study noted above, Kaplow and colleagues (2001) found that adolescents reporting elevated separation anxiety symptoms were significantly *less* likely to have initiated alcohol during the four-year follow-up period. Further, King and colleagues (2004) found no significant differences in alcohol use history (e.g., ever drank, binge drinking) by age 14 years as a function of SAD status at age 11 years.

Next, in their sample of inpatient adolescents diagnosed with an AUD, Clark and colleagues (1995) found that 11.6% also presented with comorbid separation anxiety disorder (SAD); a rate that falls within the range of lifetime estimates found in other community-based work (i.e., up to 18.6%; Clark et al., 1994). Finally, prospective analyses conducted by Brückl and colleagues (2007) indicated that SAD was unrelated to alcohol abuse, although it evidenced an association with alcohol dependence in the EDSP sample. Specifically, adolescents with SAD evidenced significantly higher rates of lifetime alcohol dependence (27.9%) as compared to those without the diagnosis (6.4%). Further, SAD at baseline predicted the subsequent onset of alcohol dependence at a four-year follow-up assessment, as well as demonstrating a significant association with lifetime alcohol dependence after controlling for additional DSM-IV psychopathology.

Collectively, available work suggests that SAD is generally unrelated to alcohol use behaviors among adolescents, with the important exception of one prospective study that reported a robust association with the presence, onset, and persistence of alcohol dependence. The specificity of this relation is striking, although it needs to be replicated, and future research is needed to better understand the underlying mechanisms and progression of these disorders as they co-occur.

Social Anxiety/Social Phobia

Five studies focused on the linkage between social anxiety and alcohol use behaviors. First, Blumenthal, Leen-Feldner, Frala, Badour, and Ham (2010) found that level of social anxiety was unrelated to frequency of alcohol consumption in a community-based sample of 50 adolescents, although rates of alcohol use in the sample were relatively low. Conversely, Zimmerman and colleagues (2003) found that social phobia was associated with the diagnosis of alcohol dependence, and prospective analyses demonstrated that baseline social

phobia was related to the onset of regular and hazardous use, as well as the persistence of alcohol dependence across the four-year follow-up period.

Similarly, in a large sample of adolescent twin girls, Nelson and colleagues (2000) reported a two-fold increase in the risk for a concurrent AUD diagnosis among those diagnosed with social anxiety disorder as compared to those without the diagnosis (controlling for chronological age). Further, among those with comorbid social anxiety disorder-AUD, the age of first social fear significantly predated the age of first alcohol intoxication. Essau, Conradt, and Petermann (1999) found that the presence of an AUD was evidenced by 9.6% of adolescents presenting with significant social fear (without meeting criteria for social phobia), and 23.5% of adolescents diagnosed with social phobia/social anxiety disorder (cf., 0.8–9.2% in community-based samples; Chung et al., 2002). Finally, among the inpatient adolescents with an AUD diagnosis assessed by Clark and colleagues (1995), 20.9% also presented with comorbid social phobia; a rate that also is higher than those observed in community-based samples (e.g., 9.2%; Kessler et al., 2009).

Collectively, this growing body of work is suggestive of a positive association between social anxiety and problematic alcohol use behaviors among adolescents. Further, large-scale retrospective (Nelson et al., 2000) and prospective (Zimmerman et al., 2003) work suggests that social anxiety is often the primary, or antecedent, disorder. Future research will be required to further delineate the specificity of social anxiety as a risk factor for problematic alcohol use among adolescents, the role of alcohol use behaviors in the maintenance and progression of social anxiety, as well as additional variables that may influence these relations.

Simple/Specific Phobias

Three studies have examined the link between simple/specific phobias and alcohol use behaviors. First, Zimmerman and colleagues (2003) reported significant baseline associations between the diagnosis of a specific phobia and hazardous drinking, the diagnosis of any AUD, alcohol abuse, and alcohol dependence; however, prospective analyses indicated that these relations did not persist over time. Next, Clark and colleagues (1995) reported that 16.2% of inpatient adolescents with an AUD also were diagnosed with a simple phobia; a rate which was not significantly different from that found in a matched control group drawn from the general community. Finally, Ilomäka and colleagues (2004) examined the relation between phobic disorders broadly (i.e., simple phobia, agoraphobia, social phobia) and alcohol dependence among adolescents in a psychiatric inpatient unit. After controlling for age, gender, and additional diagnoses, phobic patients were approximately 4.5 times more likely to present with alcohol dependence (without another substance use disorder) than were non-phobic patients. Finally, the onset of the phobic disorder preceded or occurred at the same time as the onset of comorbid substance dependence (including alcohol) in 90.5% of comorbid cases. Importantly, these findings are conflated with the inclusion of social phobia and agoraphobia, thus must be viewed with caution in terms of assessing relations with specific phobias exclusively.

The scant research on the specific phobia-alcohol use association suggests the link is tentative at best. Importantly, the diagnosis of a specific phobia can include a wide variety of focal fears (e.g., water, injections, specific animals) and thus, as in the case of OCD, it may be important to parse apart relations among specific manifestations of the disorder before definitive conclusions can be drawn.

Traumatic Event Exposure/PTSD

Finally, a growing body of work suggests an association between problematic alcohol use, traumatic event exposure, and PTSD, although findings are not uniform (Blumenthal et al., 2008). Specifically, with few exceptions (Lipschitz et al., 2003; Stein et al., 2002), extant work indicates a relation between traumatic event exposure and elevated (e.g., increased frequency; Schiff, Benbenishty, & McKay, 2006) and/or problematic alcohol use among adolescents (e.g., AUD symptoms/diagnosis; Clark, Lesnick, & Hegedus, 1997; Giaconia, Reinherz, & Silverman, 1995; Perkonigg, Kessler, Storz, & Wittchen, 2000). Further, preliminary analyses of temporal patterning suggests a bi-directional relation (Clark, Lesnick, et al., 1997; Perkonigg et al., 2000), with some work finding the most frequent temporal pattern to be an AUD preceding traumatization (Clark, Lesnick, et al., 1997), and others reporting traumatization predicting the onset of a subsequent AUD (Perkonigg et al., 2000). Research regarding the association between problematic alcohol use behaviors and PTSD has been less consistent, with a number of large-scale studies indicating a positive relation between PTSD and AUD diagnoses (e.g., Clark, Pollock, et al., 1997; Giaconia et al., 1995; Perkonigg et al., 2000), and other work finding no association above and beyond the effects of traumatic event exposure alone (Lipschitz, Rasmusson, Anyan, Cromwell, & Southwick, 2000; Schiff et al., 2006). Please see Blumenthal and colleagues (2008) for a comprehensive review of this literature, including discussion of potential moderators and mediators (e.g., cultural influences, motivational models) as well as future directions in terms of research and treatment design.

Summary

The literature focused on specific constellations of DSM-defined anxiety and alcohol use behaviors among adolescents is still in its infancy although some general patterns are discernable. Specifically, a final analysis of the extant literature in which the more rigorous studies available are given particular emphasis suggests that OCD and overanxious disorder are unrelated to adolescent alcohol use behaviors; generalized anxiety, SAD, specific phobias, and agoraphobia evidence tentative associations with specific alcohol use behaviors, and panic attacks, panic disorder, and social anxiety demonstrate relatively consistent associations with a wide variety of problematic alcohol use indicators. For example, the research to date suggests that certain constellations of symptoms are unrelated to frequency of alcohol use (e.g., SAD, social anxiety), but positively associated with the development of AUDs (e.g, Blumenthal et al., 2010; Brückl et al., 2007; Nelson et al., 2000; Zimmerman et al,, 2003), and others appear related to initiation of use, but not problematic use behaviors (e.g., GAD; Kaplow et al., 2001; Zimmerman et al, 2003). Further, initial evidence suggests that certain symptom clusters tend to onset prior to the development of problematic use behaviors (i.e., panic, social anxiety), whereas others evidence concurrent, but not prospective, associations (e.g., agoraphobia; Zimmerman et al., 2003). Finally, prior work suggests that traumatic event exposure and PTSD also evidence associations with elevated alcohol use (e.g., frequency) as well as the presence of an alcohol use disorder (please see Blumenthal et al., 2008). Collectively, these data suggest variation in the anxiety-alcohol use linkage among adolescents when specific diagnostic categories are considered; importantly, these data suggest unique relations with certain constellations of symptoms (e.g., panic disorder, social anxiety) even after variance associated with important demographic (e.g., gender), psychological (e.g., depression), and behavioral (e.g., other substance use) variables are accounted for (e.g., Zimmerman et al., 2003). However, the defining limitation of this body of work is its size; independent replication and extension of extant work is indicated for every anxiety disorder if we are to have a sophisticated and comprehensive perspective on alcohol use –anxiety comorbidity among adolescents. Further, no studies have utilized experimental or laboratory-based designs to better understand this association. The following discussion summarizes the methodological

strengths and challenges of the research base and utilizes an experimental psychopathology framework to provide specific suggestions for forwarding this important area of work.

Future Directions

Although considerable work is still required to draw definitive conclusions regarding the relative role of specific constellations of anxiety psychopathology in relation to adolescent alcohol use behaviors, there is some evidence to suggest that panic and social anxiety demonstrate relatively consistent associations and may hold predictive value in terms of the onset and progression of problematic drinking behaviors among adolescents. Accordingly, these two forms of psychopathology serve as primary illustrative examples in the discussion of specific ways in which this literature can best be advanced. In this section, methodological considerations and suggestions for future research are first articulated. Potential moderators, mediators, and shared factors of these relations are then highlighted and discussed as important factors to consider in forwarding developmentally sensitive models of anxiety-alcohol use comorbidity among adolescents.

General Methodological Considerations

First, it is important to note that the literature is characterized by single study data-collections (e.g., Clark et al., 1995; Zimmerman et al., 2003). Thus, independent replication of the current findings is a necessary first step in this line of research. Further, almost no work has sought to delineate relations among the onset, frequency, and progression of alcohol use as it relates to prodromal, subclinical, and diagnostic status across the anxiety disorders. A convergence of methodological approaches will be necessary to comprehensively address these questions. However, research to date has exclusively utilized self-report indices to measure anxiety and alcohol use behaviors. Efforts to reduce reporting biases (e.g., memory distortions), including the employment of multi-informant, “real time” (e.g., momentary random sampling), and experimental psychopathology procedures will enhance confidence in conclusions drawn from future work, particularly in terms of etiological and maintaining processes (e.g., self-medication; Robinson et al., 2009; Sayette, 1999). For example, preliminary work conducted with nicotine dependent adults indicates that individuals who report greater difficulty maintaining quit attempts (e.g., longer than 24 hours) also evidence increased negative affect (e.g., anxiety, irritation) in response to laboratory-based stressors, providing direct evidence for a link between emotional responding and smoking relapse indicated by prior self-report work (Brown, Lejuez, Kahler, & Strong, 2002; Zvolensky, Feldner, Eifert, & Brown, 2001). Because experimental psychopathology techniques represent an essential extension to the literature, the remainder of this section will focus specifically on this approach as an important avenue for better understanding the relation between adolescent anxiety and alcohol use outcomes.

The Role of Experimental Psychopathology

There is a rich history of using safe and effective techniques to model various affective and clinically-relevant states among children and adolescents (e.g., Brenner, 2000; Pine et al., 2005; Tsao, Lu, Kim, & Zeltzer, 2006). Careful application of these types of approaches, with particular attention to unique ethical issues that pertain to working with vulnerable populations, holds particular promise in terms of advancing our understanding of the anxiety-alcohol use linkage among adolescents. Indeed, experimental psychopathology techniques represent a uniquely powerful, yet thus far untapped, mechanism through which a more precise understanding of anxiety-problematic alcohol use comorbidity can be obtained. Work conducted with adults has provided important data regarding the linkage between anxiety and problematic alcohol use (e.g., Abrams, Kushner, Medina, & Voight, 2002; Coffey et al., 2002; Coffey, Stasiewiez, Hughes, & Brimo, 2006; de Wit, Söderpalm, Nikolayev, & Young, 2003; Mulligan & McKay, 2001). Ascertainment of similar or distinct

findings among adolescents, above and beyond other related variables (e.g., depression, illicit substance use), would enhance our understanding of developmental factors contributing to the anxiety-alcohol association.

