Different Dimensions of Anxiety Differentially Predict Binge Drinking among Juvenile

Offenders

by

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ABSTRACT

Although research has documented robust prospective relationships between externalizing symptomatology and subsequent binge drinking among adolescents, the extent to which internalizing symptoms increase risk for drinking remains controversial. In particular, the role of anxiety as a predictor of binge drinking remains unclear. Recent evidence suggests that one possible reason for these mixed findings is that separate dimensions of anxiety may differentially confer risk for alcohol use. The present study tested two dimensions of anxiety – worry and physiological anxiety -- as predictors of binge drinking in a longitudinal study of juvenile delinquents. Overall, results indicate that worry and physiological anxiety showed differential relations with drinking behavior. In general, worry was protective against alcohol use, whereas physiological anxiety conferred risk for binge drinking, but both effects were conditional on levels of offending. Implications for future research examining the role of anxiety in predicting drinking behavior among youth are discussed.

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INTRODUCTION

Binge Drinking among U.S. Adolescents

Alcohol consumption is a serious and pervasive public health problem in the United States, representing the most widely abused substance among American youth (NIAAA, 2014). Recent estimates from the 2012 Monitoring the Future Survey found that 41.5% of 12th graders reported drinking alcohol in the past month, and 23.7% engaged in binge drinking at least once in the previous two weeks (Johnston, O'Malley, Bachman, & Schulenberg, 2012). Binge drinking is defined as consuming 5 or more drinks at one time for boys, or 4 or more drinks for girls (NIAAA, 2006). Binge drinking episodes currently represent the most common pattern of excessive alcohol use among adolescents in the United States (Johnston, 2010). The present investigation will focus on this pattern of drinking, given its ubiquity among U.S. adolescents and its association with other types of hazardous behavior (Johnston et al., 2012).

Binge drinking among adolescents is a major source of morbidity and mortality in the United States, and is associated with an array of deleterious short-term and long-term consequences. In the short term, binge drinking among youth is associated with increased risk for fatal and non-fatal injuries (Miller, Chen, & Zhou, 2007), physical/sexual assault (Champion et al., 2004), risky sexual behavior (Cooper & Orcutt, 1999), academic failure (Duncan, Duncan, & Strycker, 2000), illicit drug and tobacco use (Hill, White, Chung, Hawkins, & Catalano, 2000), suicide (Miller et al., 2007), and a host of medical consequences, such as alcohol poisoning (Perkins, 2002). Binge drinking is also a major contributor to fatal motor vehicle injuries, the leading cause of death among

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youth under 21 in the United States (CDC, 2014). To put this statistic into perspective, approximately 30% of fatal crashes in the U.S. involve teenage drivers under the influence of alcohol (National Highway Traffic Safety Administration, 2014).

Over the long term, emerging evidence suggests that frequent, heavy alcohol consumption during adolescence may be associated with alterations in the developing brain, producing detrimental effects that could persist into adulthood (Tapert, Caldwell, & Burke, 2004). Beyond possible lasting effects on the brain, longitudinal research also indicates that the earlier youth engage in binge drinking, the higher their odds will be to develop a substance use disorder later in life (Jennison, 2004; Hawkins et al., 1997) and experience greater lifetime alcohol related consequences (Hingson, Heeren, & Winter, 2006). Moreover, continually drinking at high levels through the lifespan is associated with numerous medical complications, including increased risk for several cancers, liver cirrhosis, and stroke (Room, Babor, & Rehm, 2005).

Of course, binge drinking among youth also puts others at risk (Wechsler, Lee, Hall, Wagenaar, & Lee, 2002; US Department of Health and Human Services, 2007). For example, approximately 45% of those who lose their life in fatal motor vehicle crashes with youth drivers under the influence are those other than the driver (National Highway Traffic Safety Administration, 2014). The total damage of the aforementioned ramifications are not trivial; it is estimated that each year in the United States the costs attributed to underage alcohol use exceeds $27 billion (Bouchery, Harwood, Sacks, Simon, & Brewer, 2011).

Developmental Pathways Toward Adolescent Binge Drinking

Given the clear harm of binge drinking and its associated negative consequences, the U.S. government has long cited teen drinking as one of its primary public health priorities among youth (US Department of Health and Human Services, 2007). Significant funds have been allocated towards research investigating developmental factors that may increase or buffer risk for alcohol and other substance use during adolescence (NIAAA, 2014). Over the past several decades, an extensive body of scientific evidence has implicated numerous interacting factors that have been shown empirically to increase risk (US Department of Health and Human Services, 2007). These factors include, but are not limited to, genetic risk, social/environmental influence, familial relations, developmental/maturational processes, and individual personality factors (for reviews, see Chassin & Hussong, 2009; Hawkins, Catalano, & Miller, 1992). Developmental science has focused on identifying disparate developmental pathways of risk for the onset and escalation of alcohol use during adolescence and into emerging adulthood, considering the interplay among these known risk factors (Kendler, Prescott, Myers, & Neale, 2003; Chassin, Pitts, DeLucia, & Todd 1999; King, Iacono, & McGue, 2004; Iacono, Carlson, Taylor, Elkins, & McGue, 1999)

Developmental pathways can be conceptualized as the mechanisms and trajectories by which early life factors lead to risk behaviors later in life (Cicchetti & Rogosch, 2002; Hussong, Jones, Stein, Baucom, & Boeding, 2011). Adopting a developmental psychopathology framework, theories about developmental pathways of risk are grounded in the notion of equifinality, the idea that individuals may arrive at the same outcome (e.g., binge drinking) through a variety of different developmental

trajectories (Cicchetti & Rogosch, 1996). Importantly, although a child may "fit" into a given developmental pathway based on behavioral symptomatology, their outcome is not necessarily determined or fixed (Cicchetti & Rogosch, 1996).

Numerous developmental pathways towards alcohol use have been proposed (Zucker, 1979; Sher, Walitzer, Wood, & Brent, 1991; Tarter et al., 1999; Iacono et al., 1999). However, two pathways that have been the subject of considerable investigation are the internalizing and externalizing pathways (Chassin et al., 1999; Hussong et al., 2011; Zucker et al. 2011; Sher, Grekin, & Williams, 2005). Briefly, the externalizing pathway posits a developmental model by which children (particularly males) show a difficult temperament early in life, experience conduct/impulsivity problems during childhood, and are increasingly susceptible to early onset and escalation of substance use problems (Tarter et al., 1999). The primary deficits underlying this pathway are postulated to be those of "behavioral under-control", a functional inability to self-regulate or inhibit undesirable behavior (Iacono et al., 1999).

In contrast, the internalizing pathway is hypothesized to align with a "self-medication hypothesis", whereby individuals that experience high levels of negative affectivity such as anxiety and depression will use alcohol or other substances as a means of attempting to reduce negative affect and relieve tension (Hussong et al., 2011). This pathway posits that alcohol use may result from a pattern of attempting to self-medicate aversive symptoms induced by negative mood states (Hussong et al., 2011). Alternatively, heightened use may occur because an individual's self-control gets worn down through frequent efforts to cope with negative affect. Some research has also suggested that youth with internalizing symptomology may be at increased risk for

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substance use because of increased affiliation with deviant peer groups (Kaplan, Martin, & Robbins, 1984).

Results from numerous prospective investigations of youth have yielded strong support for the externalizing pathway in increasing risk for adolescent alcohol use and abuse (Hussong et al., 1998; Iacono et al., 1999; Chassin et al., 1999; King et al., 2004). For example, prior investigations have found robust prospective associations between early externalizing indicators, such as sensation seeking, impulsivity, and conduct problems, with early onset and rapid escalation of adolescent alcohol use (King et al., 2004). Moreover, externalizing symptoms have been found to mediate the relationship between parental alcoholism and young adult substance abuse/dependence, over and above the effects of parental psychopathology (Chassin et al., 1999).

In contrast to the robust relationship between externalizing symptoms and alcohol use, the contribution of internalizing symptoms remains more unclear and controversial (Hussong et al., 2011). Although the self-medication hypotheses may be theoretically and clinically appealing, research has not upheld the theory well, with some studies providing support (e.g., Kaplow, Curran, Angold, & Costello, 2001) and others refuting it (e.g., King et al., 2004). On the one hand, cross-sectional results from psychiatric epidemiological surveys consistently find a strong relationship between internalizing disorders and alcohol abuse/dependence (Grant et al., 2004; Kessler et al., 2005). For example, Costello et al. (2003), found that adolescents with anxiety disorders were twice as likely to meet criteria for a substance use disorder than those who did not meet criteria.

On the other hand, longitudinal studies examining early and middle childhood internalizing symptoms as predictors of later adolescent alcohol use have yielded mixed

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findings (see Hussong et al., 2011). For example, King, Iacono, and McGue (2004) found that externalizing disorders at age 11 were associated with first use of alcohol, regular use, and advanced drinking experience; however, internalizing disorders were not associated with significantly increased odds for any type of alcohol use. Similar results have been found by other prospective studies investigating the relationship between internalizing symptoms and substance use in sub-clinical samples of adolescents (Hussong, Curran, & Chassin, 1998).

However, it is important to note that a significant proportion of the extant literature examining the relationship between internalizing symptoms and alcohol use has focused on their association with DSM-IV alcohol abuse/dependence, and not necessarily other patterns of risky alcohol consumption (e.g., binge drinking), which is the focus of the current investigation. For example, to date, only a handful of studies have examined the longitudinal relations between depression and anxiety symptoms and quantity and frequency of alcohol use (Nolen-Hoeksema & Harrell, 2002; Ciesla et al., 2011; Swendsen et al., 2000). Nonetheless, given that empirical evidence indicates frequent binge drinking during adolescence is associated with greater odds for the subsequent development of an alcohol use disorder, this literature is relevant and important for consideration (Dawson et al., 2004).

Several explanations have been suggested for the inconsistent findings concerning negative affectivity and adolescent alcohol. One major criticism of previous investigations is the way in which negative affectivity has been operationally defined (Hussong et al., 2011). Hussong and Chassin (1994) point out that many prior studies have used aggregate measures of negative affect that combined constellations of

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symptoms from different domains (e.g., anger, depression, anxiety). Moreover, Hussong & colleagues (2011) argue that prior investigations may have failed to detect effects because different forms of negative affect may be associated with alcohol use in divergent ways. There is some evidence to substantiate this argument, as findings from studies examining different types of maladaptive cognitions related to negative affect (e.g., depressive rumination, worry) have shown differential associations with alcohol use (e.g., Nolen-Hoeksema & Harrell, 2002; Ciesla, Dickson, Anderson, & Neal, 2011). This research has important implications for the field of alcohol research, as it suggests that some adolescents who experience different types of affective states or negative affect related cognitions might be more likely to use alcohol than others (Shoal, Castaneda, & Giancola, 2005).