There are at least three other benefits of experimental psychopathology methods that could significantly advance current models. First, tightly controlled experimental designs permit causally-oriented hypothesis testing and control for a number of threats to internal validity that characterize naturalistic work in this area. Second, experimental psychopathology techniques can incorporate real-time multi-modal assessment, allowing for more sophisticated analyses of complex behavioral, physiological, and cognitive correlates and potential mechanisms underlying comorbid presentation. Finally, laboratory analogues can provide important information regarding the etiology, maintenance, and treatment of comorbid conditions, particularly in the context of longitudinal designs. Each of these features is discussed in more detail below.

Experimental Design—The ability of researchers to induce anxious responding in the laboratory provides fertile ground for the assessment of alcohol-related variables in the context of anxiety, and there are multiple studies utilizing analogues of both panic (e.g., voluntary hyperventilation; Leen-Feldner, Feldner, Bernstein, McCormick, & Zvolensky, 2005; Unnewehr, Schneider, Margraf, Jenkins, & Florin, 1996) and social anxiety (e.g., the Trier Social Stress Test; Buske-Kirschbaum et al., 1997) among adolescents. Further, although ethical considerations clearly exclude the use of conventional alcohol-related manipulations among adolescents (e.g., alcohol administration; c.f., Behar et al., 1983), there are a number of available methods for assessing alcohol-relevant outcomes, including self-reported desire to use alcohol (e.g., Love, James, & Willner, 1998) and alcohol use expectancies (e.g., Fromme & D'Amico, 2000), as well as experimental tasks such as dichotic listening, dot probe, and implicit memory tasks designed to assess for selective attention to alcohol-related cues. These types of methods lend themselves to addressing causally-oriented hypotheses and allow for other important experimental features (e.g., random assignment; control groups) which can reduce concerns related to the specificity of associations identified in naturalistic designs (e.g., comorbid psychopathology, additional substance use). For example, attentional bias toward alcohol-relevant stimuli among adolescents randomly assigned to a social anxiety induction, as compared to a control condition, would provide evidence relevant to whether social anxiety elevates risk for increased alcohol consumption. Indeed, related work conducted with adult samples provides evidence for elevated alcohol consumption (e.g., number of beverages, strength of beverage) following a social stressor (e.g., Abrams et al., 2002; deWit et al., 2003); however, to date no work has examined this relation among adolescents. Importantly, such designs could be used among healthy adolescents in efforts to clarify questions related to etiology (Zvolensky, Lejuez, Stuart, & Curtin, 2001) as well as among adolescents with elevated social anxiety/social anxiety disorder addressing questions related to maintenance-type processes.

Multimodal, Real-Time Assessment—Experimental psychopathology techniques also allow for real time, multi-modal assessment, such that psychological (e.g., disorder-specific symptom level), cognitive (e.g., desire to drink), physiological (e.g., heart rate), neurological (e.g., prefrontal activation; Tapert et al., 2003) and behavioral (e.g., approach/avoidance behaviors during a speech task; Roelofs, Elzinga, & Rotteveel, 2005) responding to a challenge procedure can be concurrently assessed. These types of indicators would allow for the kinds of sophisticated analyses of the anxiety-problematic alcohol use association that are currently missing from the literature. For example, drawing upon adult work in the area (e.g., Coffey et al., 2002; Mulligan & McKay, 2001), self-reported anxiety, desire to drink, and psychophysiological responding to alcohol-relevant cues (e.g., words, pictures;

Lowman, Hunt, Litten, & Drummond, 2000; Tapert et al., 2003) following anxiety induction would provide a much richer picture of the alcohol-anxiety linkage among adolescents than is permitted by exclusive reliance on self-reported anxiety and alcohol use behaviors.

Longitudinal Designs—Prospective research designs are required to draw meaningful conclusions regarding the temporal, causal, and functional relations among anxiety symptomatology, disorder, and problematic alcohol use among adolescents. Indeed, questions related to temporal ordering are at the heart of this body of research. Although the majority of the extant literature has focused on the role of anxiety in promoting or exacerbating problematic drinking (i.e., anxiety temporally precedes and/or causally influences consumption; Carrigan & Randall, 2003; Robinson et al., 2009; Sayette, 1999), it is also plausible that 1) problematic alcohol use, via biological, cognitive, and/or social mechanisms precipitates or exacerbates anxiety psychopathology (e,g, Brady, & Lydiard, 1993; Haynes et al., 2005), or 2) both anxiety and problematic alcohol use may be related to an underlying, shared risk factor (e.g., genetic influences; Saraceno et al., 2009). Experimental psychopathology techniques can be integrated into longitudinal studies aimed at clarifying questions related to temporal order, providing a sophisticated and novel complement to traditional self-report methods and enhanced sensitivity to prodromal symptoms. Importantly, repeated assessment that begins *prior* to the onset of anxiety psychopathology and alcohol exposure will allow for a better understanding of the progression of comorbid problems. For example, if currently abstaining adolescents who evidence significant anxiety and/or attenuated dishabituation to a social stress task go on to evidence a problematic alcohol use trajectory (e.g., earlier initiation, symptoms of abuse or dependence, elevated coping-related consumption), the conclusion can be drawn that a proclivity to social anxiety is related to later alcohol use problems. Finally, experimental psychopathology methods can be used to assess the maintaining role of comorbidity in the context of treatment. Indeed, laboratory-based assessments of anxiety and alcohol craving in conjunction with clinical sessions among adults with these problems have provided promising functional and theoretical data which will be important to consider in the refinement of existing treatment models (e.g., Coffey et al., 2006).

Summary—At present, the available research on adolescent anxiety and problematic alcohol use poses more questions than are addressed. Further, while there is some evidence that anxiety psychopathology, particularly panic and social anxiety disorder, may confer risk for problematic alcohol use among adolescents, the literature is characterized by a number of limitations including a pressing need for additional studies. Going forward, sophisticated and creative research designs, including the use of experimental psychopathology techniques, will be needed to fully understand the nature and direction of the association. Finally, as articulated in the next section, the research base will be most usefully advanced by testing multivariate models in which key developmentally relevant mediators, moderators, and shared factors are examined.

Developmentally Relevant Moderators, Mediators, and Shared Factors

Comprehensive study of the nature of the anxiety-alcohol association among adolescents is needed, including systematic focus on variables that may account for (mediate) or influence (moderate) this linkage, as well as factors that drive the development and maintenance of anxiety and alcohol use problems (shared factors). Indeed, researchers have identified a broad range of factors which may contribute to problematic alcohol consumption among adolescents (e.g., genetic factors, executive function, depression, externalizing problems; Brown et al., 2008; Saraceno et al., 2009; Windle et al., 2008). Further, regular alcohol consumption often occurs in the context of additional substance use (e.g., nicotine, marijuana; Yamaguchi & Kandel, 1984a); accordingly, research examining the role of

polysubstance use and related processes (e.g., distress tolerance; Zvolensky, Feldner, et al., 2001) will be important in forwarding the larger literature, as well as the specificity of the anxiety-problematic alcohol use linkage, among adolescents. Gender, parental psychopathology, alcohol expectancies and motives, anxiety sensitivity, and pubertal timing are briefly illuminated here as specific variables in need of additional study. These particular factors were selected because they: 1) reflect important developmental facets of adolescence (e.g., increased gender typing, cognitive development; Galambos, Almeida, & Petersen, 1990; Kuhn & Franklin, 2006; Luna, Garver, Urban, Lazar, & Sweeney, 2004), 2) have been linked to both anxiety and alcohol use, as well as additional forms of psychopathology associated with alcohol use problems (e.g., depression; Brown et al., 2008) and problematic substance use broadly (e.g., Marsh & Dale, 2005; Wallace et al., 2003), and 3) can be readily incorporated into ongoing and future research designs (e.g., via self-report measures and/or brief clinical interviews). Finally, the phenomenology of adolescent alcohol use behaviors (e.g., polysubstance use) is briefly discussed prior to conclusionary remarks.

Gender—Although research suggests that overall, adolescent boys tend to be at greater risk for the onset of problematic drinking behaviors (e.g., Wallace et al., 2003), numerous large-scale studies indicate that female adolescents evidence elevated panic and social anxiety symptoms (Chorpita, Yim, Moffitt, Umemto, & Francis, 2000), as well as increased rates of panic attacks, panic disorder (Reed & Wittchen, 1998) and social anxiety disorder (Essau et al., 1999) as compared to male adolescents. To date, the role of gender in this line of work has been addressed, if at all, via methodological (e.g., Hayward et al., 1997; Nelson et al., 2000) or statistical (e.g., Goodwin et al., 2004; Zimmerman et al., 2003) control, and no work has directly examined the relation between adolescent panic or social anxiety and alcohol use behaviors across genders. A number of theoretically-relevant questions need to be addressed, including the specificity of associations across genders (e.g., Buckner & Turner, 2009), whether temporal patterning is similar across genders, as well as the role of gender-specific biological (e.g., sensitivity to alcohol) and contextual (e.g., cultural expectations) factors that may influence trajectories in terms of alcohol-anxiety comorbidity.

Parental psychopathology—The extant literature also suggests a high degree of co-occurrence across parent-child anxiety psychopathology (Beidel & Turner, 1997; McClure, Brennan, Hammen, & LeBrocque, 2001) and problematic alcohol use (Alati et al., 2005; Russell, 1990). Given high rates of comorbid alcohol use disorders, panic, and social anxiety among adults (Kushner et al., 1990), future research will benefit from further assessing whether and how comorbid anxiety-AUDs among parents relate to panic, social anxiety, and alcohol use behaviors among adolescents. A number of methodological techniques can be utilized to examine questions such as the presence of comorbidity among offspring of parents of varying diagnostic status as well as the direct and indirect role of genetic transmission, parental modeling, and information transmission in precipitating familial co-occurrence. For example, parental psychophysiological and behavioral response to an anxiety provocation procedure and voluntary alcohol administration task could be examined as prospective predictors of offspring anxiety psychopathology and alcohol use behaviors; such designs would begin to clarify the unique and additive/interactive effects of parental alcohol use behaviors and anxious reactivity on comorbid anxiety-alcohol use among their children. Further, assessment tools such as the Learning History Questionnaire (Ehlers, 1993; Stewart et al., 2001), modified to examine parental alcohol use in the context of anxiety, could then be tested as a partial mediator of parent and offspring drinking behaviors (e.g., actual and/or desired) following a laboratory-based anxiety induction.

Alcohol use expectancies and motives—Both positive outcome expectancies and coping-related motives for alcohol consumption evidence strong associations with increased

alcohol consumption (i.e., amount and frequency) and alcohol-related problems (e.g., missing school) among adolescents (Christiansen, Smith, Roehling, & Goldman, 1989; Comeau, Stewart, & Loba, 2001; Kuntsche, Knibbe, Gmel, & Engels, 2005). Drawing upon the extant literature conducted with adults, there is reason to believe that both panic and social anxiety may be related to increased coping-related alcohol consumption (Ham, Zamboanga, Bacon, & Garcia, 2009; Stewart, Morris, Mellings, & Komar, 2006; Thomas, Randall, & Book, 2008) as well as positive outcome expectancies (e.g., tension reduction, social facilitation; Lehman, Brown, Palfai, & Barlow, 2002; Mulligan & McKay, 2001; O'Hare, 1990), and preliminary evidence exists indicating increased coping-related motives for alcohol use among socially anxious (Blumenthal et al., 2010) and trauma-exposed (Dixon, Leen-Feldner, Ham, Feldner, & Lewis, 2009) adolescents. In addition to continued efforts to clarify the patterning of alcohol motives/expectancies and anxiety symptomatology among adolescents (e.g., Comeau et al., 2001), work in this area may be most usefully advanced by the use of experimental designs. For example, examination of the potential mediating or moderating role of alcohol use expectancies and motives in the relation between anxious responding to a laboratory-challenge and subsequent desire to consume alcohol would provide important information regarding potential mechanisms underlying these commonly comorbid conditions.

Anxiety sensitivity—Anxiety sensitivity (AS), or fear of anxiety-relevant sensations (e.g., racing heart; Reiss, 1991), is arguably the most well-established cognitive vulberability factor identified in research pertaining to both anxiety (Olatunji, & Wolitzky-Taylor, 2009; Taylor, 1999) and problematic alcohol use (e.g., Comeau et al., 2001; Schmidt, Buckner, & Keough, 2007). For example, research conducted with adolescents indicates that elevated AS is associated with fearful responding to a panic-relevant voluntary hypervenitlation challenge (Leen-Feldner et al., 2005) as well as problematic alcohol use behaviors (e.g., coping-related consumption; Comeau et al., 2001), and prospectively predicts the development of panic attacks (Hayward, Killen, Kraemer, & Taylor, 2000) as well as AUD diagnoses (sample age 16–24 years; Schmidt et al., 2007). Further, preliminary data suggest that selective interventions targeting AS, shown to increase abstinence and reduce alcohol-related problems (e.g., missing school; Conrod, Stewart, Comeau, & Maclean, 2006), also reduce the prevelance of panic attacks among adolescents (Castellanos & Conrod, 2006). Importantly, no work has directly tested the role of AS in terms of comorbid anxiety-problematic alcohol use among adolescents. The utilization of experimental psychopathology techniques as this literature advances could provide important data in terms of both prevention and treatment efforts, including the specific role of AS in this linkage. For example, the efficacy of prevention efforts targeting AS would be bolstered by data addressing real time responding to anxiety and alcohol-relevant provocations. Further, research indicating that comorbid, high-AS adolecents continue to evidence fearful responding to biological challenge procedures following successful AUD treatment would provide more compelling evidence for the role of AS as a shared vulnerability factor in terms of the panic-AUD linkage, and thus forward the development and research of intervention efforts targeting AS in precluding adolescent (and adult) panic-AUD comorbidity.

Pubertal timing—Finally, as previously discussed, the hallmark feature of this developmental phase, puberty (Hayward & Sanborn, 2002), evidences unique incremental validity in the prediction of both anxiety psychopathology and alcohol use (Hayward, 2003). Further, there is compelling evidence to suggest that early maturation in particular may confer specific risk for the development of panic-spectrum problems (please see Reardon, Leen-Feldner, & Hayward, 2009 for a review), social anxiety (Deardorff et al., 2007), as well as problematic alcohol use (Hayward, 2003), suggesting this may be a potential shared

risk factor. A number of proposed mechanisms have been implicated in these relations, including preparation for the psychosocial changes that accompany puberty (Deardorff et al., 2007; Hayward, 2003), increases in somatic perturbation (Reardon et al., 2009), real or perceived isolation from the larger peer group (Blumenthal et al., 2009; Greene, Kremar, Walters, Rubin, & Hale, 2000), as well as association with deviant peers (Hayward, 2003). However, prior to testing of these more sophisticated models of co-occurring anxiety psychopathology and alcohol use in the context of maturational timing, research must first establish *whether* pubertal development, and the timing of development specifically, is related to an increased risk for comorbid alcohol problems and social anxiety or panic, or whether it simply marks the onset of processes related to the independent development of each.

Phenomenology of alcohol use among adolescents—In seeking to better understand etiologic, intervening, and maintenance factors related to the anxiety-problematic alcohol use association among adolescents, careful attention must be paid to the broader context in which this linkage unfolds over time. In particular, it is noteworthy that polysubstance use is common (e.g., Kessler et al., 2005; Yamaguchi, & Kandel, 1984a) so for instance, clarifying the role of nicotine and/or marijuana in this association is warranted. Better integration of extant work linking anxiety to other types of substances will inform these efforts. From a methodological perspective, this could mean selecting samples on the basis of particular constellations of substances used (e.g., comparing anxious responding to a laboratory challenge as a function of alcohol versus co-morbid alcohol and marijuana use). For example, Buckner, Silgado, & Schmidt (2011) examined the role of gender and diagnostic status in predicting craving for marijuana throughout a speech task (as compared to a reading task) among marijuana using adults. Results indicated that increased craving was evidenced by women and participants with social anxiety disorder, particularly *during* the speech task; importantly, the speech task did not elevate craving among men (as compared to women) or those without social anxiety disorder (as compared to those with the diagnosis). Utilization of a similar paradigm to examine craving among adolescent alcohol, marijuana, and co-morbid users will provide important information regarding the role of gender and social anxiety in predicting adolescent substance use behaviors. Finally, efforts must be directed at disentangling anxiety psychopathology *per se* from correlated risk processes that also elevate risk for alcohol use, including distress tolerance (e.g., Zvolensky, Feldner, et al., 2001), impulsivity (e.g., Askénazy et al., 2003), and attentional biases (e.g., Field, Christainsen, Cole, & Goudie, 2007). This kind of fine-grained analysis is now needed if we are to have a sophisticated and comprehensive understanding of the complex relation between anxiety and alcohol use behaviors among adolescents.

Conclusion

Collectively, an emerging body of work suggests reliable associations among panic-spectrum problems, social anxiety, and problematic alcohol use behaviors among adolescents. Overall, the literature base is small; needed are studies aimed at replicating and uniquely extending available work as well as a more comprehensive evaluation of why and how these factors are related. Further, rigorous and creative methodologies are necessary to parse apart these proposed associations. Specifically, longitudinal and experimental designs aimed at specifying the relations among anxiety psychopathology and specific stages of alcohol use will be necessary for the development of sophisticated prevention and treatment efforts for indicated adolescents. The use of experimental psychopathology techniques specifically will significantly advance our understanding of the boundaries and underlying mechanisms related to anxiety-problematic alcohol use comorbidity among adolescents, and thus represent a critical next step in this line of research.

Acknowledgments

This project was supported, in part, by a National Institute on Alcohol Abuse and Alcoholism National Research Service Award (F31 AA018589) awarded to the first author.

Appendix A: Overview of research (listed alphabetically) on the relation between alcohol use and DSM-defined anxiety disorders among adolescents

Table 1

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
Blumenthal et al., 2010 *Cross-sectional* Descriptives; linear regression controlling for age, frequency of alcohol use, and affective problems	$N = 50$ adolescents (12–17 years; $M_{age} = 16.35$, $SD = 1.1$ years; 52% girls; 10% Hispanic, 78% Caucasian, 10% African American, 2% Native American, 10% "other") with a positive history of alcohol consumption drawn from the general community	**DSM Anxiety** Level of social anxiety **Alcohol Use** Current frequency of use Motives for use (i.e., coping, enhancement, social, conformity)	RCADS-SP AADIS DMQ-R	• Across entire sample: • Social anxiety $M = 8.10$, $SD = 5.08$; 30% "tried" alcohol, 36% used several times per year, 18% several times per month, 16% on weekends • Social anxiety unrelated to frequency of alcohol use ($r = .10$), enhancement ($r = .20$), social ($r = .23$), or conformity motives ($r = .10$), and significantly associated with coping motives ($r = .47$) • **Primary analyses** • After controlling for age, frequency of alcohol use, and affective problems, level of social anxiety significantly predicted coping-related motives ($t = 2.69$, $\beta = .41$, $sr^2 = .13$), but not enhancement ($sr^2 = .00$), social ($sr^2 = .07$), or conformity motives ($sr^2 = .00$)

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
Brückl, et al., 2007 *Prospective (4-year)* Frequency counts; Cox regressions with time-dependent covariates adjusted for gender and age	*N* = 1,090 youth (14–24 years) who completed baseline (ages 14–17 years) and two follow-up assessments (approximately 2 years apart), drawn from a larger random population sample of residents in Munich	**DSM Anxiety** SAD Symptomatic: at least one SAD symptom Subthreshold: falls short of diagnosis by one criterion Threshold: meets DSM-IV criteria **Alcohol Use** Lifetime alcohol abuse and dependence	M-CIDI	• **Alcohol abuse (AA)** • Present in 20.9% of no SAD group, 17.5% of Symptomatic group (OR: 1.0, 95% CI: 0.5–2.0), 15.3% Subthreshold (OR: 0.8, 95% CI: 0.4–1.6), and 7.3% Threshold (OR: 0.3, 95% CI: 0.0–2.7) • AA was not significantly related to subthreshold (HR = 0.9, 95% CI: 0.5–1.6) or threshold (HR = 0.5, 95% CI: 0.0–2.8) SAD • **Alcohol dependence (AD)** • Present in 6.4% of no SAD group, 8.8% of Symptomatic group (OR: 1.9, 95% CI: 0.7–4.6), 11.3% Subthreshold (OR: 2.3, 95% CI: 1.0–5.2, $p < .05$), and 27.9% Threshold (OR: 17.7, 95% CI: 1.8–32.7, $p < .05$) • AD significantly associated with subthreshold (HR = 2.1, 95% CI: 1.1–4.1) and threshold (HR = 4.7, 95% CI: 1.7–12.4) SAD • Strictly prospective analyses indicated that SAD predicted the subsequent onset of AD (OR: 3.3, 95% CI: 1.06–10.2) • Relation between subthreshold

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
				SAD and AD lost statistical significance when controlling for DSM-IV disorders occurring prior to SAD (HR = 1.8, 95% CI: 0.9–3.3)Relation between threshold SAD and AD remained stable after controlling for prior DSM-IV disorders as well as lifetime panic disorder with agoraphobia (HR = 3.5, 95% CI: 1.02–12.1)
Clark et al., 1995 *Cross-sectional (descriptive)* Frequency counts; McNemer test for dependent samples	*N* = 132 adolescents *n* = 43 youth (ages 12–18 years, M_{age} = 15.8, *SD* = 1.3 years; 51% girls; 79% Caucasian, 21% African American) diagnosed with an AUD from an inpatient psychiatric unit *n* = 89 adolescents from the community *n* = 30 pairs selected from the above samples matched on age, gender, race, and mother's education level	**DSM Anxiety** Social phobia Simple phobia Overanxious disorder SAD Agoraphobia OCD Panic Disorder GAD **Alcohol use** AUD (inpatient participants only)	K-SADS (1981) LHA Interview	• Among all inpatient youth: 39.5% were met criteria for any anxiety disorder, 27.9% multiple anxiety disorders, 20.9% social phobia, 16.2% PTSD, 16.2% simple phobia, 13.9% overanxious disorder, 11.6% SAD, 6.9% agoraphobia, 2.3% OCD, 2.3% PD, and none for GAD • Inpatient youth with an anxiety disorder: 88.2% comorbid affective disorder, 64.7% disruptive behavior disorder • Matched pairs: anxiety disorders diagnosed in significantly more inpatient (36.6%) than community (10%) participants

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
				• Simple phobias did not differ across groups • 23.5% of patients who had met criteria for an anxiety disorder at intake were noted as having an anxiety disorder at discharge
Domalanta et al., 2003 *Cross-sectional (descriptive)* Frequency counts	*N* = 1,024 (19% Caucasian, 39% African American, 35% Hispanic, 7% "other") adolescents (ages 11–18 years; 26% girls) held in the Harris County Juvenile Detention Center for more than 48 hours	**DSM Anxiety** Panic Disorder **Alcohol Use** Symptoms of alcohol abuse in the past 6 months	PHQ	• 9.7% of youth presented with MDD, 11.9% with symptoms of a depressive disorder NOS, 4.7% with symptoms of another mood disorder, 40.3% with symptoms of drug abuse, 14.8% with symptoms of a somatoform disorder, and 8.4% with symptoms of any anxiety disorder • 5.4% met criteria for PD • 26.3% presented with symptoms of alcohol abuse • Of those with PD, 61.4% presented with comorbid alcohol abuse symptoms
Essau et al., 1999 *Cross-sectional (descriptive)* Frequency counts	*N* = 1035 adolescents (ages 12–17 years; M_{age} = 14.3, *SD* = 1.7 years; 59% girls) randomly selected from 36 schools in Bremen	**DSM Anxiety** Social Phobia Social fear: endorsed significant fear of at least one social situation without meeting full criteria for social phobia **Alcohol Use** Lifetime AUD	M-CIDI	• 47.2% endorsed social fears; 1.6% met criteria for social phobia • **Any social fear** • 24.3% presented with a depressive disorder, 25.4% an anxiety disorder, 17.8% a somatoform disorder, and 12.3% any SUD • 9.6% presented a lifetime AUD