However, to date, few studies have attempted to disaggregate the roles of different types of negative affect and examine their respective associations with alcohol use (Hussong et al., 2011). Anxiety is one type of negative affect that has been particularly unexplored in this capacity. For example, although factor analytic work indicates that anxiety is comprised of several independent yet related constructs (e.g., worry, physiological symptoms), little is known about how each of these dimensions may be differentially related to alcohol use (Reynolds & Richmond, 1985). In the following sections, existing literature on these topics areas will be presented.

Negative Repetitive Thought and Alcohol Use

Negative repetitive thought has been defined as an unconstructive pattern of "repetitive, prolonged, and recurrent thought about one's self, one's concerns, and one's experiences" (Watkins, 2008; Segerstrom, Stanton, Alden, & Shortridge, 2003).

According to response styles theory (Nolen-Hoeksema, 1991), individuals who experience heightened levels of negative repetitive thought (NRT) are at increased likelihood to meet criteria for mood and anxiety disorders, as well as suffer poorer prognosis of the disorder (Nolen-Hoeksema & Harrell, 2002). Prior research indicates that several distinct types of NRT exist, including worry, depressive rumination, co-rumination, and angry rumination (Shoal et al., 2005; Watkins, 2008; Muris, Roelofs, Meesters, & Boomsma, 2004; Nolen-Hoeksema & Harrell, 2002).

Although different forms of NRT may co-occur within the same individual, research has demonstrated that these cognitions are conceptually distinct from one another, and each have been linked with disparate outcomes (Watkins, 2008; Muris et al., 2004). For example, worry is characterized as an unproductive, repetitive cognitive process that focuses on possible dangers and consequences of future events (Segerstrom, Tsao, Alden, & Craske, 2000). In contrast, depressive rumination is defined as a passive, repetitive thought process that involves perseverating about depressed feelings, the causes of those feelings, and possible consequences of the distress (Nolen-Hoeksema, 1991; Mood, 2004). Studies employing factor analysis have indicated that the two constructs load on separate factors (e.g., Muris et al., 2004).

Recent evidence also suggests that different types of NRT may be associated with alcohol use in divergent ways (Ciesla et al., 2011). For example, depressive rumination has been found to be positively associated with alcohol use, heavy alcohol use, and alcohol related consequences among youth (Nolen-Hoeksema & Harrell, 2002). The relationship between depressive rumination and alcohol use is hypothesized to occur as a result of the individual attempting to "escape the self" by using excessive alcohol to

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minimize the cyclical thought patterns of rumination that evoke distress (Nolen-Hoeksema, 2004).

In contrast to depressive rumination, research examining the relationship between worry and alcohol use suggest that the two may be negatively related (Ciesla et al., 2011; Shoal et al., 2005). Ciesla et al (2011) investigated the influence of four different types of NRT (depressive rumination, angry rumination, co-rumination, worry) on weekly alcohol use and binge drinking among a sample of undergraduate college students (Ciesla et al., 2011). Angry rumination was defined as the tendency to think about angry thoughts and feelings, whereas co-rumination was characterized by excessive thought and discussion of problems with other people. This study found that while angry rumination and co-rumination were significantly associated with greater frequency of weekly drinking, worry was associated with both lower frequency of weekly alcohol consumption and decreased likelihood of binge drinking. More specifically, students that were characterized as 'high-worriers' were less likely to engage in occasional or binge drinking behavior.

Similarly, Shoal et al. (2005) conducted a longitudinal investigation to examine the relationships among negative affectivity, worry, fearfulness, and alcohol use among a sample of adolescent boys. The investigators included fearfulness in the study to address the possibility that high worriers may demonstrate heightened fearful inhibition toward alcohol use. Hence, the study was able to parse out the relations between worry and fearfulness as cognitions that may act independently of each other. The results of this study found that higher levels of negative affect were associated with greater alcohol use among low-level worriers, however, no association was found among high-level worriers.

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Based on these findings, Shoal et al. (2005) theorized that rather than worry and alcohol use being similar and possibly mutually reinforcing, the two behaviors may in fact be distinct coping strategies which may displace one another in the context of negative emotions. That is, some youth may use alcohol as a means of alleviating distress, whereas others may unconsciously use worry as a means of occupying the mind to accomplish the same overall goal.

An alternative explanation to this finding could be that alcohol use may not be a good coping strategy for youth who exhibit heightened worry because it may exacerbate concerns about the consequences of engaging in an illegal behavior, or other possible negative effects of drinking (e.g., likelihood for impaired driving, injury, sexual assault). For example, studies on adolescents with high levels of worry suggest that physical harm, personal health, and trouble with the law are primary concerns (Weems, Silverman, & La Greca, 2000).

In sum, previous research suggests that different forms of negative repetitive thought may contribute differentially toward risk for alcohol use. Prior evidence indicates that youth who worry may be at lower risk for heavy alcohol use, as the act of worrying may make alcohol consumption seem undesirable given the negative consequences associated with this high-risk behavior.

Physiological Anxiety

Physiological anxiety has been described as an unpleasant state of autonomic arousal characterized by a feeling that "all is not going so well" (Sullivan, 1953). Although fear and anxiety responses can be adaptive as means of providing heightened vigilance to escape an externally threatening stressor, they may also be considered

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developmentally maladaptive in some situations (Reynolds & Richmond, 1985). For example, in scenarios where a stimulus is perceived as harmful but is not actually so, it may cause an individual to respond inappropriately or aversively to their environment. Furthermore, chronic heightened physiological anxiety (e.g., cortisol and its correlates) is associated with poor psychological and physical health outcomes (Kiecolt-Glaser, Glaser, Gravenstein, Malarkey, & Sheridan, 1996; Miller, Chen, & Zhou, 2007).

Autonomic arousal in response to a perceived stressor is associated with an increase in circulative levels of cortisol, a steroid excreted by the adrenal gland (Andreassi, 2000). Physiological response to anxiety involves a constellation of symptoms, including rapid heart rate, increased perspiration, shortness of breath, uneasiness in the stomach, feelings of nervousness, sleep disturbances, as well as other symptoms (Andreassi, 2000)

Several lines of research suggest that heightened physiological arousal associated with anxiety response may be associated with increased risk for alcohol use (Greeley & Oei, 1999; Pohorecky, 1981). Such evidence has emanated from different areas of psychophysiological research, including experimental studies of animals and humans (Sinha, 2012), psychiatric epidemiology (Grant et al., 2004), and prospective, longitudinal studies (Swendsen et al, 2000).

In terms of experimental literature, animal studies have shown that acute stress induction and prolonged exposure to corticosterone, the stress hormone in animals analogous to cortisol to humans, is associated with increased craving for alcohol and higher alcohol consumption (Sinha, 2012). In humans, however, the relationship between acute stress and laboratory-based alcohol consumption does not appear to be as linear

(Greeley & Oei, 1999). Nonetheless, experimental studies employing standardized acute stressor paradigms (e.g., trier-stress task, electric shock, etc) indicate that alcohol may be used to dampen the effects anticipated stress (Sayette, 1999). For example, Levenson and colleagues (1980) examined the psychophysiological and self-reported measures of stress among a sample of experienced drinkers who anticipated delivery of a significant stressor (electric shock or speech task) and found that that alcohol consumption significantly reduced several physiological indices of stress, including magnitude of heart rate, pulse transmission time (PTT), and anxiety response of subjects to stressors.

More recently, research on the possible stress dampening effects of alcohol has investigated possible mediators of this relationship, such as anxiety sensitivity (Sherry and Kushner, 2001), attention (Sher et al., 2007), and alcohol based expectancies (Cooper et al., 1992). For example, some evidence suggests that the effects of alcohol on reduction of psychological stress are indirect and mediated by allocation of attention (Sher et al., 2007; Josephs & Steele, 1990). However, to date, the definitive mechanisms by which stress and autonomic arousal confer risk for alcohol consumption remain to be fully characterized (Smith & Randall, 2012; Sher et al., 2007). This point is particularly salient for youth, given that ethical considerations have constrained the ability to examine these associations through experimental research.

Another potential limitation of prior experimental research on physiological anxiety and alcohol use is that it fails to mimic how individuals experience stress in real world conditions (Greeley & Oei, 1999). For example, to date, most experimental work has only allowed for the examination of how acute (albeit artificial) stress induction affects laboratory-based drinking behavior (Greeley & Oei, 1999). These types of

methodological designs may be subject to low generalizability, as they do not account for the complex social and contextual components that drinking behavior encompasses in the real world (Cappell & Greeley, 1987).

Some investigators have tried to bridge this gap by using in-vivo techniques to examine the relationship between different cognitive and physiological mood states and drinking behavior (Henker, Whalen, Jamner, & Delfino, 2002; Swendsen et al., 2000). For example, Swendsen et al. (2000) conducted a prospective, longitudinal study using ecological momentary assessment to examine the relationship between various mood states and alcohol consumption over a 30-day period using a non-clinical sample of adult drinkers. The results of this study found that whereas being in a 'happy' mood was associated with increases in later alcohol consumption, nervousness was the only form of negative affect that prospectively predicted subsequent alcohol use. Furthermore, a significant gender interaction was found in this relationship, with men showing higher alcohol consumption than women when nervous. The authors concluded that individuals who experience elevated levels of nervousness, characterized as a state of unpleasant autonomic arousal, may use alcohol as a form of coping to alleviate these aversive symptoms. Furthermore, the authors underscore the importance of identifying individuals who may experience chronic elevations of autonomic arousal (e.g., nervousness), as these individuals may be at increased risk for alcohol abuse/dependence (Swendsen et al., 2000).

Findings from epidemiological studies also provide preliminary evidence that physiological anxiety increases risk for alcohol use, relative to other dimensions of anxiety (Grant et al., 2004). Results from the National Epidemiologic Survey on Alcohol

and Related Conditions (NESARC) survey indicate that individuals with Panic Disorder with agoraphobia are nearly twice as likely to meet criteria for DSM-IV Alcohol Abuse as those with Generalized Anxiety Disorder (Grant et al., 2004). This is relevant because whereas Panic Disorder is characterized by unprecipitated surges of anxiety which are highly physiological in nature (e.g., heart racing, difficulty breathing), the essential characteristic of Generalized Anxiety Disorder is excessive worry (American Psychological Association, 1994). To this end, it is plausible that physiological symptoms of anxiety may be a stronger predictor of alcohol use than are cognitive components of anxiety such as excessive worry.

In conclusion, several lines of research suggest that individuals who experience elevated levels of physiological anxiety may be at increased risk for alcohol use/misuse, both acutely and over the long term. However, to date, these associations remain poorly understood, especially among youth populations where research is limited because of ethical considerations. Nonetheless, prior research underscores the importance of examining the extent to which physiological symptoms of anxiety may increase risk for alcohol consumption as a possible form of self-medication.

Gender Differences

Gender has been identified as a potentially important moderator of the link between physiological anxiety and alcohol consumption (Sher, 1987). Numerous studies have indicated that men report higher alcohol-related tension reduction expectancies than do women (Kushner et al., 1994; Brown, Goldman, Inn, & Anderson, 1980; Abrams & Wilson, 1979). Moreover, laboratory-based investigations examining the stress-dampening effects of alcohol have found that alcohol expectancies may produce

anxiolytic properties for men, yet may actually increase stress among women (Sutker, Allain, Brantley, & Randall, 1982; Abrams & Wilson, 1979). Results from prospective, longitudinal studies indicate that men may be more likely to use alcohol to reduce tension when stressed compared to women. For example, Swendsen et al. (2000) found that gender moderated the relationship between nervousness and alcohol consumption, such that men who were nervous drank at significantly higher rates than women (Swendsen et al., 2002). Taken together, these findings suggest that men may be more likely than women to engage in alcohol use when feeling physiologically anxious, which may occur as a result of stronger alcohol-based tension reduction expectancies (Kushner et al., 1994; Cooper et al., 2002)

Research on the relationship between worry and alcohol use suggest that there also may be significant gender differences (Shoal et al., 2005; Ciesla et al., 2011). Although there is a paucity of research examining the relations between these two behaviors, some research suggests that young women who experience high levels of worry may be at decreased risk for binge drinking relative to young men with excessive worry (Ciesla et al., 2011). For example, Ciesla et al. (2011) found that female undergraduate students scoring high on trait worry were significantly less likely to engage in binge drinking behavior compared with males with matched worry scores. One possible explanation for this finding may be that relative to men, women who report high levels of worry are particularly fearful about the dangers associated with binge drinking, especially in regards to the potential consequences of losing control. However, to date, few studies have investigated how worry may increase or decrease likelihood for engagement in alcohol use, especially among youth. Moreover, little work has explored

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possible gender differences in this association.

Negative Affect and Alcohol Use among Adolescents

Thus far, a significant portion of the literature covered in this review has pertained to the ways negative affect has been shown empirically to increase risk for alcohol use among adults. As previously discussed, the internalizing pathway to substance use aligns with a self-medication model, hypothesizing that individuals who experience high levels of negative affect will be at elevated risk for engaging in substance use as a form of coping (Hussong et al., 2011). Youth who are temperamentally prone (e.g., anxious, propensity towards negative emotionality) and/or exposed to high levels of environmental stress may be particularly vulnerable to this developmental model of substance use (see Chassin & Ritter, 2001).

Research on the relationship between internalizing symptoms and alcohol use among adolescents has yielded equivocal results (Kaplow et al., 2001; Hussong et al., 2011; Costello et al., 1999). Similar to findings with adult samples, epidemiological studies using community samples of adolescents find strong cross-sectional associations between mood and anxiety disorders and substance use disorders (Kessler et al., 2012; Roberts et al., 2007). For example, Kessler et al. (2012) found that adolescents categorized as having a "distress disorder" (e.g., Generalized Anxiety Disorder, Major Depressive Disorder) were between two and three times more likely to meet criteria for DSM-IV Alcohol Abuse. Similar estimates of risk have been reported in other studies of non-clinically referred youth (Costello et al., 1999; Rohde, Lewinsohn, & Seeley, 1996).

Contrary to strong cross-sectional associations, results from prospective, longitudinal studies have produced mixed evidence about the potential contribution of

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internalizing behavior for the onset and escalation of alcohol use among adolescents (Hussong, Curran, & Chassin, 1998; Caspi, Moffitt, Newman, & Silva, 1996; Kaplow et al., 2001; Dierker, Vesel, Sledjeski, Costello, & Perrine, 2007). Although some studies have found that internalizing behavior increased risk for adolescent alcohol use (Costello et al., 1999; Roberts, Roberts, & Xing, 2007; Woodard & Fergusson, 2001), others find the opposite effect (Maggs, Patrick, & Feinstein, 2008). These differences in findings seem to be related to a range of methodological factors, including how the study operationally defined internalizing behavior, as well as sample characteristics (Chassin et al., 1999, Dierker et al., 2007). For example, some studies using aggregate measures of internalizing behavior that included both depression and anxiety symptoms found a significant association with later alcohol use, abuse, and dependence (e.g., Guo, Hawkins, Hill, & Abbott, 2001). However, these results are more inconsistent when depression and anxiety become disaggregated (Costello et al., 1999; Kaplow et al., 2001; Wu et al., 2006). For example, in a nationally representative sample of youth aged 9 to 13, Costello and colleagues (1999) found that depression but not anxiety symptoms were longitudinally associated with alcohol use at age 16 (Costello et al., 1999).

The role of anxiety as a contributor to adolescent alcohol use over and above other comorbid psychopathology is controversial (Hussong et al., 1998). Some findings indicate that the presence of an anxiety disorder during adolescence increases risk for alcohol use during emerging adulthood (e.g., Woodard and Fergusson, 2001). However, other investigators posit that it is not overall anxiety symptomatology but specific types of anxiety symptoms that may confer risk (Kaplow et al., 2001). For example, Kaplow et al. (2001) found that symptoms of generalized anxiety disorder at age 9, 11, and 13 were

associated with increased risk for initiation of alcohol use four years later. Conversely, separation anxiety symptoms were inversely related to alcohol consumption.

In summary, the contribution of negative affect as a predictor of adolescent alcohol use remains contentious and unclear (see Hussong et al., 2011). Although robust cross-sectional associations exist between mood and anxiety disorders and substance use disorders among adolescents, longitudinal studies do not offer clear evidence in one direction or another (Kessler et al., 2012; Costello et al., 1999; Maggs et al., 2008). More recently, some studies have suggested that specific types of anxiety symptomatology may differentially confer risk for alcohol use among youth (Ciesla et al., 2011; Kaplow et al., 2001). However, such work is in its adolescence and more research needs to be conducted that investigates these associations.

Negative Affect among Juvenile Delinquents

Juvenile delinquents are often regarded as an important population for research on alcohol use, as this population shows elevated prevalence rates compared to more normative samples of adolescents (Abram, Teplin, McClelland, & Dulcan, 2003; McClelland, Elkington, Teplin, & Abram, 2004). Numerous studies have examined externalizing behavior among juvenile delinquents, investigating the link between early life conduct and impulsivity problems with odds for later substance use, delinquency, and recidivism (Lahey, Moffitt, & Caspi, 2003; Moffit, 1990; Farrington, Loeber, & Van Kammen, 1990).

Although juvenile delinquents are commonly thought of as a highly and perhaps purely externalizing group, research examining psychopathology among juvenile offenders does not support this theory well (McManus, Alessi, Grapentine, & Brickman

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1984; Neighbors, Kempton, & Forehand, 1992; Loeber, Stouthamer-Loeber, & Raskin-White, 1999; Armistead, Wierson, Forehand, & Frame,1992). Evidence suggests that while juvenile delinquents do show high levels of externalizing problems, a significant portion of these youth also report internalizing problems as well (Neighbors et al., 1992; Loebner et al.; 1999; Armistead et al., 1992). For example, Teplin et al. (1999) found that approximately 30% of incarcerated juvenile offenders who met criteria for a substance use disorder also met criteria for one or more anxiety disorders (Teplin et al., 1999). Similarly, Neighbors et al. (1992) found that symptoms of anxiety and conduct problems were highly co-occurring among a sample of juvenile detainees previously diagnosed with a substance use disorder.

Given the significant proportion of juvenile delinquents who engage in heavy alcohol use (McClelland et al., 2004), in addition to experiencing internalizing and externalizing problems (Teplin et al., 2003), this population represents a high-risk group to examine the potential role that negative affect may play in alcohol use behavior. Moreover, it is possible that by examining internalizing symptoms among a group that has some level of externalizing behavior, it may have been easier to reveal the effects of the negative affect model, as to some extent it may control for the externalizing pathway.

The Present Study

The present study aims to better understand how different dimensions of anxiety may be differentially related to binge drinking in a sample of juvenile delinquents. More specifically, this study seeks to expand on previous literature that suggests that different components of negative affectivity may be associated with risk for alcohol use in divergent ways (Kaplow et al., 2001; Ciesla et al., 2011; Hussong et al., 2011). A

significant proportion of previous studies examining the role of negative affect and adolescent alcohol use have been limited methodologically because they failed to differentiate disparate forms of negative affect, instead using aggregate measures (see Hussong et al. 2011 for a detailed review). Moreover, to date, few studies have examined whether different components of anxiety (e.g., cognitive, physiological) may be differentially predictive of alcohol use (e.g., Swendsen et al., 2000; Ciesla et al., 2011).

Taking into account limitations of previous studies, the current study makes several new contributions to the literature. First, this study is the first empirical investigation that examines whether symptoms of physiological anxiety contribute to heightened risk for binge drinking among a youth sample. Second, this study assesses the extent to which worry may be a protective factor against binge drinking behavior among adolescents, which has been suggested in one study but never replicated (Ciesla et al., 2011). The present study also contributes to the literature by investigating potential gender differences in these relations, as previous literature has been inconclusive about whether gender may moderate the association between physiological anxiety and alcohol use, as well as worry and alcohol use (Shoal et al., 2005; Ciesla et al., 2011; Swendsen et al., 2000).

Lastly, this study expands the literature by determining whether race/ethnicity is an important factor to consider in these relations, which has never previously been studied likely due to inadequate sample size and low power. The current study provides an ample opportunity to examine potential ethnic differences in these associations, given the significant ethnic heterogeneity and large size. Moreover, the longitudinal design provides advantages over most previous studies, which have relied primarily on cross-

sectional data that fails to allow for the establishment of temporal precedence regarding the relationship between negative affectivity and alcohol use.

In sum, the primary goal of the present study was to examine how worry and physiological anxiety may differentially confer risk for binge drinking in a high-risk sample of juvenile delinquents. Furthermore, this study aimed to determine whether these relationships may be moderated by gender and race/ethnicity, as previous studies have proposed (Shoal et al., 2005; Swendsen et al., 2000; Ciesla et al., 2011)

Hypotheses

In accordance with prior literature, there were four hypotheses in the current study. First, it was hypothesized that baseline physiological anxiety would be associated with increased binge drinking at Wave 2, over and above initial baseline binge drinking behavior and covariates. Second, it was hypothesized that this relationship would be moderated by gender, with male adolescents showing a stronger association between physiological anxiety and binge drinking. Third, it was hypothesized that worry would be negatively associated with binge drinking at Wave 2, over and above baseline binge drinking and covariates. Fourth, it was hypothesized that this relationship would moderated by gender, with female adolescents showing a stronger association between worry and binge drinking.