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
				• **Social phobia** • 29.4% presented with a comorbid depressive disorder, 64.7% at least one other anxiety disorder, 41.2% a somatoform disorder, and 23.5% any SUD • 23.5% presented with an AUD
Gardner & Kutcher, 1993 *Case study* Case descriptions	*N* = 3 youth (one 17 year old boy, one 17 year old girl, and one 18 year old girl) presenting with dimenhydrinate abuse	**Case 1: DSM** **Anxiety** Panic disorder **Alcohol use** Lifetime alcohol abuse **Case 2: DSM** **Anxiety** Separation anxiety Panic attacks **Alcohol use** History of use **Case 3: DSM** **Anxiety** Panic attacks **Alcohol use** History of use	K-SADS Urine analysis K-SADS Not identified Self-reported use Not identified Self-reported use	• **Case 1** • 17 year old boy, met criteria for MDD, dysthymia and PD • Denied alcohol abuse and urine analysis was negative • **Case 2** • 18 year old girl diagnosed with depression, separation anxiety which spontaneously remitted by age 14 years, and repeated panic attacks • Reported occasional alcohol use and binge drinking • **Case 3** • 17 year old girl, diagnosed with bipolar disorder type II and occasional panic attacks • Reported occasional alcohol use and binge drinking
Goodwin et al., 2004 *Prospective (4-year)* Frequency counts; logistic regression adjusted for age and gender	*N* = 3,021 youth (14–24 years) drawn from a government registry of residents in Munich *n* = 1,228 (ages 14–17 years at	**DSM Anxiety** Panic attacks **Alcohol use** Lifetime AUD	M-CIDI	• **Baseline prevalence** • 4.3% presented with a lifetime history of panic attacks

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
	baseline) completed the 2-year follow-up assessment n = 2548 (ages 14–24 at baseline) completed the 4-year follow-up assessment			• 15.9% presented with an AUD • AUD more frequent among those with panic attack history (34.9%) than those without (15.1%; OR: 4.3, 95% CI: 2.6–7.2, $p < .05$) • **Cumulative lifetime incidence** (total incident cases at baseline and both follow-up assessments) • 7.2% presented with a lifetime history of panic attacks • 28.5% presented with an AUD • Participants with panic attack history more likely to present with an AUD at any assessment than those without (OR: 2.7, 95% CI: 1.9–4.0, $p < .05$) • **Incidence at follow-up** • Controlling for age, gender, and all other diagnoses, onset of AUD during follow-up more frequent among those with panic attacks at baseline (21.2%) than those without (14.8%; OR: 2.4, 95% CI: 1.2–5.1, $p < .05$)
Hayward et al., 1997 *Cross-sectional* Logistic regression	N = 1,013 female adolescents (ages 11.6–16.2 years; M_{age} = 13.5, SD = 0.7 years; 34.5%	**DSM Anxiety** Panic attacks Panic disorder **Alcohol Use** Consumption over past 30 days	SCID Selected questions from the Project SMART Questionnair e (Graham et al., 1984)	• 1.7% met criteria for PD • 3.8% met criteria for panic attacks but not PD; 50% (1.9%

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
	Caucasian, 29.3% Hispanic, 14.8% Asian, 8.1% Pacific Islander, 13.3% "other") from four suburban public middle schools near San Jose, CA			entire sample) reported attacks uncued • After controlling for ethnicity, alcohol consumption (i.e., at least 2–4 full drinks or "being drunk") was more frequently reported by girls with PD (24.4%) and panic attacks (31.6%) than those without a history of panic (14.1%; OR: 3.1, 95% CI: 1.5–6.6, $p < .05$) • Alcohol use did not differ significantly between girls with cued versus uncued (including those with PD) panic attacks
Hayward et al., 1989 *Cross-Sectional* Frequency counts; Yates-corrected chi-square analysis	$N = 95$ ninth-grade students (age 14–16 years, $M_{age} = 14.5$; 48% girls; 14.7% Hispanic, 48.4% Caucasian, 20% Asian, 6.3% African American, 3.2% Native American, 5.4% "other") in one of three physical education classes at a suburban high school in California	**DSM Anxiety** Panic Attacks **Alcohol use** Consumption history	SCID Ever used alcohol	• 11% experienced at least one four-symptom panic attack; 3.2% at least one limited-symptom panic attack • Youth who had experienced panic attacks evidenced significantly higher symptoms of depression and were significantly more likely to have tried smoking cigarettes • Prior alcohol use reported by 77% of those with panic, and 83% of those without • Ever having used alcohol did not differ significantly across groups

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
Hayward et al., 1995 *Cross-sectional* Frequency counts; matched-pair t-tests	*N* = 160 female adolescents (Mage = 11.8, *SD* = 0.7; 42.5% Caucasian, 12.5% Asian-American, 45% Hispanic) drawn from a sample of girls who participated in a health curriculum intervention study in two northern California school districts	**DSM Anxiety** Panic attacks **Alcohol use** Consumption over past 30 days	SCID Selected questions from the Project SMART Questionnair e (Graham et al., 1984)	• 40 girls had experienced at least one lifetime panic attack • 120 girls were selected for the matched comparison group; for each panic participant, three girls who had never had a panic attack were matched for age, pubertal status, and ethnicity • Alcohol use did not differ across groups • 18% of each group reported alcohol consumption (i.e., at least 2–4 full drinks or "being drunk")
Ilomäka et al., 2004 *Cross-sectional* Frequency counts; logistic regression adjusted for age, gender, and additional diagnoses	*N* = 238 adolescents (ages 12–17 years; 56% girls) admitted to the psychiatric inpatient facility at Oulu University Hospital between April 2001 and July 2003	**DSM Anxiety** Phobic disorders (simple phobia, agoraphobia, and social phobia) **Alcohol use** Alcohol dependence	K-SADS	• 43.3% presented with a depressive disorder, 3.4% with bipolar disorder, 43.3% with conduct and oppositional defiant disorder, 29.8% with an anxiety disorder other than a phobia, 11.3% psychotic, 8.8% "other" • 18.1% presented with a phobic disorder • Phobic disorders more prevalent among patients with alcohol dependence (28.9%) than those without a SUD (13.1%) • After controlling for age, gender, and additional diagnoses, phobic patients were significantly

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
				more likely to present with alcohol dependence (without another SUD) than non-phobic patients (OR: 4.47, 95% CI: 1.63–12.29, $p < .01$) • The phobic disorder preceded or began at the same time as substance dependence (including alcohol) in 90.5% of comorbid cases
Kaplow et al., 2001 *Prospective (4-year)* Descriptives; *t*-tests; logistic regression	$N = 936$ adolescents ($M_{age} = 10.77$, $SD = 1.59$; 45.4% girls; 70.3% Caucasian, 6% African American, 23.7% Native American) initially interviewed at age 9, 11, or 13, and then followed for four years	**DSM Anxiety** Generalized anxiety symptoms Separation anxiety symptoms **Alcohol use** Initiation of alcohol use	CAPA Parent or child reported child drinking at least one alcoholic beverage during the follow-up period	• 17% of participants initiated alcohol use within the follow-up • Initiation of alcohol use not significantly related to generalized anxiety [$t(934) = 0.88$] or separation anxiety [$t(934) = -1.13$] symptoms • **Logistic regression controlling for age, gender, race, and depressive symptoms:** • Elevated symptoms of generalized anxiety at baseline predicted initiation of alcohol use during follow-up (OR: 1.14, 95% CI: 1.03–1.25, $p < .05$) • Youth with elevated separation anxiety at baseline were less likely to initiate alcohol use during follow-up (OR: 0.71, 95% CI:

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
				0.51–0.94, $p < .05$)
King et al., 2004 *Prospective (3-year)* Frequency counts; log-linear analyses adjusted for non-independence of observations on twin pairs	*N* = 708 twin girls (age 11 years at baseline and 14 years at follow up) taking part in the larger Minnesota Twin Family Study	**DSM Anxiety** SAD Overanxious disorder **Alcohol use** General consumption history	DICA-R Ever used Regularly use Ever drunk Ever binge drink	• By age 14 years, 29% ever drank, 9.6% regularly drank (≥ 1 drink/month over the past year), 10.7% had been drunk, 8.8% at least one binge drinking episode (≥ 6 beers, bottle of wine, or 4–5 liquor drinks in one sitting) • **SAD at age 11 years** • By age 14 years 35.6% ever drank, 12.9% regularly drank, 13.7% had been drunk, and 10.9% binge drinking • Not significantly related to any drinking outcome at 14 years: • Ever drank OR: 1.38, 95% CI: 0.92–2.07; Regularly drank OR: 1.32, 95% CI: 0.71–2.47; Ever drunk OR: 1.57, 95% CI: 0.96–2.58; Binge drinking OR: 1.36, 95% CI: 0.72–2.57 • **Overanxious disorder at age 11 years** • By age 14 years 30.2% ever drank, 11.1% regularly drank, 9.3% had been drunk, and 9.3% binge drinking • Not significantly related to any drinking

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
				outcome at 14 years: • Ever drank OR: 0.82, 95% CI: 0.45–1.49; Regularly drank OR: 0.81, 95% CI: 0.81–3.60; Ever drunk OR: 0.99, 95% CI: 0.64–1.54; Binge drinking OR: 1.00, 95% CI: 0.42–2.41
Neighbors et al., 1992 *Cross-Sectional* Frequency counts; chi-square analysis; descriptives; ANOVA	*N* = 111 youth (ages 12.7–18.7 years, M_{age} = 15.11 years; 47.7% Caucasian, 52.3% African American) currently incarcerated in detention facilities in the southeast US and flagged at intake for potential mild-severe mental health problems	**DSM Anxiety** Overanxious disorder **Alcohol use** Current AUD	DISC-2	• *n* = 59 youth with no AUD/SUD • *n* = 23 youth with an AUD (alone or with comorbid marijuana abuse/dependence) • *n* = 29 youth with an illicit SUD (polysubstance users; most with a comorbid AUD) • Among youth diagnosed with overanxious disorder, 17% presented with no AUD/SUD, 22% with an AUD, and 38% polysubstance use/SUD • Chi-square analysis evidenced no significant differences across groups ($p < .09$) • Significantly more AUD (96%) and polysubstance (93%) youth diagnosed with conduct disorder as compared to no SUD group (62%) • As compared to no SUD, AUD youth evidenced significantly higher

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
				symptoms of conduct disorder, and polysubstance youth significantly higher symptoms of both conduct disorder and depression • Symptoms of overanxious disorder increased (M = 1.83, 2.14, and 2.84) but did not vary significantly across groups
Nelson et al., 2000 *Cross-Sectional* Frequency counts; t-tests; logistic regression adjusted for non-independence of observations on twin pairs	N = 1344 female twins (ages 16–19.5 years; M_{age} = 18.2 years) drawn from the Missouri Adolescent Female Twin Study	**DSM Anxiety** Social phobia **Alcohol use** Lifetime AUD	DICA	• 16.3% met criteria for lifetime social phobia; first social fear M_{age} of onset = 10.8 years • Frequency of AUD higher among those with (17.8%) than without (9.3%) social phobia • Controlling for age, social phobia (with or without comorbid depression) significantly predicted an AUD (OR: 2.07, 95% CI: 1.38–3.12) • Controlling for age, social phobia (without comorbid depression) significantly predicted any AUD (OR: 1.73, 95% CI: 1.03–2.91) • Among those with comorbid social phobia and an AUD, age of first social fear (M_{age} = 10.6, SD = 3.49) predated first alcohol intoxication (M_{age} = 15.4,