METHOD

The Original Study

     Participants. Participants selected for the current study were from a larger multi-site, longitudinal study of serious juvenile offenders called the Pathways to Desistance Project (Mulvey et al,, 2004). The Pathways to Desistance Project, which began in 2000, consisted of a sample of 1,354 juvenile offenders enrolled in Philadelphia, PA or Maricopa County, AZ. The mean age of participants in the original sample was 15.9 (SD=1.4), with 86% males and 14% females. Study participants self-identified as 25% Non-Hispanic Caucasian, 44% African American, 29% Hispanic, and 2% other.

     Recruitment. Adolescents were considered for enrollment in the Pathways to Desistance Project following review of their court files in either Philadelphia, PA or Maricopa County, AZ. Participants were deemed eligible for enrollment in the study if they met the following criteria: (1) court files revealed they were adjudicated delinquent or found guilty of a serious offense (predominantly felonies). Eligible crimes included all felony offenses with the exception of misdemeanor weapons offenses, misdemeanor sexual assaults, and less serious property crimes; (2) were at least 14 years old and under 18 years at the time of committing the offense; and (3) provided informed assent or consent (if under 18 years at the time of enrollment). To ensure drug-related offenses were not over-represented in the sample, male youth found guilty of committing a drug charge were capped at 15% of the total sample. This policy was deemed necessary because a significant proportion of offenses committed by male juveniles delinquents are drug offenses, and therefore it was necessary to limit these crimes to retain heterogeneity in the sample (Schubert et al., 2004). This enrollment rule did not apply to females in the

study, however, who were eligible to participate provided they met age and adjudicated crime requirements, regardless of the nature of the offense.

Between the enrollment period of November 2000 and January 2003, approximately 10,461 adolescents of requisite age and petitioned charge status were processed in the court system in either of the two study locations. Of this original sample, 5,382 were dropped from participation because their charges were reduced below a felony-level offense at the point of adjudication. In addition, court data were not adequate to determine eligibility status in 1,272 cases and therefore those cases were excluded. Approximately one half of youth assessed to be adjudicated on an eligible charge were approached for study enrollment, while those not approached were excluded due to operational and design constraints (e.g., interviewer overflow, 15% drug offender cap). For example, in some instances eligible participants were not enrolled when the flow of these cases might have overloaded available study interviewers (see Schubert et al., 2004). By the end of the enrollment period, approximately 1 of every 3 adjudicated juvenile offenders who were processed in the courts were enrolled into the study (n=1,374).

Recruitment Biases. There were some significant group differences found between juvenile offenders enrolled and not-enrolled in the original study. These differences included age (M=15.9 vs 16.1, $p<.001$), age at first court appearance (13.9 vs. 14.2, $p<.001$), number of previous course petitions (M=2.10 vs. 1.50, $p<.001$), and percentage of females (14.0% vs. 9.0%, $p<.001$). Racial/ethnic differences were also found, with significantly more Non-Hispanic Caucasian offenders ($p<.001$) and fewer

African Americans (p<.001) found in the enrolled group than the non-enrolled group (see Schubert et al., 2004).

Procedure. As previously reported, 1,354 adjudicated juvenile delinquents between the ages of 14 and 17 at the time of initial offense were recruited into the study from the juvenile and adult court systems. Following informed assent/consent, adolescents who agreed to enroll in the study completed a baseline interview on topics related to psychological development, antisocial behavior, and mental health. Participants who were processed in the juvenile court system completed the baseline interview within 75 days of their adjudication hearing; however, those in the adult court system completed the interview within 90 days of either (1) a decertification hearing in Philadelphia, where it was determined whether the case would be processed in adult court or be returned to juvenile court, or (2) an adult arraignment hearing in Phoenix, where charges were formally presented and the defendant had the opportunity to enter into a plea.

Following the initial baseline interview, participants completed a number of "time-point" interviews. These interviews consisted of a standard set of measures administered at 6-month intervals beginning six months after baseline assessment and continuing at this level of frequency for the first 3 years. Thus, repeated assessments were made every six months after baseline for the first 36 months. Following 36 months, follow-ups were conducted every 12 months until the termination of the study at 84-months in March, 2010. In sum, each study participant was followed for a period of seven years following enrollment in the study.

Dates for time-point interviews were calculated based on the date of each participants respective baseline interview to ensure approximately equal measurement

periods across all participants. The range for collecting the time-point interview was approximately six weeks prior to the follow-up until eight weeks following the target date. If the interview was not conducted during this time period, the interview was considered absent and no further attempts to complete the interview were made until the next time-point assessment. Unless a participant completely withdrew from the study, they were still contacted for future interviews even in the absence of one or more missed time-point interviews.

In terms of procedure and logistics, trained interviewers conducted baseline and time-point interviews by reading survey items aloud to participants. In general, participants responded orally with their responses, which were entered electronically. However, in some scenarios where items inquired about confidential or sensitive topics, participants were given a portable keypad as an alternative option to obtain a non-verbal response. All data collected were under a certificate of confidentiality issued by the U.S. Department of Justice to ensure the highest level of protection available given the sensitive nature of the information in the study (Schubert et al., 2004).

Approximately 53% of all interviews (N=5,500) were conducted in the participants' home, 36% in a facility, and 11% elsewhere. Participants not restricted to institutional settings were allowed to choose a location where they felt most comfortable and secure for the location of the time-point interviews. Baseline interviews took approximately four hours on average to complete, and were broken down into two, two hour sessions. Follow-up interviews were conducted in one 2-hour session, which covered changes in behavior that had occurred in the previous six months, as well as the

addition of some new measures. Adolescents were compensated between $50 and $150 for their participation at each time-point.

The Current Study

Participants. The present study employed a sub-sample of the original participants from the Pathways to Desistance project. Participants were selected for analysis on the basis of four criteria. Eligible participants must have (1) completed the Revised Children's Manifest Anxiety Scale (RCMAS) measure at baseline assessment; (2) self-reported their frequency of binge drinking at Wave 1 and Wave 2; (3) self-identified as either Non-Hispanic Caucasian, Hispanic, or African-American; (4) not been held under supervised settings (e.g., jail, detention center) for the entirety of the duration between Wave 1 and Wave 2 (e.g., received a score of 1; see page 31**). Participants who had missing data on any of the aforementioned variables were excluded from the current analyses using listwise deletion. Using the listwise deletion method, an entire case was excluded from the analysis if any single value on a given variable was missing. Thus, participants who did not meet these four criteria (n=385) were excluded, leaving 969 juvenile delinquents who comprised the current sub-sample. At Wave 1, the mean age of participants at baseline was 15.99 (SD=1.14) and 16.54 for Wave 2 (SD=1.15). The sample consisted of 84.2% men and 15.8% women, with 24% identifying as non-Hispanic Caucasian, 34.8% Hispanic, and 41.2% African American

Measures. The measures utilized in the present study were part of a larger battery of measures from the Pathways to Desistance Project. See Appendix A for a complete list of worry and physiological anxiety items and Table 1 for descriptive statistics of all predictors, outcomes, and covariates.

The Revised Children's Manifest Anxiety Scale (RCMAS)

The Revised Children's Manifest Anxiety Scale (RCMAS) is one the most widely used instruments for the assessment of childhood and adolescent anxiety, and has been shown to be valid and reliable across gender, race/ethnicity, and different age groups (Reynolds & Richmond, 1985). The measure consists of 28 items broken down into three anxiety subscales: Physiological Anxiety, Worry/Oversensitivity, Social Concerns/Concentration. In addition, the RCMAS includes a lie scale that allows for the detection of social desirability and untruthfulness of responses. The RCMAS uses dichotomous (e.g., yes/no) items, which are summed to form total subscale scores, with higher scores indicating more anxiety in that respective area. The current analysis excluded examination of the lie scale in relation to RCMAS sub-scale scores, as numerous studies have highlighted the significant inconsistency of lie scores with RCMAS self-reported anxiety symptoms (Pina, Silverman, Saavedra, & Weems, 2001; Dadds, Perrin, & Yule, 1998). More specifically, some investigators have emphasized the poor utility of the scale, as anxiety and lie scores do not correlate well for either gender or age-grouping (Dadds et al., 1998)

Confirmatory factor analyses of the RCMAS measure using Pathways to Desistance data indicated that a three factor model of the three anxiety subscales fit the data well, allowing for several correlated error terms within factors. Fit indices included the normed fit index (NFI=0.892), Comparative fit index (CFI=0.943), and Root mean square error of approximation (RMSEA=0.028). For the NFI and CFI, scores .90 and above conventionally represent good model fit (Hu & Bentler, 1999). For the RMSEA, a

value of .08 represents acceptable fit, and values at or below .05 represent good model fit (Hu & Bentler, 1999).

      Physiological Anxiety. Adolescents self-reported symptoms of physiological anxiety using the Physiological Anxiety sub-scale of the Revised Children's Manifest Anxiety Scale (RCMAS) (Reynolds & Richmond, 1985). The Physiological Anxiety subscale includes 10 items assessing different types of physiological manifestations of anxiety using items such as, "I often have trouble getting my breath", "My hands feel sweaty", and "Often I feel sick in my stomach". Adolescents responded to each statement by indicating "Yes" or "No", coded as 0 or 1. Physiological anxiety subscale scores were summed, with higher affirmative scores indicating higher levels of physiological anxiety ($\alpha = .66$). As shown in Table 1, there were no problems with kurtosis, skewness, ceiling, or floor effects, with values indicating a distribution close to normal (kurtosis=.561) that was fairly symmetric (skewness=-.236). See Appendix 1 for a complete list of survey items.

      Worry/Oversensitivity. Adolescents self-reported symptoms of worry/oversensitivity using the Worry/Oversensitivity sub-scale from the RCMAS (Reynolds & Richmond, 1985). This subscale includes 11 items, including "I worry a lot of the time", "I get nervous when things do not go the right way for me", and "I worry when I go to bed at night". Adolescents responded to each statement by reporting "Yes" or "No", coded as 0 or 1. Subscale scores were summed, with higher affirmative scores indicating higher levels of worry/oversensitivity ($\alpha = .81$). As shown in Table 1, there were no problems with kurtosis or skewness, with values indicating a distribution close to

normal (kurtosis=.485) that was fairly symmetric (-.678). See Appendix 1 for a complete list of survey items.

Race/Ethnicity. Adolescents reported race/ethnicity at baseline, self-identifying as either (1) Non-Hispanic Caucasian (2) Hispanic (3) African-American/Black (4) Asian (5) Native American, or (6) some other race. For the current analyses, only Non-Hispanic Caucasians, Hispanics, and African-Americans were included. The subsample included 24.0% Non-Hispanic Caucasians (n=233), 34.8% Hispanics (n=337), and 41.2% African Americans (n=399).