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
				SD = 1.85; *t* = 8.21, *p* < .01)
Zimmerman et al., 2003 *Prospective (4-year)* Frequency counts; logistic regression controlling for age and gender; prospective logistic regression controlling for age, gender, other anxiety disorders, depression, dysthymia, bipolar disorders, illegal drug use disorders, and antisocial behavior	*N* = 3021 youth (14–24 years) drawn from a government registry of residents in Munich *n* = 2548 completed the 4-year follow-up assessment	**DSM Anxiety** Panic attacks Panic disorder Agoraphobia w/o panic disorder Social phobia Specific phobia Phobia NOS GAD **Alcohol use** Regular use Hazardous use Alcohol dependence and abuse	M-CIDI	• **Baseline prevalence** • Lifetime: 46.4% reported occasional alcohol use, 10% regular use (3 times/ week during peak use), 8.4% hazardous use [40 g/day (men) or 20 g/ day (women) during peak use], 15.9% any AUD, 9.7% alcohol abuse (AA), and 6.2% alcohol dependence (AD) • 12-month: 45.3% occasional use, 9.2% regular use, 3.9% hazardous use, 10.1% any AUD, 5.3% AA, and 4.7% AD • Lifetime: 26.9% any anxiety disorder, 4.3% panic attacks, 1.6% PD, 2.3% agoraphobia, 7.3% social phobia, 16.2% specific phobia, 5.2% phobia NOS, and 3.4% GAD • 12-month: 18.2% any anxiety disorder, 2.7% panic attacks, 1.2% PD, 1.4% agoraphobia, 5.2% social phobia, 10.9% specific phobia, 2.7% phobia NOS, and 1.7% GAD • **Significant baseline associations** • Regular use: Panic attacks (OR: 4.2, 95%

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
				CI: 2.2–7.7), and agoraphobia (OR: 2.2, 95% CI: 1.0–4.8) • Hazardous use: Panic attacks (OR: 3.5, 95% CI: 1.7–6.9), agoraphobia (OR: 5.0, 95% CI: 2.3–10.9), specific phobia (OR: 1.9, 95% CI: 1.3–2.9), and GAD (OR: 2.2, 95% CI: 1.1–4.4) • Any AUD: Panic attacks (OR: 4.4, 95% CI: 2.4–8.0), PD (OR: 4.1, 95% CI: 1.6–10.1), agoraphobia (OR: 3.3, 95% CI: 1.6–6.7), and specific phobia (OR: 2.0, 95% CI: 1.4–2.8) • AA: Panic attacks (OR: 2.6, 95% CI: 1.2–5.5), and specific phobia (OR: 1.6, 95% CI: 1.1–2.4) • AD: Panic attacks (OR: 6.2, 95% CI: 3.0–12.6), PD (OR: 7.1, 95% CI: 2.4–20.5), agoraphobia (OR: 5.0, 95% CI: 1.9–12.8), social phobia (OR: 2.0, 95% CI: 1.1–3.5) and specific phobia (OR: 2.5, 95% CI: 1.6–3.8) • **Significant baseline anxiety and onset/ progression of use at follow-up** • Regular use: Social phobia (OR: 1.9, 95% CI: 1.0–3.4) • Hazardous use: Panic attacks (OR: 2.5, 95%

Author(s)/Design/Analytic Approach	Sample	Primary Variables	Measures	Results
				CI: 1.1–5.8) and social phobia (OR: 2.1, 95% CI: 1.2–3.8) • AA: Panic attacks (OR: 2.7, 95% CI: 1.1–6.1) • **Significant baseline anxiety and persistence of use at follow-up** • Any AUD: Panic attacks (OR: 18.7, 95% CI: 4.7–73.6) and PD (OR: 13.2, 95% CI: 1.4–124.0) • AD: Social phobia (OR: 19.7, 95% CI: 1.1–352.2)

AADIS: Adolescent Alcohol and Drug Involvement Scale (Moberg, 2000). ANOVA: Analysis of variance. AUD: Alcohol use disorder (includes both abuse and dependence). CAPA: Child and Adolescent Psychiatric Assessment (Angold & Costello, 1995). CI: Confidence interval. DICA: Diagnostic Interview for Children and Adolescents (Reich, 1996). DICA-R: Diagnostic Interview for Children and Adolescents-Revised (Reich & Welner, 1988). DISC-2: Diagnostic Interview for Children (Shaffer, Fisher, Piacentini, Schwab-Stone, & Wicks, 1989). DMQ-R: Drinking Motives Questionnaire-Revised (Cooper, 1994). GAD: Generalized anxiety disorder. HR: Hazard ratio. K-SADS: Schedule for Affective Disorders and Schizophrenia for School Age Children (unpublished manuscript, Puig-Antich and associates, 1981). LHA Interview: Lifetime History of Alcohol and Drug Use Interview (Skinner, 1982). M-CIDI: Munich Composite International Diagnostic Interview (Wittchen, Lachner, Wunderlich , & Pfister, 1998). MDD: Major Depressive Disorder. NOS: Not otherwise specified. OCD: Obsessive-Compulsive Disorder. OR: Odds ratio. PD: Panic Disorder. PHQ: Patient Health Questionnaire (Spitzer, Kroenke, & Williams, 1999). PTSD: Posttraumatic Stress Disorder. RCADS-SP: Revised Child Anxiety and Depression Scale-Social phobia subscale (Chorpita et al., 2000). SAD: Separation anxiety disorder. SCID: Structured Clinical Interview for DSM-III-R (Spitzer, Williams, & Gibbon, 1987). SUD: Substance use disorder (includes both abuse and dependence).

References

Abrams K, Kushner MG, Medina KL, Voight A. Self-administration of alcohol before and after a public speaking challenge by individuals with social phobia. Psychology of Addictive Behaviors. 2002; 16:121–128. doi:10.1037/0893-164X.16.2.121. [PubMed: 12079250]

Achenbach, TM.; Edelbrock, C. Manual for the Teacher's Report Form and Teacher Version of the Child Behavior Profile. University of Vermont; Burlington, VT: 1986.

Achenbach, TM.; Edelbrock, CS. Manual for the Youth Self-Report and Profile. University of Vermont; Burlington, VT: 1987.

Achenbach, TM. Manual for the Child Behavior Checklist/4–18 and 1991 profiles. University of Vermont; Burlington, VT: 1991.

Alati R, Najman JM, Kinner SA, Mamun AA, Williams GM, O'Callaghan M, Bor W. Early predictors of adult drinking: A birth cohort study. American Journal of Epidemiology. 2005; 162:1098–1107. doi:10.1093/aje/kwi320. [PubMed: 16236998]

Allan CA. Alcohol problems and anxiety disorders - A critical review. Alcohol and Alcoholism. 1995; 30:145–151. [PubMed: 7662032]

American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th edition Text Revision. Author; Washington, DC: 2000.

Angold A, Costello EJ. A test-retest study of child-reported symptoms and diagnoses using the Child and Adolescent Psychiatric Assessment (CAPA). Psychological medicine. 1995; 25:755–762. doi: 10.1017/S0033291700034991. [PubMed: 7480452]

Arnett JJ. Emerging adulthood: A theory of development from the late teens through the twenties. American Psychologist. 2000; 55:469–480. doi:10.1037/0003-066X.55.5.469. [PubMed: 10842426]

Arnett JJ. Emerging adulthood: What is it and what is it good for? Child Development Perspectives. 2007; 1:68–73. doi:10.1111/j.1750-8606.2007.00016.x.

Askénazy FL, Sorci K, Benoit M, Lestideau K, Myguel M, Lecrubier Y. Anxiety and impulsivity levels identify relevant subtypes in adolescents with at-risk behavior. Journal of Affective Disorders. 2003; 74:219–227. doi:10.1016/S0165-0327(02)00455-X. [PubMed: 12738040]

Beck AT, Epstein N, Brown G, Street RA. An inventory for measuring clinical anxiety: Psychometric properties. Journal of Consulting and Clinical Psychology. 1988; 56:893–897. doi: 10.1037/0022-006X.56.6.893. [PubMed: 3204199]

Behar D, Berg CJ, Rapoport JL, Nelson W, Linnoila M, Cohen, Marshall T. Behavioral and physiological effects of ethanol in high-risk and control children: A pilot study. Alcoholism: Clinical and Experimental Research. 1983; 7:404–410. doi:10.1111/j.1530-0277.1983.tb05495.x.

Beidel DC, Turner SM. At risk for anxiety: I. Psychopathology in the offspring of anxious parents. Journal of the American Academy of Child and Adolescent Psychiatry. 1997; 36:918–924. doi: 10.1097/00004583-199707000-00013. [PubMed: 9204669]

Blumenthal H, Blanchard L, Feldner MT, Babson KA, Leen-Feldner EW, Dixon L. Traumatic event exposure, posttraumatic stress, and substance use among youth: A critical review of the empirical literature. Current Psychiatry Reviews. 2008; 4:228–254. doi:10.2174/157340008786576562.

Blumenthal H, Leen-Feldner EW, Frala JL, Badour CL, Ham LS. Social anxiety and motives for alcohol use among adolescents. Psychology of Addictive Behaviors. 2010; 24:529–534. doi: 10.1037/a0019794. [PubMed: 20853939]

Brady KT, Lydiard RB. The association of alcoholism and anxiety. Psychiatric Quarterly. 1993; 64:135–149. doi:10.1007/BF01065866. [PubMed: 8316598]

Brenner E. Mood induction in children: Methodological issues and clinical implications. Review of General Psychology. 2000; 4:264–283. doi:10.1037/1089-2680.4.3.264.

Brown RA, Lejuez CW, Kahler CW, Strong DR. Distress tolerance and duration of past smoking cessation attempts. Journal of Abnormal Psychology. 2002; 111:180–185. doi: 10.1037/0021-843X.111.1.180. [PubMed: 11866171]

Brown SA, McGue M, Maggs J, Schulenberg J, Hingson R, Swartzwelder S, Murphy S. A developmental perspective on alcohol and youths 16 to 20 years of age. Pediatrics. 2008; 121:S290–S310. doi:10.1542/peds.2007-2243D. [PubMed: 18381495]

Bruce SE, Yonkers KA, Otto MW, Eisen JL, Weisberg RB, Pagano M, Keller MB. Influence of psychiatric co-morbidity on recovery and recurrence in generalized anxiety disorder, social phobia, and panic disorder: A 12-year prospective study. American Journal of psychiatry. 2005; 162:1179–1187. doi:10.1176/appi.ajp.162.6.1179. [PubMed: 15930067]

Brückl TM, Wittchen H, Höfler M, Pfister H, Schneidr S, Lieb R. Childhood separation anxiety and the risk of subsequent psychopathology: Results from a community study. Psychotherapy and Psychosomatics. 2007; 78:47–56.

Buckner JD, Schmidt NB, Lang AR, Small JW, Schlauch RC, Lewinsohn PM. Specificity of social anxiety disorder as a risk factor for alcohol and cannabis dependence. Journal of Psychiatric Research. 2008; 42:230–239. doi:10.1016/j.jpsychires.2007.01.002. [PubMed: 17320907]

Buckner JD, Silgado J, Schmidt NB. Marijuana craving during a public speaking challenge: Understanding marijuana use vulnerability among women and those with social anxiety disorder. Journal of Behavior Therapy & Experimental Psychiatry. in press.

Buckner JD, Turner RJ. Social anxiety disorder as a risk factor for alcohol use disorders: A prospective examination of parental and peer influences. Drug and Alcohol Dependence. 2009; 100:128–137. doi:10.1016/j.drugalcdep.2008.09.018. [PubMed: 19022589]

Bunaciu L, Feldner MT, Blumenthal H, Babson KA, Schmidt NB, Sachs-Ericsson N. A test of the relations between avoidance of panic-related situations and substance use, substance dependence, and depression among subclinical panickers. Behaviour Research and Therapy. 2010; 48:158–163. doi:10.1016/j.brat.2009.10.001. [PubMed: 19857860]

Buske-Kirschbaum A, Jobst S, Wustmans A, Kirschbaum C, Rauth W, Hellhammer D. Attenuated free cortisol response to psychosocial stress in children with atopic dermatitis. Psychosomatic Medicine. 1997; 59:419–426. [PubMed: 9251162]

Carrigan MH, Randall CL. Self-medication in social phobia: A review of the alcohol literature. Addictive Behaviors. 2003; 28:269–284. doi:10.1016/S0306-4603(01)00235-0. [PubMed: 12573678]

Castellanos N, Conrod P. Brief interventions targeting personality risk factors for adolescent substance misuse reduce depression, panic, and risk-taking behaviors. Journal of Mental Health. 2006; 15:645–658. doi:10.1080/09638230600998912.

Chorpita BF, Yim L, Moffitt C, Umemoto LA, Francis SA. Assessment of symptoms of DSM-IV anxiety and depression in children: A revised child anxiety and depression scale. Behavior Research and Therapy. 2000; 38:835–855. doi:10.1016/S0005-7967(99)00130-8.

Christiansen BA, Smith GT, Roehling PV, Goldman MS. Using alcohol expectancies to predict adolescent drinking behavior after one year. Journal of Consulting and Clinical Psychology. 1989; 57:93–99. doi:10.1037/0022-006X.57.1.93. [PubMed: 2925979]

Chung T, Martin CS, Armstrong TD, Labouvie EW. Prevalence of DSM-IV alcohol diagnoses and symptoms in adolescent community and clinical samples. Journal of the American Academy of Child and Adolescent Psychiatry. 2002; 41:546–563. doi:10.1097/00004583-200205000-00012. [PubMed: 12014787]

Cicchetti D, Rogosch FA. Psychopathology as a risk for adolescent substance use disorders: A developmental psychopathology perspective. Journal of Clinical Child Psychology. 1999; 28:355–365. doi:10.1207/S15374424jccp280308. [PubMed: 10446685]

Clark DB, Bukstein OG, Smith MG, Kaczynski NA, Mezzich AC, Donovan JE. Identifying anxiety disorders in adolescents hospitalized for alcohol abuse or dependence. Psychiatric Services. 1995; 46:618–620. [PubMed: 7641008]

Clark DB, Lesnick L, Hegedus AM. Traumas and other adverse life events in adolescents with alcohol abuse and dependence. Journal of the American Academy of Child and Adolescent Psychiatry. 1997; 36:1744–1751. doi:10.1097/00004583-199712000-00023. [PubMed: 9401336]

Clark DB, Pollock N, Bukstein OG, Mezzich AC, Bromberger JT, Donovan JE. Gender and comorbid psychopathology in adolescents with alcohol dependence. Journal of the American Academy of Child and Adolescent Psychiatry. 1997; 36:1195–1203. doi:10.1097/00004583-199709000-00011. [PubMed: 9291720]

Clark DB, Smith MG, Neighbors BD, Skerlec LM, Randall J. Anxiety disorders in adolescence: Characteristics, prevalence, and comorbidities. Clinical Psychology Review. 1994; 14:113–137. doi:10.1016/0272-7358(94)90012-4.

Coffey SF, Saladin ME, Drobes DJ, Brady KT, Dansky BS, Kilpatrick DG. Trauma and substance cue reactivity in individuals with comorbid posttraumatic stress disorder and cocaine or alcohol dependence. Drug and Alcohol Dependence. 2002; 65:115–127. doi:10.1016/S0376-8716(01)00157-0. [PubMed: 11772473]

Coffey SF, Staiewicz PR, Hughes PM, Brimo ML. Trauma-focused imaginal exposure for individuals with comorbid posttraumatic stress disorder and alcohol dependence: Revealing mechanisms of alcohol craving in a cue reactivity paradigm. Psychology of Addictive Behaviors. 2006; 20:425–435. doi:10.1037/0893-164X.20.4.425. [PubMed: 17176177]

Comeau N, Stewart SH, Loba P. The relations of trait anxiety, anxiety sensitivity and sensation seeking to adolescents' motivations for alcohol, cigarette and marijuana use. Addictive Behaviors. 2001; 26:803–825. doi:10.1016/S0306-4603(01)00238-6. [PubMed: 11768546]

Conrod PJ, Stewart SH, Comeau N, Maclean AM. Efficacy of cognitive-behavioral interventions targeting personality risk factors for youth alcohol misuse. Journal of Clinical Child and Adolescent Psychology. 2006; 35:550–563. doi:10.1207/s15374424jccp3504_6. [PubMed: 17007600]

Cooper ML. Motivations for alcohol use among adolescents: Development and validation of a four-factor model. Psychological Assessment. 1994; 6:117–128. doi:10.1037/1040-3590.6.2.117.

de Wit H, Söderpalm AHV, Nikolayev L, Young E. Effects of acute social stress on alcohol consumption in healthy subjects. Alcoholism: Clinical and Experimental Research. 2003; 27:1270–1277. doi:10.1097/01.ALC.0000081617.37539.D6.

Deardorff J, Hayward C, Wilson KA, Bryson S, Hammer LD, Agras S. Puberty and gender interact to predict social anxiety symptoms in early adolescence. Journal of Adolescent Health. 2007; 41:102–104. doi:10.1016/j.jadohealth.2007.02.013. [PubMed: 17577541]

Deas D, Riggs P, Langenbucher J, Goldman M, Brown S. Adolescents are not adults: Developmental considerations in alcohol users. Alcoholism: Clinical and Experimental research. 2000; 24:232–237. doi:10.1111/j.1530-0277.2000.tb04596.x.

Deckel AW. Tests of executive functioning predict scores on the MacAndrew Alcoholism Scale. Progress in Neuropsychopharmacology and Biological Psychiatry. 1999; 23:209–223. doi:10.1016/S0278-5846(98)00108-0.

Derogatis, LR. Brief Symptom Inventory: Administration, scoring, and procedures manual-II. National Computer Systems; Minneapolis, MN: 1993.

Dixon LJ, Leen-Feldner EW, Ham LS, Feldner MT, Lewis SF. Alcohol use motives among traumatic event-exposed, treatment-seeking adolescents: The role of posttraumatic stress. Addictive Behaviors. 2009; 34:1065–1068. doi:10.1016/j.addbeh.2009.06.008. [PubMed: 19632052]

Dobkin PL, Tremblay RE, Masse LC, Vitaro F. Individual and peer characteristics in predicting boys' early onset of substance abuse: a seven-year longitudinal study. Child Development. 1995; 66:1198–1214. doi:10.2307/1131807. [PubMed: 7671656]

Domalanta DD, Risser WL, Roberts RE, Risser JMH. Prevalence of depression and other psychiatric disorders among incarcerated youths. Journal of the American Academy of Child and Adolescent Psychiatry. 2003; 42:477–484. doi:10.1097/01.CHI.0000046819.95464.0B. [PubMed: 12649635]

Dunn, MG.; Mezzich, AC. Development in childhood and adolescence: Implications for prevention research and practice. In: Tolan, P.; Szapocznik, J.; Sambrano, S., editors. Preventing youth substance abuse: Science-based programs for children and adolescents. American Psychological Association; Washington, DC: 2007. p. 21-40.doi:10.1037/11488-001

Ehlers A. Somatic symptoms and panic attacks: A retrospective study of learning experiences. Behaviour Research and Therapy. 1993; 31:269–78. doi:10.1016/0005-7967(93)90025-P. [PubMed: 8476401]

Essau CA, Conradt J, Petermann F. Frequency and comorbidity of social phobia and social fears in adolescents. Behavior Research and Therapy. 1999; 37:831–843. doi:10.1016/S0005-7967(98)00179-X.

Falk DE, Yi H, Hilton ME. Age of onset and temporal sequencing of lifetime DSM-IV alcohol use disorders relative to comorbid mood and anxiety disorders. Drug and Alcohol Dependence. 2008; 94:234–245. doi:10.1016/j.drugalcdep.2007.11.022. [PubMed: 18215474]

Ferdinand RF, Dieleman G, Ormel J, Verhulst FC. Homotypic versus heterotypic continuity of anxiety symptoms in young adolescents: Evidence for distinctions between DSM-IV subtypes. Journal of Abnormal Child Psychology. 2007; 35:325–333. doi:10.1007/s10802-006-9093-0. [PubMed: 17226094]

Fidalgo TM, da Silveira ED, da Silveira DX. Psychiatric comorbidity related to alcohol use among adolescents. American Journal of Drug and Alcohol Abuse. 2008; 34:83–89. doi:10.1080/00952990701764664. [PubMed: 18161646]

Field M, Christiansen P, Cole J, Goudie A. Delay discounting and the alcohol Stroop in heavy drinking adolescents. Addiction. 2007; 102:579–586. doi:10.1111/j.1360-0443.2007.01743.x. [PubMed: 17309540]

Fox NA, Henderson HA, Marshall PJ, Nichols KE, Ghera MM. Behavioral inhibition: Linking biology and behavior within a developmental framework. Annual Review of Psychology. 2005; 56:235–262. doi:10.1146/annurev.psych.55.090902.141532.

Fromme K, D'Amico EJ. Measuring adolescent alcohol outcome expectancies. Psychology of Addictive Behaviors. 2000; 14:206–212. doi:10.1037/0893-164X.14.2.206. [PubMed: 10860120]

Galambos NL, Almeida DM, Petersen AC. Masculinity, femininity, and sex role attitudes in early adolescence: Exploring gender intensification. Child Development. 1990; 61:1905–1914. doi: 10.2307/1130846. [PubMed: 2083504]

Gardner DM, Kutcher S. Dimenhydrinate abuse among adolescents. Canadian Journal of Psychiatry. 1993; 38:113–116.

Giaconia RM, Reinherz HZ, Silverman AR. Traumas and posttraumatic stress disorder in a community population of older adolescents. Journal of the American Academy of Child and Adolescent Psychiatry. 1995; 34:1369–1380. doi:10.1097/00004583-199510000-00023. [PubMed: 7592275]

Goodwin RD, Lieb R, Hoefler M, Pfister H, Bittner A, Beesdo K, Wittchen H-U. Panic attack as a risk factor for severe psychopathology. American Journal of Psychiatry. 2004; 161:2207–2214. doi: 10.1176/appi.ajp.161.12.2207. [PubMed: 15569891]

Greene K, Kremar M, Walters LH, Rubin DL, Hale JL. Targeting adolescent risk-taking behaviors: The contributions of egocentrism and sensation-seeking. Journal of Adolescence. 2000; 23:439–461. doi:10.1006/jado.2000.0330. [PubMed: 10936016]

Haddock CK, Rindskopf D, Shadish WR. Using odds ratios as effect sizes for meta-analysis of dichotomous data: A primer on methods and issues. Psychological Methods. 1998; 3:339–353. doi:10.1037/1082-989X.3.3.339.

Ham LS, Zamboanga BL, Bacon AK, Garcia TA. Drinking motives as mediators of social anxiety and hazardous drinking among college students. Cognitive Behaviour Therapy. 2009; 38:133–145. doi: 10.1080/16506070802610889. [PubMed: 19306146]

Haynes JC, Farrell M, Singleton N, Meltzer H, Araya R, Lewis G, Wiles NJ. Alcohol consumption as a risk factor for anxiety and depression. British Journal of Psychiatry. 2005; 187:544–551. doi: 10.1192/bjp.187.6.544. [PubMed: 16319407]

Hayward, C. Gender differences at puberty. Cambridge University Press; New York: 2003. doi: 10.1017/CBO9780511489716

Hayward C, Killen JD, Kraemer HC, Taylor CB. Predictors of panic attacks in adolescents. Journal of the American Academy of Child and Adolescent Psychiatry. 2000; 39:207–214. doi: 10.1097/00004583-200002000-00021. [PubMed: 10673832]

Hayward C, Killen JD, Kraemer HC, Blair-Greiner A, Strachowski D, Cunning D, Taylor CB. Assessment and phenomenology of nonclinical panic attacks in adolescent girls. Journal of Anxiety Disorders. 1997; 11:17–32. doi:10.1016/S0887-6185(96)00032-1. [PubMed: 9131879]

Hayward C, Killen JD, Taylor CB. Panic attacks in young adolescents. American Journal of Psychiatry. 1989; 146:1061–1062. [PubMed: 2787606]

Hayward C, Killen JD, Wilson DM, Hammer LD, Blair-Greiner A, Strachowski D, Taylor CB. School refusal in young adolescent girls with nonclinical panic attacks. Journal of Anxiety Disorders. 1995; 9:329–338. doi:10.1016/S0887-6185(96)00032-1.