In order to compare the three race/ethnicity, two dummy coded variables were created. The first dummy code variable assigned a value of "0" to Non-Hispanic Caucasians and Hispanics, and a value of "1" to African-Americans. The second dummy code gave a value of "0" to African-American and Non-Hispanic Caucasians, and "1" to Hispanics. A value of "0" was given to both Non-Hispanic Caucasian groups to allocate this group as the reference group. This decision was made in order to be able to detect effects unique to African-Americans relative to the other ethnic groups. The current form of dummy coding allowed for the first dummy coded variable to contrast African-Americans to Non-Hispanic Caucasians, and the second dummy coded variable to contrast Hispanics and Non-Hispanic Caucasians.

Frequency of Binge Drinking. Frequency of binge drinking was measured at Wave 1 and Wave 2 using an adapted version of a substance use measure from a prior study of children of alcoholics (Chassin et al., 1991). Adolescents were asked to report how many times they had drunk five or more drinks at one time during the past six months. Response options included 1=not at all, 2= 1-2 times, 3= Less than one time per

month, 4= Once per month, 5= 2-3 times per month, 6= Once per week, 7= 2-3 times per week, 8= 4-5 times per week, 9= Everyday.

As can be seen in greater detail in Table 1, there was significant zero inflation of the binge drinking variable at both waves. At Wave 1, 62.8% (n=609) of the sample reported not engaging in any binge drinking in the past 6 months. At Wave 2, 68.9% (n=668) of the sample reported not engaging in any binge drinking in the prior 6 months.

Given the significant proportion of observations for this count measure clustered around zero, the current study employed a series of Poisson regressions to account for the non-normality of the distribution. Poisson regression is a form of estimation used for modeling count variables (e.g., substance use frequency) in which distributions are non-normally distributed, include excess zeroes, and tend to be positively skewed (Lambert, 1992). In order to assess which type of Poisson model estimation would be most appropriate for the current analyses, a series of analyses were conducted and dispersion parameters were examined (Scott & Freese, 2006)

Proportion of Supervised Time (PST).

Between the Wave 1 and Wave 2 assessments, some participants were sentenced to institutional facilities. Given the restrictive nature of these types of environments, it is probable that these participants may have had less opportunity to engage in binge drinking behavior relative to their unrestricted counterparts. The current analyses accounted for restricted opportunity using an item measuring proportion of supervised time (PST), which assessed the amount of time participants spent in spent in settings with no community access (see Mauricio et al., 2008; Piquero et al., 2001).

Proportion of supervised time was calculated as the number of days each participant spent in any type of supervised setting (e.g., prison, detention, or residential treatment) divided by the total number of days elapsed between the Wave 1 interview and Wave 2 interview. This calculation was subsequently transformed into a proportion score ranging from 0 to 1. For example, a participant who was placed in a secure environment at Wave 1 for three months would receive a PST score of .50 at Wave 2 (given that assessments were made every six months).

For the current analyses, participants that received a PST score of "1" were excluded from the sample, as these participants spent the entire duration between Wave 1 and Wave 2 under supervised settings with no community access. This decision was made because there was a high likelihood that these participants had significantly less opportunity to engage in binge drinking relative to other participants that were less detained. In the present sample, the mean PST score was .36 (SD= .39), with 40.8% (n=395) of participants reporting no restriction of community access.

Non-Drug Related Self-Reported Offending (SRO). Lifetime Non-Drug Related Self-Reported Total Offending (SRO) was controlled for in the current analyses using an adapted measure designed to account for involvement in illegal and antisocial activities (Huizinga, Esbensen, & Weihar, 1994). The Non-Drug Related Self-Reported Offending measure consisted of 22-items that assessed the extent to which subjects were involved in different types of illegal offending behaviors (e.g., initiating a fight, starting a fire, stealing a car). Importantly, the Non-Drug SRO proportion score used included all lifetime antisocial behavior involvement with the exception of three behaviors that pertained to drug and/or substance related offenses (e.g. sold marijuana, sold other illegal

drugs, drove while drunk or high). Non-Drug Self-Reported Offending was calculated as the total number of acts endorsed (numerator) divided by the total number of SRO items answered (denominator). These numbers were subsequently transformed into proportion scores ranging from 0 to 1, with proportion scores closer to 1 indicating greater variety of offenses the participant had committed (see Knight et al., 2004). In the present sample, the mean PST score was .29 (SD= .19).

DATA ANALYTIC PLAN

The first hypothesis of the current study was that Wave 1 physiological anxiety would predict frequency of binge drinking at Wave 2, over and above frequency of baseline binge drinking and other covariates. The second hypothesis of the study was that gender would moderate this relationship, with male adolescents showing a stronger relationship between physiological anxiety and binge drinking than females. To assess whether physiological anxiety scores predicted variance in youth's binge drinking behavior, Possion regression analysis were conducted using RCMAS Physiological Anxiety as the predictor and frequency of binge drinking as the criterion, with age, gender, race/ethnicity, baseline binge drinking, self-reported offending, and proportion of supervised time (PST) as preliminary covariates. Interaction terms representing the interaction of age and physiological anxiety, gender and physiological anxiety, ethnicity and physiological anxiety, and PST and physiological anxiety were included and tested for significance in preliminary models. Hypothesis 1 was tested by examining the regression coefficients representing the effects of physiological anxiety on frequency of binge drinking, including significant interactions. Hypothesis 2 was tested by examining

the interaction between physiological anxiety and gender on frequency of binge drinking. Interaction effects represent the combined effects of variables on the criterion (Cohen, Cohen, West, Aiken, 2013).

The third hypothesis of the current study was that Wave 1 Worry scores would predict Wave 2 frequency of binge drinking, over and above baseline binge drinking and other covariates. To determine whether worry scores predicted frequency of binge drinking behavior, Possion regression analysis were conducted using RCMAS Worry as the predictor and frequency of binge drinking as the criterion. Analogous to the physiological model, age, gender, race/ethnicity, baseline binge drinking, self reporting offending, and proportion of supervised time (PST) were included as preliminary covariates in the model. The fourth hypothesis of the study was that gender would moderate this relationship, with female adolescents showing a stronger relationship between worry and binge drinking than males. Hypothesis 4 was tested by examining the interaction between worry and gender on frequency of binge drinking.

Regression Diagnostics

Outliers can have a disruptive impact on regression coefficients (Cohen, Cohen, West, & Aiken, 2003). In order to detect possible errant data points, regression diagnostics were conducted to check for any non-normally distributed variables. More specifically, regression diagnostics were run to examine possible outliers, leverage, influence, and collinearity that could be influencing the weights of the regression coefficients. No outlier cases were found in the current analyses. Hence, it was not deemed necessary to transform or exclude specific cases (Cohen, Cohen, West & Aiken, 2003).

Power Analyses

       Power analyses were conducted using G*Power version 3.1 to determine the effect sizes the overall regression models would have to able to detect main effects, over and above the covariates and interaction terms (Erdfelder, Faul, & Buchner, 1996). For Hypothesis 1 and 3, that Wave 1 physiological anxiety and worry would predict Wave 2 binge drinking, there was sufficient power (>.99) to detect small (f^2 =.02), medium (f^2 =.15), and large effects (f^2 =.35). Likewise, for Hypothesis 2 and 4, that gender would moderate the relationship between these associations, there was sufficient power (>.99) to detect small (f^2 =.02), medium (f^2 =.15), and large effects (f^2 =.35). However, it is important to note that these power calculations were conducted under the assumptions of an OLS regression (e.g., under a normal distribution), and not for Poisson regression models. G*Power V3.1 does not currently allow for power calculations using Poisson models. Thus, the power achieved in the aforementioned calculations were not an accurate reflection of the statistical power in the current set of analyses.

RESULTS

Regression Diagnostics and Descriptive Statistics

Prior to conducting all analyses, continuous variables were centered to reduce potential problems with non-essential multicollinearity (Cohen, Cohen, West & Aiken, 2013). Multicollinearity may occur when correlations among independent variables are strong, which poses problems in multiple regression because it mistakenly inflates standard errors of the regression coefficients thereby possibly affecting the statistical significance of predictors (Cohen, Cohen, West, & Aiken, 2013). Mplus v6.1 does not yield regression diagnostics, so a Poisson regression was run using SPSS v21 to check for non-normally distributed variables that could be exerting exert undue influence on the coefficients.

Multicollinearity was assessed through examination of the Variance Inflation Factors (VIF) and tolerance of each predictor. All cases fell within the acceptable range for VIF (>10) and tolerance (<.10) (Cohen, Cohen, West, & Aiken, 2013). Further analyses using regression diagnostics DFFITS and DFEBTAS were run to examine residuals and potential sources of leverage and influence. Results detected no outliers, and therefore, no cases needed to be deleted or transformed for subsequent analyses (Cohen, Cohen, West, & Aiken, 2013). Moreover, correlations between study variables (see Table 2) did not indicate problems with multicollinearity (values exceeding .50 are suspect), aside from the correlation between physiological anxiety and worry ($r = .582$, $p < .05$). However, given that these variables were tested in separate models, there were no suspected problems with multicollinearity in the present analyses.

Descriptive statistics for study variables are presented in Table 1. As previously noted in greater detail (see pages 30-34), all predictor variables fell within normal ranges for skewness (<1) and kurtosis (<3) (Field, 2009), with the exception of Wave 1 and Wave 2 frequency of binge drinking, which were positively skewed due to zero inflation in the data. Zero inflation, or excess zero values which may occur in count/frequency data, is common in adolescent substance use data where a significant proportion of participants may be abstainers or non-users (Atkins & Gallop, 2007). Given the non-normality of the outcome variable in the present sample, a Poisson regression model was selected as the most appropriate method of analysis to account for and model such data (see Connell, Dishion, & Deater-Deckard, 2006). Whereas standard OLS regression operates under the assumption of a normal Gaussian distribution, the Poisson regression assumes the outcome variable has a discrete probability distribution, which therefore estimates the likelihood of a rare event around a known average rate of occurrence (Gardner, Mulvey, & Shaw, 1995).

Zero-Order Correlations among Study Variables

Table 2 presents the zero-order correlations among all predictors, outcomes, and covariates. Because Pearson-product moment correlations are inappropriate for count variables given their limited range (non-negative integer values), both count variables (Wave 1 and Wave 2 binge drinking) were log-transformed prior to estimating zero-order correlations. Log transformations were conducted in order to give a more accurate estimation of bivariate associations between count and other continuous variables. In addition, comparisons between two dichotomous variables were estimated using phi coefficients rather than correlation coefficients (Kaplan & Saccuzo, 2012).