Hayward C, Sanborn K. Puberty and the emergence of gender differences in psychopathology. Journal of Adolescent Health. 2002; 30S:49–58. doi:10.1016/S1054-139X(02)00336-1. [PubMed: 11943575]

Hingson, R.; Kenkel, D. Social, health, and economic consequences of underage drinking. In: Bonnie, RJ.; O'Connell, ME., editors. Reducing Underage Drinking: A Collective Responsibility. National Academies Press; Washington, DC: 2004. p. 251-383.

Ilomäka R, Hakko H, Timonen M, Lappalainen J, Mäkikyrö T, Räsänen P. Temporal relationship between the age of onset of phobic disorders and development of substance dependence in adolescent psychiatric patients. Drug and Alcohol Dependence. 2004; 75:327–330. doi:10.1016/j.drugalcdep.2004.03.014. [PubMed: 15283954]

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future national results on adolescent drug use: Overview of key findings, 2007. National Institute on Drug Abuse; Bethesda, MD: 2008. NIH Publication No. 08-6418

Kandel DB, Logan JA. Patterns of drug use from adolescence to young adulthood: I. Periods of risk for initiation, continued use, and discontinuation. American Journal of Public Health. 1984; 74:660–666. doi:10.2105/AJPH.74.7.660. [PubMed: 6611092]

Kaplow JB, Curran PJ, Angold A, Costello EJ. The prospective relation between dimensions of anxiety and the initiation of adolescent alcohol use. Journal of Clinical Child Psychology. 2001; 30:316–326. doi:10.1207/S15374424JCCP3003_4. [PubMed: 11501249]

Kessler RC. The National Comorbidity Survey of the United States. International Review of Psychiatry. 1994; 6:365–376. doi:10.3109/09540269409023274.

Kessler RC, Avenevoli S, Green J, Gruber MJ, Guyer M, He Y, Merikangas KR. National Comorbidity Survey Replication Adolescent Supplement (NCS-A): III. Concordance of DSM-IV/CIDI diagnoses with clinical reassessments. Journal of the American Academy of Child and Adolescent Psychiatry. 2009; 48:386–399. doi:10.1097/CHI.0b013e31819a1cbc. [PubMed: 19252450]

Kessler RC, Chiu WT, Demler O, Walters EE. Prevelence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. Archives of General Psychiatry. 2005; 62:617–627. doi:10.1001/archpsyc.62.6.617. [PubMed: 15939839]

King SM, Iacono WG, McGue M. Childhood externalizing and internalizing psychopathology in the prediction of early substance use. Addiction. 2004; 99:1548–1559. doi:10.1111/j.1360-0443.2004.00893.x. [PubMed: 15585046]

Kuhn, D.; Franklin, S. The second decade: What develops (and how). In: Kuhn, D.; Siegler, RS., editors. Handbook of Child Psychology: Vol. 2. Cognition, perception, and language. 6th ed.. Wiley; Hoboken, NJ: 2006. p. 953-993.

Kuntsche E, Knibbe R, Gmel G, Engels R. Why do young people drink? A review of drinking motives. Clinical Psychology Review. 2005; 25:841–861. doi:10.1016/j.cpr.2005.06.002. [PubMed: 16095785]

Kushner MG, Sher KJ, Beitman BD. The relation between alcohol problems and the anxiety disorders. American Journal of Psychiatry. 1990; 147:685–695. [PubMed: 2188513]

Kushner MG, Abrams K, Thuras P, Hanson KL, Brekke M, Sletten S. Follow-up study of anxiety disorder and alcohol dependence in comorbid alcoholism treatment patients. Alcoholism: Clinical and experimental research. 2005; 29:1432–1443. doi:10.1097/01.alc.0000175072.17623.f8.

Labouvie, E.; White, HR. Drug sequences, age of onset, and use trajectories as predictors of drug abuse/dependence in young adulthood. In: Kandel, DB., editor. Stages and pathways of drug involvement: Examining the gateway hypothesis. 2002. p. 19-41.doi:10.1017/CBO9780511499777.004

Last C, Perrin S, Hersen M, Kazdin A. DSM-III-R anxiety disorders in children: Sociodemographic and clinical characteristics. Journal of American Child and Adolescent Psychiatry. 1992; 31:1070–1076. doi:10.1097/00004583-199211000-00012.

Leen-Feldner EW, Feldner MT, Bernstein A, McCormick JT, Zvolensky MJ. Anxiety sensitivity and anxious responding to bodily sensations: A test among adolescents using a voluntary hyperventilation challenge. Cognitive Therapy and Research. 2005; 29:593–609. doi:10.1007/s10608-005-3510-5.

Lehman CL, Brown TA, Palfai T, Barlow DH. The effects of alcohol outcome expectancy on a carbon-dioxide challenge in patients with panic disorder. Behavior Therapy. 2002; 33:447–463. doi:10.1016/S0005-7894(02)80038-7.

Levy, D.; Miller, T.; Lox, K. Costs of underage drinking. U.S. Department of Justice, Office of Justice Programs, Office of Juvenile Justice and Delinquency Prevention; Washington, DC: 1999.

Lewinsohn PM, Hops H, Roberts RE, Seeley JR, Andrews JA. Adolescent psychopathology: I. Prevalence and incidence of depression and other DSM-III-R disorders in high school students. Journal of Abnormal Psychology. 1993; 102:133–144. doi:10.1037/0021-843X.102.1.133. [PubMed: 8436689]

Lewinsohn PM, Shankman SA, Gau JM, Klein DN. The prevalence and co-morbidity of subthreshold psychiatric conditions. Psychological Medicine. 2004; 34:613–622. doi:10.1017/S0033291703001466. [PubMed: 15099416]

Lipschitz DS, Rasmusson AM, Anyan W, Cromwell PF, Southwick SM. Clinical and functional correlates of posttraumatic stress disorder in urban adolescent girls at a primary care clinic. Journal of the American Academy of Child and Adolescent Psychiatry. 2000; 39:1104–1111. doi:10.1097/00004583-200009000-00009. [PubMed: 10986806]

Lipschitz DS, Rasmusson AM, Anyan W, Gueorguieva R, Billingslea EM, Cromwell PF, Southwick SM. Posttraumatic stress disorder and substance use in inner-city adolescent girls. The Journal of Nervous and Mental Disease. 2003; 191:714–721. doi:10.1097/01.nmd.0000095123.68088.da. [PubMed: 14614338]

Loeber, R.; Farrington, DP.; Stouthamer-Loeber, M.; Van Kammen, WB. Antisocial Behavior and Mental Health Problems: Explanatory Factors in Childhood and Adolescence. Lawrence Erlbaum Associates; Mahwah, NJ: 1998.

Love A, James D, Willner P. A comparison of two alcohol craving questionnaires. Addiction. 1998; 93:1091–1102. doi:10.1046/j.1360-0443.1998.937109113.x. [PubMed: 9744139]

Lowman C, Hunt WA, Litten RZ, Drummond CD. Research perspectives on alcohol craving: An overview. Addiction. 2000; 95:S45–S54. [PubMed: 11002901]

Luna B, Garver KE, Urban TA, Lazar NA, Sweeney JA. Maturation of cognitive processes from late childhood to adulthood. Child Development. 2004; 75:1357–1372. doi:10.1111/j.1467-8624.2004.00745.x. [PubMed: 15369519]

Manacebo MC, Grant JE, Pinto A, Eisen JL, Rasmussen SA. Substance use disorders in an obsessive compulsive disorder clinical sample. Journal of Anxiety Disorders. 2009; 23:429–435. doi:10.1016/j.janxdis.2008.08.008. [PubMed: 18954963]

Marmorstein NR, White HR, Loeber R, Stouthammer-Loeber M. Anxiety as a predictor of age at first use of substances and progression to substance use problems among boys. Journal of Abnormal Child Psychology. 2010; 38:211–224. doi:10.1007/s10802-009-9360-y. [PubMed: 19821024]

Marsh A, Dale A. Risk factors for alcohol and other drug disorders: A review. Australian Psychologist. 2005; 40:73–80. doi:10.1080/00050060500094662.

McClure EB, Brennan PA, Hammen C, LeBrocque RM. Parental anxiety disorders, child anxiety disorders, and the perceived parent-child relationship in an Australian high-risk sample. Journal of Abnormal Child Psychology. 2001; 29:1–10. doi:10.1023/A:1005260311313. [PubMed: 11316331]

Merikangas KR, Mehta RL, Molnar BE, Walters EE, Swendsen JD, Anguilar-Gaziola S, Kessler RC. Comorbidity of substance use disorders with mood and anxiety disorders: Results of the international consortium in psychiatric epidemiology. Addictive Behaviors. 1998; 23:893–907. doi:10.1016/S0306-4603(98)00076-8. [PubMed: 9801724]

Mineka S, Watson D, Clark LA. Comorbidity of anxiety and unipolar mood disorders. Annual Review of Psychology. 1998; 49:377–412. doi:10.1146/annurev.psych.49.1.377.

Moberg DP. The Adolescent Alcohol and Drug Involvement Scale: An instrument for measuring adolescent use and misuse of alcohol. Journal of Studies on Alcohol. 2000; 40:291–300.

Morris EP, Stewart SH, Ham LS. The relationship between social anxiety disorder and alcohol use disorders: A critical review. Clinical Psychology Review. 2005; 25:734–760. doi:10.1016/j.cpr.2005.05.004. [PubMed: 16042994]

Mulligan ME, McKay D. Hyperventilation, anxiety sensitivity, and the expectations for alcohol use: Subjective and physiological reactivity to alcohol cues. Addictive Behaviors. 2001; 26:375–383. doi:10.1016/S0306-4603(00)00113-1. [PubMed: 11436929]

National Highway Traffic Safety Administration. DOT HS 809476. U.S. Department of Transportation; Washington, DC: 2002. Traffic Safety Facts 2001 Overview.

Neighbors B, Kempton T, Forehand R. Co-occurrence of substance abuse with conduct, anxiety, and depression disorders in juvenile delinquents. Addictive Behaviors. 1992; 17:379–386. doi:10.1016/0306-4603(92)90043-U. [PubMed: 1502971]

Nelson CB, Wittchen H. DSM-IV alcohol disorders in a general population sample of adolescents and young adults. Addiction. 1998; 93:1065–1077. doi:10.1046/j.1360-0443.1998.937106511.x. [PubMed: 9744137]

Nelson EC, Grant JD, Bucholz KK, Glowinski A, Madden PAF, Reich W, Heath AC. Social phobia in a population-based female adolescent twin sample: Co-morbidity and associated suicide-related symptoms. Psychological Medicine. 2000; 30:797–804. doi:10.1017/S0033291799002275. [PubMed: 11037087]

Newes-Adeyi, G.; Chiung, CM.; Williams, GD.; Faden, VB. NIAAA Surveillance Report No. 74: Trends in Underage Drinking in the United States, 1991–2003. National Institute on Alcohol Abuse and Alcoholism; Bethesda, MD: 2005.

Nisbett, R.; Ross, L. Human Inference: Strategies and Shortcomings of Social Judgment. Prentice Hall; Englewood Cliffs, NJ: 1980.

O'Hare TM. Alcohol expectancies and social anxiety in male and female undergraduates. Addictive Behaviors. 1990; 15:561–566. doi:10.1016/0306-4603(90)90057-5. [PubMed: 2075853]

Olatunji BO, Wolitzky-Taylor KB. Anxiety sensitivity and the anxiety disorders: A meta-analytic review and synthesis. Psychological Bulletin. 2009; 135:974–999. doi:10.1037/a0017428. [PubMed: 19883144]

Pardini D, White HR, Stouthamer-Loeber M. Early adolescent psychopathology as a predictor of alcohol use disorders by young adulthood. Drug and Alcohol Dependence. 2007; 88S:S38–S49. doi:10.1016/j.drugalcdep.2006.12.014. [PubMed: 17257781]

Perkonigg A, Kessler RC, Storz S, Wittchen H-U. Traumatic events and post-traumatic stress disorder in the community: Prevalence, risk factors and comorbidity. Acta Psychiatrica Scandinavica. 2000; 101:46–59. doi:10.1034/j.1600-0447.2000.101001046.x. [PubMed: 10674950]

Pine DS, Klein RG, Roberson-Nay R, Mannuzza S, Moulton JL III, Woldehawariat G, Guardino M. Response to 5% carbon dioxide in children and adolescents: Relationship to panic disorder in parents and anxiety disorders in subjects. Archives of General Psychiatry. 2005; 62:73–80. doi: 10.1001/archpsyc.62.1.73. [PubMed: 15630075]

Reardon LE, Leen-Feldner EW, Hayward C. A critical review of the empirical literature on the relation between anxiety and puberty. Clinical Psychology Review. 2009; 29:1–23. doi:10.1016/j.cpr. 2008.09.005. [PubMed: 19019513]

Reed V, Wittchen H. DSM-IV panic attacks and panic disorder in a community sample of adolescents and young adults: How specific are panic attacks? Journal of Psychiatric Research. 1998; 32:335–345. doi:10.1016/S0022-3956(98)00014-4. [PubMed: 9844949]

Reich, W. Diagnostic Interview for Children and Adolescents (DICA). Washington University Division of Child Psychiatry; St. Louis: 1996.

Reich, W.; Welner, Z. Diagnostic Interview for Children and Adolescents-revised (DICA-R). Washington University School of Medicine; St. Louis: 1988.

Reiss S. Expectancy model of fear, anxiety, and panic. Clinical Psychology Review. 1991; 11:141–153. doi:10.1016/0272-7358(91)90092-9.

Robinson J, Sareen J, Cox BJ, Bolton J. Self-medication of anxiety disorders with alcohol and drugs: Results from a nationally representative sample. Journal of Anxiety Disorders. 2009; 23:38–45. doi:10.1016/j.janxdis.2008.03.013. [PubMed: 18571370]

Roelofs K, Elzinga BM, Rotteveel M. The effects of stress-induced cortisol responses on approach-avoidance behavior. Psychoneuroendocrinology. 2005; 30:665–677. doi:10.1016/j.psyneuen. 2005.02.008. [PubMed: 15854783]

Rogol AD, Roemmich JN, Clark PA. Growth at puberty. Journal of Adolescent Health. 2002; 31:192–200. doi:10.1016/S1054-139X(02)00485-8. [PubMed: 12470915]

Russell, M. Prevalence of alcoholism among children of alcoholics. In: Windle, M.; Searles, JS., editors. Children of alcoholics: Critical perspectives. Guilford Press; New York, NY: 1990. p. 9-38.

Saraceno L, Munafó M, Heron J, Craddock N, van den Bree MBM. Genetic and non-genetic influences on the development of co-occurring alcohol problem use and internalizing symptomatology in adolescence: A review. Addiction. 2009; 104:1100–1121. doi:10.1111/j. 1360-0443.2009.02571.x. [PubMed: 19438423]

Sayette MA. Does drinking reduce stress? Alcohol Research and Health. 1999; 23:250–255. [PubMed: 10890821]

Schiff M, Benbenishty R, McKay M. Exposure to terrorism and Israeli youths' psychological distress and alcohol use: An exploratory study. The American Journal on Addictions. 2006; 15:220–226. doi:10.1080/10550490600626200. [PubMed: 16923668]

Schmidt MB, Buckner JD, Keough ME. Anxiety sensitivity as a prospective predictor of alcohol use disorders. Behavior Modification. 2007; 31:202–219. doi:10.1177/0145445506297019. [PubMed: 17307935]

Schuckit MA, Hesselbrock V. Alcohol dependence and anxiety disorders: What is the relationship? American Journal of Psychiatry. 1994; 151:1723–1734. [PubMed: 7977877]

Schuckit MA, Mazzanti C, Smith TL, Ahmed U, Radel M, Iwata N, Goldman D. Selective genotyping for the role of 5-HT2A, 5-HT2C, and GABA alpha 6 receptors and the serotonin transporter in the level of response to alcohol: a pilot study. Biological Psychiatry. 1999; 45:647–651. doi: 10.1016/S0006-3223(98)00248-0. [PubMed: 10088053]

Schwinn TM, Schinke SP, Trent DN. Substance use among late adolescent urban youths: Mental health and gender influences. Addictive Behaviors. 2010; 35:30–34. doi:10.1016/j.addbeh.2009.08.005. [PubMed: 19716660]

Seguí J, Márquez M, Canet J, Cascio A, García L, Oriz M. Panic disorder in a Spanish sample of 89 patients with pure alcohol dependence. Drug and Alcohol Dependence. 2001; 63:171–121.

Shaffer, D.; Fisher, PW.; Piacentini, J.; Schwab-Stone, M.; Wicks, J. Diagnostic Interview Schedule for Children—Second Revision (DISC-II). New York State Psychiatric Institute; New York: 1989.

Shedler J, Block J. Adolescent drug use and psychological health: A longitudinal inquiry. American Psychologist. 1990; 5:612–630. doi:10.1037/0003-066X.45.5.612. [PubMed: 2350080]

Skinner, HA. Instructions for the Lifetime Drinking History. Alcohol Research Foundation; Toronto, Canada: 1982.

Smith JP, Book SW. Comorbidity of generalized anxiety disorder and alcohol use disorders among individuals seeking outpatient substance abuse treatment. Addictive Behaviors. 2010; 35:42–45. doi:10.1016/j.addbeh.2009.07.002. [PubMed: 19733441]

Spitzer R, Kroenke K, Williams J. Validation and utility of a self-report version of PRIME-MD: The PHQ primary care study. Journal of the American Medical Association. 1999; 282:1737–1744. doi:10.1001/jama.282.18.1737. [PubMed: 10568646]

Spitzer, RL.; Williams, JB.; Gibbon, M. Structured Clinical Interview for DSM-III-R-Non-patient Version (SCID-NP). New York State Psychiatric Institute, Biometrics Research Department; New York: 1987.

Stein MB, Höfler M, Perkonigg A, Lieb R, Pfister H, Maercker A, Wittchen H-U. Patterns of incidence and psychiatric risk factors for traumatic events. International Journal of Methods in Psychiatric Research. 2002; 11:143–153. doi:10.1002/mpr.132. [PubMed: 12459818]

Stewart SH. Alcohol abuse in individuals exposed to trauma: A critical review. Psychological Bulletin. 1996; 120:83–112. doi:10.1037/0033-2909.120.1.83. [PubMed: 8711018]

Stewart, SH.; Conrod, PJ. Anxiety disorder and substance use disorder co-morbidity: Common themes and future directions. In: Stewart, SH.; Conrod, PJ., editors. Anxiety and substance use disorders: The viscous cycle of comorbidity. Springer; New York: 2008. p. 239-257.doi: 10.1007/978-0-387-74290-8_13

Stewart SH, Conrad PJ, Marlatt GA, Comeau MN, Thrush C, Krank M. New developments in prevention and early intervention for alcohol abuse in youths. Alcoholism: Clinical and Experimental Research. 2005; 29:278–286. doi:10.1097/01.ALC.0000153547.34399.E8.

Stewart SH, Morris E, Mellings T, Komar J. Relations of social anxiety variables to drinking motives, drinking quanity and frequency, and alcohol-related problems in undergraduates. Journal of Mental Health. 2006; 15:671–682. doi:10.1080/09638230600998904.

Stewart SH, Taylor S, Jang KL, Cox BJ, Watt MC, Fedoroff IC, Borger SC. Causal modeling of relations among learning history, anxiety sensitivity, and panic attacks. Behaviour Research and Therapy. 2001; 39:443–456. doi:10.1016/S0005-7967(00)00023-1. [PubMed: 11280342]

Tapert SF, Cheung EH, Brown GG, Frank LR, Paulus MP, Schweinsburg AD, Brown SA. Neural response to alcohol stimuli in adolescents with alcohol use disorder. Archives of General Psychiatry. 2003; 60 doi:10.1001/archpsyc.60.7.727.

Taylor, S. Anxiety sensitivity. Erlbaum; Mahwah, NJ: 1999.

Thomas SE, Randall PK, Book S. The complex relationship between co-occurring social anxiety and alcohol use disorders: What effects does treating social anxiety have on drinking? Alcoholism: Clinical and Experimental Research. 2008; 32:77–84. doi:10.1111/j.1530-0277.2007.00546.x.

Tsao JCI, Lu Q, Kim SC, Zeltzer LK. Relationships among anxious symptomatology, anxiety sensitivity and laboratory pain responsivity in children. Cognitive Behaviour Therapy. 2006; 35:207–215. doi:10.1080/16506070600898272. [PubMed: 17189238]

Tull MT, Schulzinger D, Schmidt NB, Zvolensky MJ, Lejuez CW. Development and initial examination of a brief intervention for heightened anxiety sensitivity among heroin users. Behavior Modification. 2007; 31:220–242. doi:10.1177/0145445506297020. [PubMed: 17307936]

Unnewehr S, Schneider S, Margraf J, Jenkins M, Florin I. Exposure to internal and external stimuli: Reactions in children of patients with panic disorder and animal phobia. Journal of Anxiety Disorders. 1996; 10:489–508. doi:10.1016/S0887-6185(96)00025-4.

Wallace JM Jr, Bachman JG, O'Malley PM, Schulenberg JE, Cooper SM, Johnston LD. Gender and ethnic differences in smoking, drinking and illicit drug use among American 8th, 10th and 12th grade students, 1976-2000. Addiction. 2003; 98:225–234. doi:10.1046/j.1360-0443.2003.00282.x. [PubMed: 12534428]

Weber MD, Graham JW, Hansen WB, Flay BR, Johnson CA. Evidence for two paths of alcohol use onset in adolescents. Addictive Behavior. 1989; 14:399–408. doi:10.1016/0306-4603(89)90027-0.

Wilson GT. Alcohol and anxiety. Behaviour Research and Therapy. 1988; 26:369–381. doi:10.1016/0005-7967(88)90070-8. [PubMed: 3056391]

Windle M, Spear LP, Fuligini AJ, Angold A, Brown JD, Pine D, Dahl RE. Transitions into underage and problem drinking: Developmental processes and mechanisms between 10 and 15 years of age. Pediatrics. 2008; 121:S273–S289. doi:10.1542/peds.2007-2243C. [PubMed: 18381494]

Wittchen H, Behrendt S, Höfler M, Perkonnig A, Lieb R, Bühringer G, Beesdo K. What are the high risk periods for incident substance use and transitions to abuse and dependence? Implications for early intervention and prevention. International Journal of Methods in Psychiatric Research. 2008; 17:S16–S29. doi:10.1002/mpr.254. [PubMed: 18543359]

Wittchen HU, Lachner G, Wunderlich U, Pfister H. Test-retest reliability of the computerized DSM-IV version of the Munich-Composite International Diagnostic Interview (M-CIDI). Social Psychiatry and Psychiatric Epidemiology. 1998; 33:568–578. doi:10.1007/s001270050095. [PubMed: 9803825]

Yamaguchi K, Kandel DB. Patterns of drug use from adolescence to young adulthood: II. Sequences of progression. American Journal of Public Health. 1984a; 74:673–681. doi:10.2105/AJPH.74.7.673. [PubMed: 6742253]

Yamaguchi K, Kandel DB. Patterns of drug use from adolescence to young adulthood: III. Predictors of progression. American Journal of Public Health. 1984b; 74:668–672. doi:10.2105/AJPH.74.7.668. [PubMed: 6742252]

Zimmerman P, Wittchen H, Höfler M, Pfister H, Kessler RC, Lieb R. Primary anxiety disorders and the development of subsequent alcohol use disorders: A 4-year community study of adolescents and young adults. Psychological Medicine. 2003; 33:1211–1222. doi:10.1017/S0033291703008158. [PubMed: 14580076]

Zvolensky MJ, Feldner MT, Eifert GH, Brown RA. Affective style among smokers: Understanding anxiety sensitivity, emotional reactivity, and distress tolerance using a biological challenge. Addictive Behaviors. 2001; 26:901–915. doi:10.1016/S0306-4603(01)00242-8. [PubMed: 11768551]

Zvolensky MJ, Lejuez CW, Stuart GL, Curtin JJ. Experimental psychopathology in psychological science. Review of General Psychology. 2001; 5:371–381. doi:10.1037/1089-2680.5.4.371.