Several correlations are worthy of note. First, a strong positive relationship was found between Wave 1 binge drinking and Wave 2 binge drinking (r=.436, p<.01). This association suggests there was a robust degree of stability in binge drinking frequency across waves of data collection. Second, a significant relationship was found between Physiological Anxiety and Wave 1 (r=.198, p<.01) as well as Wave 2 binge drinking (r=.096, p<.05). This association supports Hypothesis 1, suggesting that heightened levels of physiological anxiety were associated with greater frequency of binge drinking. Likewise, the negative association found between Worry and Wave 2 binge drinking (r= -.107, p<.01) support Hypothesis 3, suggesting that higher levels of worry were related to decreased frequency of binge drinking.

In terms of demographic covariates, zero-order correlations indicated that women experienced higher levels of physiological anxiety (r=.144, p<.01) and worry (r=.167, p<.01) than males. Males engaged in greater frequency of binge drinking at both Wave 1 (r= -.068, p<.05) and Wave 2 (r= -.104, p<.01) compared to females. African-American participants were significantly less likely to engage in Wave 1 (r= -.319, p<.01) and Wave 2 binge drinking (r= -.222, p<.01) than non-African Americans. Hispanic participants were significantly more likely to experience physiological anxiety (r= .162, p<.01) and worry (r= .110, p<.01) than non-Hispanics.

As anticipated, participants who spent high proportions of time in supervised settings (PST) were less likely to engage in binge drinking at Wave 2 (r= -.150, p<.01). This negative association suggests that youth with less access to non-supervised community settings tended to binge drink less frequently, possibly because of decreased opportunity for alcohol use. Finally, physiological anxiety and worry were found to be

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highly correlated (r=.582, p<.01). This finding is consistent with prior literature

documenting the high degree of co-occurrence between these constructs within

individuals (Grant et al., 2004).

Effect of Physiological Anxiety on Binge Drinking

      Preliminary Analyses. A Poisson regression tested the influence of physiological

anxiety on Wave 2 binge drinking, over and above Wave 1 binge drinking and other

covariates. Potential covariates were selected because they were hypothesized to correlate

with the outcome measure. Five variables (age, gender, race/ethnicity, PST, non-drug

related self-reported offending) were tested as potential covariates. Preliminary analyses

were conducted to determine which covariates and covariate by interactions to include in

the final model.

      Significant main effects of *gender* (b= -.276 (SE=.061), p<.01), *Wave 1 binge* (

b= .118 (SE=.012), p<.01*), ethnicity (Hispanic)* (b= -.216 (SE= .06), p<.01), *ethnicity*

(African-American) (b= -.180 (SE= .06), p<.01), *self-reported offending* (b= .637

(SE=.141), p<.01), and *PST* (b= -.458, (SE=.064), p<.01) were found. Moreover, a

significant *physiological anxiety by self-reported offending* (b= - .123, (SE=.061), p<.05),

as well as a marginally significant *physiological anxiety by ethnicity (Hispanic)* (b= -

.056 (SE=.031), p<.10) and *physiological anxiety by PST (* b= -.051 (SE=.032), p<.10)

interactions were observed.

      Covariate and covariate by predictor interactions that reached significance (p<.05)

or marginal significance (p<.10) were included in the final model. Non-significant

predictors and interactions were trimmed from the model. Thus, the final model included

six covariates and four covariate by predictor interactions: gender, ethnicity (Hispanic),

ethnicity (African American), Wave 1 binge drinking, self-reported offending, PST, and the interaction of physiological anxiety and gender, physiological anxiety and PST, physiological anxiety and self-reported offending, and physiological anxiety and ethnicity (Hispanic).

Final Model. As illustrated in Table 3, there were no significant main effect of physiological anxiety on Wave 2 binge drinking, over and above covariates. Gender significantly predicted Wave 2 binge drinking (b= -.269 (SE= .061), p<.01), such that men reported greater frequency of binge drinking at Wave 2 than did females. However, the two-way interaction between physiological anxiety and gender predicting Wave 2 binge drinking was non-significant. Therefore, the hypothesis of gender moderating the relationship between physiological anxiety and Wave 2 binge drinking was not supported.

Two significant non-hypothesized two-way interactions were found. The interaction between physiological anxiety and self-reported offending behavior was significant (b= -.122 (SE=.059), p<.01), such that the relationship between physiological anxiety and binge drinking weakened as participants level of offending behavior increased. To probe this interaction further, the relationship between physiological anxiety and Wave 2 binge drinking was examined at 1 standard deviation above the mean of offending, 1 standard deviation below the mean of offending, as well as at the mean of offending. Simple slopes were then calculated based on the results of these three regressions. The simple slope regression for 1 SD above the mean of offending was non-significant (b= .002 (SE= 0.019, p= .914, IRR=1.00) and 1 standard deviation below the mean was significant (b= 0.048 (SE= 0.022), p= .029, IRR= 1.05). This interaction

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suggests that for participants with low levels of offending behavior, higher levels of physiological anxiety were significantly related to increased frequency of binge drinking. More specifically, the incidence rate ratio indicated that among low-level offenders, each one-unit increase in physiological anxiety corresponded with a 5 percent increase in binge drinking. However, among high-level offenders, changes in physiological anxiety did not bear a significant relationship to binge drinking frequency. ,It is also relevant to note that in general, low offenders drank less than high offenders, however, among high offenders, this relationship was unrelated to participants physiological anxiety. The graphical display of this interaction is plotted in Figure 1.

There was also a significant two-way interaction between physiological anxiety and proportion of supervised time (b= -.060 (SE= .030), p<.05), which suggested that the association between physiological anxiety and Wave 2 binge drinking weakened as proportion of supervised time increased. Simple slope analyses indicated that higher levels of physiological anxiety predicted more binge drinking for individuals low (-1 SD) in PST (b= .062 (SE= .021), p= .004, IRR=1.06) but not high (+1 SD) in PST (b= .001 (SE= .019), p= .959, IRR= 1.00). The incidence rate ratios indicates that among youth with low PST, each one-unit increase in physiological anxiety yielded a 6 percent increase in frequency of binge drinking. Conversely, among participants with high PST scores, physiological anxiety was not significantly related to binge drinking. The graphical display of this interaction is plotted in Figure 2.

Effect of Worry on Binge Drinking

Preliminary Analyses. A Poisson regression tested the influence of worry on Wave 2 binge drinking, over and above covariates. Potential covariates were selected

because they were hypothesized to correlate with the outcome measure. Five variables (age, gender, race/ethnicity, PST, non-drug related self-reported offending behavior) were tested as potential covariates. Preliminary analyses were conducted to determine which covariates and covariate by interactions to include in the final model.

Significant main effects of *gender* (b= -.253 (SE=.066), p<.01), *Wave 1 binge drinking* (b= .119 (SE=.012), p<.01), *ethnicity (Hispanic)* (b= -.187 (SE= .067), p<.01), *ethnicity (African-American)* (b= -.250 (SE= .068), p<.01), *self-reported offending* (b= .561 (SE=.135), p<.01), and *PST* (b= -.416 (SE=.066), p<.01) were found. Additionally, a significant *physiological anxiety by self-reported offending* interaction was detected (b= -.090 (SE=.048), p<.10). Covariate and covariate by predictor interactions that reached significance (p<.05) or marginal significance (p<.10) were included in the final model, while those that were non-significant were trimmed out. Thus, the final model included six covariates and two covariate by predictor interactions: gender, Wave 1 binge drinking, ethnicity (Hispanic), ethnicity (African-American), self-reported offending, PST, the interaction of worry and gender, and the interaction of worry and self-reported offending.

Final Model. As presented in Table 4, the main effect of worry over and above covariates accounted for a significant amount for variance in Wave 2 binge drinking (b= -.024 (SE= .010), p<.05). This significant main effect supports Hypothesis 2, in that higher levels of worry were associated with decreased binge drinking. The interaction between worry and gender was non-significant. Therefore, the hypothesis that gender would moderate the relationship between worry and Wave 2 binge drinking was not supported.

A non-hypothesized interaction was found between worry and self-reported offending (b= -.109 (SE=.045), p<.05), such that the relationship between worry and binge drinking weakened as participants level of offending behavior increased. To probe this interaction further, the relationship between worry and Wave 2 binge drinking was examined at 1 standard deviation above the mean of offending, 1 standard deviation below the mean of offending, as well as at the mean of the offending. Simple slopes were then calculated based on the results of these three regressions. The simple slope regression for 1 standard deviation above the mean was significant (b = -.045 (SE= .012), p= .001, IRR= .95) and 1 SD below the mean was non-significant (b= -.004 (SE= .014), p= 0.779, IRR= 1.0). The graphical display of this interaction is plotted in Figure 3. This interaction suggests that for participants with high levels of offending, changes in levels of worry were significantly related to decreased frequency of binge drinking. More specifically, the incidence rate ratio indicated that among high-level offenders, each one-unit increase in worry scores corresponded with a 5 percent decrease in frequency of binge drinking. However, among participants with low-levels of offending, changes in worry did not bear a significant relationship to engaging in binge drinking. Moreover, in general, low offenders drank less than high offenders, however, among low offenders this relationship was unrelated to participants worry.

Post-hoc Analyses

Post-hoc analyses were conducted to examine the zero-order correlations between the Physiological Anxiety scale and Wave 1 and Wave 2 binge drinking, after several items from the Physiological Anxiety scale had been removed. These analyses were performed because several of the items from the physiological anxiety scale had poor

face validity, and concern was raised that certain items might load more on the externalizing pathway than the internalizing pathway, therefore driving the relationship. After removing item 3 ("I get mad easily") and item 9 ("I wiggle in my seat a lot"), the correlations between the Physiological Anxiety scale and Wave 1 (r= .16, p<.01) and Wave 2 (r= .07, p<.05) binge drinking were still significant.

DISCUSSION

Prior longitudinal studies have yielded mixed evidence about the importance of internalizing symptoms as a predictor of adolescent alcohol use (Hussong et al., 2011; Chassin et al., 1999; Kaplow et al., 2001; Hussong, et al., 1998; Hussong et al., 2008; Hussong & Chassin, 1994). To date, a significant proportion of studies examining this relationship have used aggregate measures, which often combine an array of different types of symptoms (e.g., depression, anxiety, anger) into a single unitary construct (Hussong et al., 2011). This methodological approach represents a significant limitation to current research, as more recent evidence suggests different types of internalizing symptoms may be associated with alcohol consumption in differing ways (Ciesla et al., 2011; Shoal et al., 2005; Swendsen et al., 2000).

The role of anxiety as a predictor of adolescent alcohol use remains particularly unclear (Hussong et al., 2011; Kaplow et al., 2001; Hussong et al., 1998). Some studies suggest that this may be the case because different forms of anxiety symptomatology may be differentially associated with alcohol use (Ciesla et al., 2011; Kaplow et al., 2001). For example, prior factor analytic work has supported the distinctiveness of several independent constructs of anxiety (e.g., physiological anxiety, worry, social anxiety) (Reynolds & Richmond, 1997). However, to date, there is a paucity of studies that have examined how each of these different dimensions of anxiety may be differentially associated with alcohol use among adolescents.

The aim of the present study was to examine the potential differential effects of two dimensions of anxiety – worry and physiological anxiety – on binge drinking in a longitudinal sample of youth. Moreover, this study tested whether gender may moderate

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the relations between each dimension of anxiety and alcohol use, as prior studies suggest there may be differences in these associations (Ciesla et al., 2011; Swendsen et al., 2000).

Physiological Anxiety and Binge Drinking

Results from the physiological anxiety model provided support for the self-medication hypothesis, such that physiological anxiety predicted higher levels of subsequent binge drinking. However, these effects were conditional on levels of offending behavior. More specifically, results from regression analyses revealed that physiological anxiety was associated with greater levels of binge drinking among low-level offenders. However, this association was not found among high-level offenders Furthermore, gender did not moderate the relationship between physiological anxiety and binge drinking.

The present findings suggest that low-level juvenile offenders with physiological anxiety may be at increased risk for binge drinking, possibly as a means to alleviate the aversive effects of anxiety. This finding is consistent with previous findings which suggest that individuals with higher levels of physiological anxiety are at increased risk for greater frequency and quantity of alcohol use (Swendsen et al., 2000). Moreover, results suggest that the negative affect model of alcohol use may be relevant for juvenile offenders who are low offenders, but there do not appear to be additive effects of physiological anxiety on binge drinking among high level offenders over and above inherent risk (e.g., externalizing characteristics). These findings underscore the importance of considering lifetime offending status in the relations between physiological anxiety and binge drinking.

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One interpretation for this finding is that drinking motives may differ for low and high level offenders. That is, low offenders with physiological anxiety may be more prone to engage in binge drinking in attempt to offset aversive bodily symptoms, whereas high offenders may drink for alternative purposes such as peer social enhancement. For example, post-hoc analyses revealed that high-level offenders scored significantly higher on measures of thrill-seeking and impulsivity relative to low-level offenders[1]. Moreover, high-level offenders reported significantly greater antisocial peer influence and antisocial peer behavior compared to low-level offenders[2]. These data suggest that high-level offenders may engage in drinking behavior because they are more sensation seeking, impulsive, and more frequently embedded in antisocial peer contexts relative to low-level offenders.

Indeed, an extensive body of research indicates that sensation seeking, impulsivity, and antisocial peer influence are some of the strongest and most consistent predictors of alcohol use among juvenile offenders and adolescents more generally (Colder & Chassin, 1997; Dishion, Spracklen, & Capaldi, 1995; Robbins & Bryan, 2004; Duncan, Duncan, & Hops, 1994). Thus, it is possible that externalizing characteristics and antisocial peer influence may drive binge drinking more strongly than does physiological anxiety among high offending youth. However, it is important to highlight that the present study did not test the predictive ability of the aforementioned set of externalizing and peer variables against physiological anxiety in predicting binge drinking for low versus high offenders, and therefore we cannot infer that these characteristics were better predictors of binge drinking for higher level offenders.

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[1] YPI Thrill Seeking, $t(416) = -11.34$ $p < .001$; YPI Impulsivity, $t(416) = -9.80$, $p < .001$
[2] Peer Influence, $t(407) = -16.71$, $p < .001$; Peer Behavior, $t(494) = -22.79$, $p < .001$

Another notable finding from this study is the interaction between physiological anxiety and proportion of time spent in supervised settings. Specifically, our results show that physiological anxiety predicted binge drinking among offenders who spent low amounts of time in supervised settings, but not among those who spent high amounts of time. This finding likely reflects an incapacitation effect (Levitt, 1998). Incapacitation effects refer to the phenomenon that a given individual's ability to commit a crime or enact a particular behavior will diminish as a function of time spent in supervised settings (e.g., noncustodial supervision, jail, youth facility, or prison) (Piquero & Blumstein, 2007). The deterrent effects of longer criminal sentences on criminal behavior are well documented in the field of criminology (Nagin, 1998; Jacob & Lefgren, 2003; Levitt, 1997; Zimring & Hawkins, 1995).

The present results suggest, perhaps unsurprisingly, that physiological anxiety did not predict binge drinking among youth that spent high amounts of time in supervised settings, likely because of decreased availability for alcohol use. This finding raises several questions worthy of further inquiry. For example, if incapacitated juvenile offenders lack access to alcohol as a means of possible self-medication, might they be using other more readily available substances to compensate? If so, which substances might they be engaging in? To date, little is known about substance use patterns among detained juvenile offenders (MacDonald, 1999). However, drug use, and particularly injecting drug misuse in prison systems is a widely recognized public health problem (Keene, 1997; Gravett, 2000). Given the significant rates of comorbidity between anxiety and substance use disorders among incarcerated juvenile offenders (Teplin et al., 2002),

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more work is needed to examine whether and to what extent juvenile offenders might be using other illicit substances as a means to ameliorate symptoms of negative affect.

Worry and Binge Drinking

As hypothesized, results indicated that worry was negatively related to binge drinking, over and above the effects of baseline drinking, time spent in supervised settings, lifetime offending status, and demographic variables. More specifically, in concert with the physiological anxiety model, this association was found to be conditional depending on level of lifetime offending status. Worry was associated with decreased levels of binge drinking among high-level offenders, however, this association was not found among low-level offenders. Moreover, gender did not moderate the relationship between worry and binge drinking.

Prior research has shown negative associations between worry and weekly alcohol consumption and binge drinking among youth (Ciesla et al., 2011). Thus, findings from the current study were consistent with previous evidence, supporting the contention that worry may be protective against alcohol consumption among adolescent populations. However, it is important to note at the outset that this study employed a sample of juvenile offenders, and discussion of the current findings should be viewed in light of this fact. That is, it is possible that juvenile offenders experience worries and/or concerns that are unique to this population relative to more representative samples of adolescents. Nonetheless, the main effects of this study parallel findings from prior research, suggesting that higher levels of worry symptoms are associated with lower alcohol consumption among juvenile offenders, and that lifetime offending status is an important factor to consider in this association.

There are several reasons why worry may be associated with decreased risk for alcohol consumption. More generally, worry has been conceptualized as an anticipatory cognitive process involving images and thoughts that function to avoid potential threats or dangerous outcomes in the future (Davey & Wells, 2006; Borkovec, Ray, & Stober, 1998). Although excessive worry is frequently characterized as maladaptive (Rowa & Antony, 2008), worry may also serve as an adaptive coping strategy, in that it involves recall of past events, and thinking about how current behaviors may effect the occurrence of temporally distant but potentially serious negative outcomes (Borkovec, Ray, & Stober, 1998). To this end, worry may be a particularly important harm reduction strategy for juvenile delinquents, as these youth engage in greater levels of risk taking behavior and experience more negative consequences relative to more representative youth populations (Thornberry & Krohn, 2003).

Results indicate that degree of lifetime offending status may be an important factor for consideration in understanding the relation between worry and binge drinking. Specifically, the present findings suggest that worry is protective against binge drinking for high-level offenders, but not low-level offending adolescents. This finding may reflect the influence of unmeasured correlates of high-offending. For example, it seems unlikely that high-level offenders may be more concerned with harm avoidance relative to low-level offenders, or that this group may be attempting to anticipate future events and identify methods to minimize negative outcomes given their more extensive criminal histories. Therefore, it is likely some other unmeasured third variable associated with being a high offender and binge drinking might explain why worry may be a particularly important process for reducing binge drinking risk in this group. Taken together, findings

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indicate that in contrast with the physiological anxiety model, worry symptoms were not associated with heightened risk for binge drinking, and may in fact be protective among some juvenile offenders.

LIMITATIONS

This study's conclusions should be considered in light of several methodological limitations. First, physiological anxiety and worry were operationalized using the Revised Children's Manifest Anxiety Scale (Reynolds & Richmond, 1997), which employs scales that are brief in nature and includes some items that have questionable face validity. Although the internal consistency of both of these scales were within the acceptable range, it is nonetheless possible that a significant amount of measurement error was present in the current analyses. Future research examining the role of different dimensions of anxiety might yield more accurate results if more comprehensive measures of worry and physiological anxiety were employed. For example, the Penn State Worry Questionnaire (PSWQ) measure examines the excessiveness, generality, and uncontrollable dimensions of worry using a more extensive set of items (Fresco, Mennin, Heimberg, & Turk, 2003). Similarly, a more inclusive measure of physiological anxiety that encompasses broad symptom domains (e.g., excessive sweating, difficulty swallowing, muscle tension, trembling, voice weakness) may be beneficial.

A second limitation of this study was the limited sample size of the female offenders. Because a significant proportion of the female offenders in this study abstained from any binge drinking, there was limited variability in drinking behavior among this subgroup. Thus, the worry and physiological anxiety models may have been underpowered to detect gender as a possible moderator in these analyses. Third, because a significant proportion of the participants in the study were kept in supervised settings for a portion of the follow-up period, it is probable that some of these youth were unable to engage in alcohol consumption due to restricted access (e.g., incapacitation effects).

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Therefore, it is likely that the effect sizes of the relevant predictors may have been stronger if alcohol was more readily available for the full duration of the study period.

Fourth, another potential limitation of this investigation was that all substance use information was self-reported by adolescent participants orally to adult interviewers. Self-report of substance use has generally been shown to be reliable (Del Boca & Noll, 2000). However, reporting biases might have been present in the current study given that participants were adjudicated juvenile offenders. For example, participants may have selectively suppressed information due to concern about the ramifications of illegal behavior (Thornberry & Krohn, 2000). Alternatively, participants may have exaggerated substance use behavior in order to project an image of defiance towards authority. Lastly, given that this study employed a sample of juvenile offenders, there may be limitations in the generalizability of the findings to a more general youth population, as empirical evidence has documented that significant individual differences exist between the characteristics of these groups (Caspi et al., 1994; Glaser, Calhoun, & Petrocelli, 2002).

SUMMARY AND CONCLUSION

The purpose of this study was to examine the associations between two dimensions of anxiety and binge drinking in a sample of juvenile offenders. To our knowledge, this is the first empirical study to investigate the potential differential effects of worry and physiological anxiety on alcohol consumption in a sample of adolescents. Overall, we found that worry and physiological anxiety showed differential relations with drinking behavior. In general, worry was protective against alcohol use, whereas physiological anxiety conferred risk for binge drinking, but both effects were conditional on levels of offending.

Current findings suggest that prior investigations examining the role of anxiety as risk factor for adolescent alcohol use might have yielded erroneous results due to anxiety being treated as a unitary construct. Our results indicate that worry and physiological anxiety represent two related yet independent dimensions of anxiety that are differentially associated with alcohol use. There are several implications of these findings for future research. First, it is advisable that future studies consider investigating the role that different symptom clusters of anxiety, such as worry and physiological anxiety, play in predicting alcohol use. Second, more research is needed to examine whether the differential effects of worry and physiological anxiety are generalizable to more representative samples of non-offending adolescents.

Table 1. Descriptive statistics for all variables

	N	Observed Min.	Observed Max.	Mean	Std. Dev.	Skewness	Kurtosis
Gender	969	Male: 816 (84.2%) Female: 153 (15.8%)					
Ethnicity	969	Non-Hispanic Caucasian: 233 (24.0%) Hispanic: 399 (41.2%) African-American: 337 (34.8%)					
Physiological Anxiety	969	0	10	3.26	2.23	.562	-.261
Worry	969	0	11	3.91	2.91	.531	-.597
Wave 1 Binge Drinking (Baseline)	969	1	9	2.31	2.19	1.62	1.32
Wave 2 Binge Drinking (Wave 2)	969	1	9	1.86	1.70	2.25	4.35
Proportion of Supervised Time	969	0	.99	.358	.398	.532	-1.44
Self-Reported Offending (Non-Drug Related)	969	0	.95	.294	1.88	.851	.185

Note: Higher scores on Physiological Anxiety and Worry scales indicate greater level of symptoms. Higher scores on Binge Drinking indicate greater frequency of binge drinking behavior during the past 6 months.

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Table 2. Correlations Among Predictor Variables, Outcome Variables, and Covariates (N=969)

	1.	2.	3.	4.	5.	6.	7.	8.
1. Gender	--							
2. Ethnicity (Black)	-.01	--						
3. Ethnicity (Hispanic)	-.04	-.611**	--					
4. Physiological Anxiety	.144**	-.181*	.162**	--				
5. Worry	.167**	-.025	.110**	.582**	--			
6. Binge Drinking (Wave 1)	-.068*	-.319**	.228**	.198**	.033	--		
7. Binge Drinking (Wave 2)	-.104**	-.222**	.088**	.096*	-.100**	.436**	--	
8. Proportion of Supervised Time	-.171*	-.221**	-.124**	.013	.116**	-.001	-.150**	--
9. Self-Reported Offending (Non-Drug Related)	-.176**	-.157**	.143**	.253**	.055	.388**	.266**	.182**

Note: $**p<.01$, $*p<.05$
Note: Comparisons between two dichotomous variables used phi coefficients rather than correlation coefficients.
Note: Gender was coded such that '0' indicates men and '1' indicates women.

Table 3. *Summary of Poisson Regression Analysis for Physiological Anxiety Predicting Adolescents' Frequency of Binge Drinking at Wave 2 (N=969)*

Variable	B	SE B	β	Incident Rate Ratio
Physiological Anxiety	.025	.017	.136	1.03
Gender	-.269	.061	-.240***	.76
Wave 1 Binge Drinking	.118	.012	.633***	1.13
Ethnicity (Black)	-.212	065	-.254***	.81
Ethnicity (Hispanic)	-.184	.065	-.213**	.83
Self-Reported Offending	.662	.141	.305***	1.94
Proportion of Supervised Time	-.452	.064	.-440***	.64
Physiological x Gender	-.011	.027	-.026	.99
Physiological x Offending	-.122	.059	-.129*	.89
Physiological x Ethnicity (Hisp)	-.041	.026	-.140	.96
Physiological x Supervised Time	-.060	.030	-.131*	.95

Note. *$p<.05$, **$p<.01$, ***$p<.001$. B= Unstandardized regression coefficient. SE= Standard error.

Table 4. *Summary of Poisson Regression Analysis for Worry Predicting Adolescents' Frequency of Binge Drinking at Wave 2(N= 969)*

Variable	B	SE B	β	Incident Rate Ratio
Worry	-.024	.010	-.176*	.98
Gender	-.239	.066	-3.74***	.79
Wave 1 Binge Drinking	.119	.012	.643***	1.23
Ethnicity (Black)	-.229	.066	.-278***	.79
Ethnicity (Hispanic)	-.179	.067	-.211***	.84
Self-Reported Offending	.601	.131	.280***	1.82
Worry x Gender	.019	.021	.349	1.02
Worry x Offending	-.109	.045	-.141*	.90

Note. *$p<.05$, **$p<.01$, ***$p<.001$. B= Unstandardized regression coefficient. SE= Standard error.

Figure 1: Significant interaction between physiological anxiety and self-reported offending behavior predicting frequency of binge drinking.
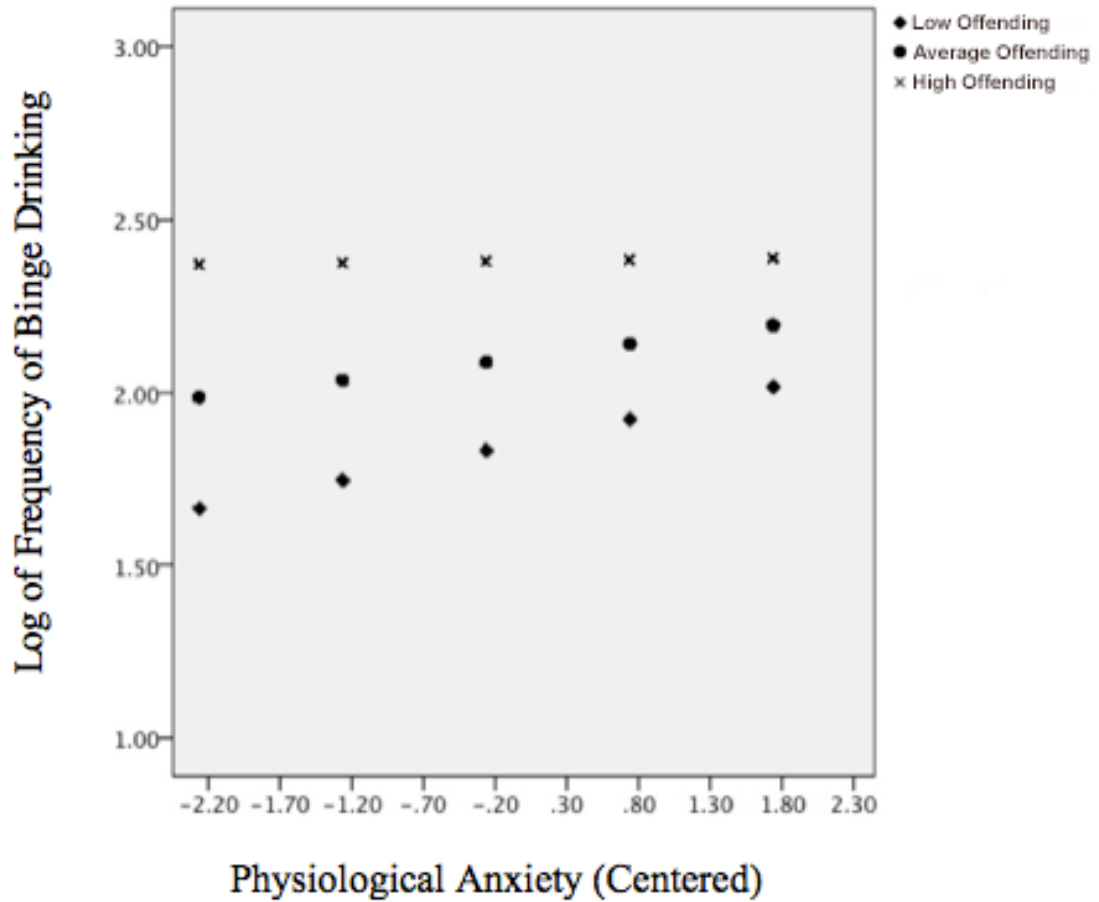
Figure 2: Significant interaction between physiological anxiety and proportion of supervised time (PST) predicting frequency of binge drinking.
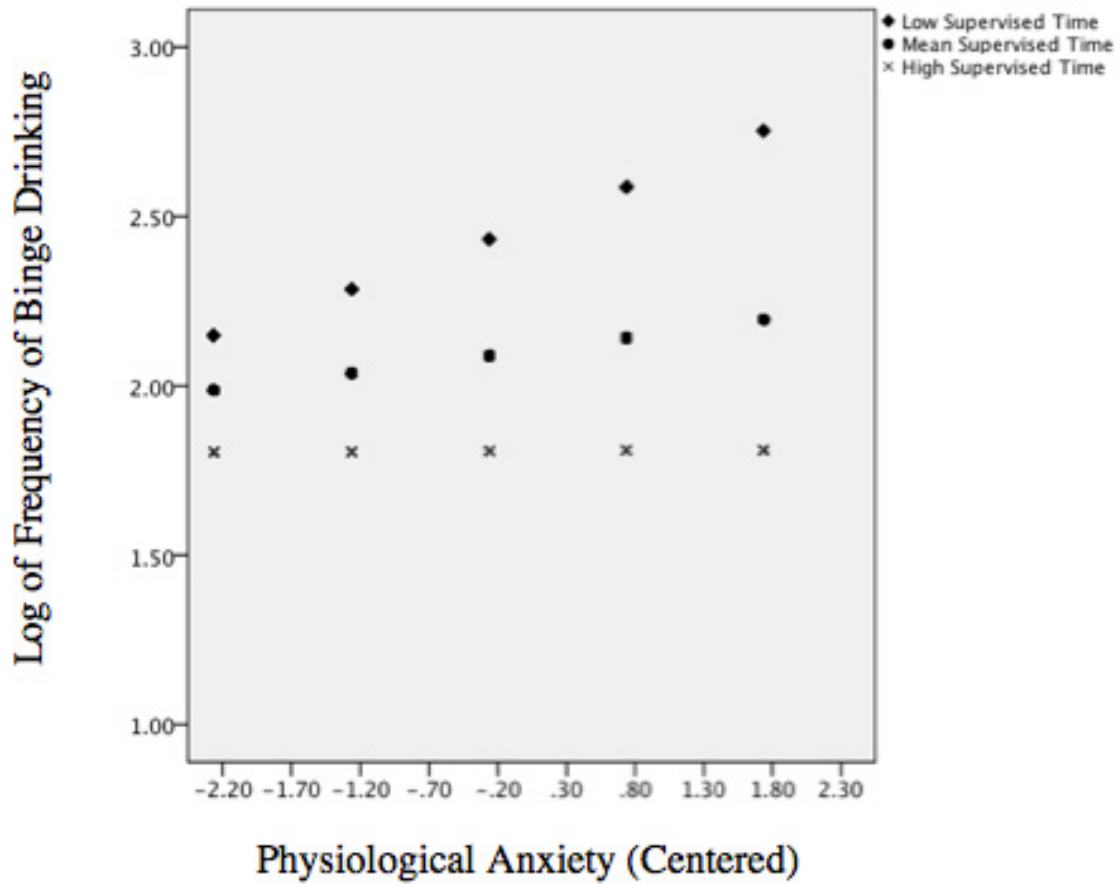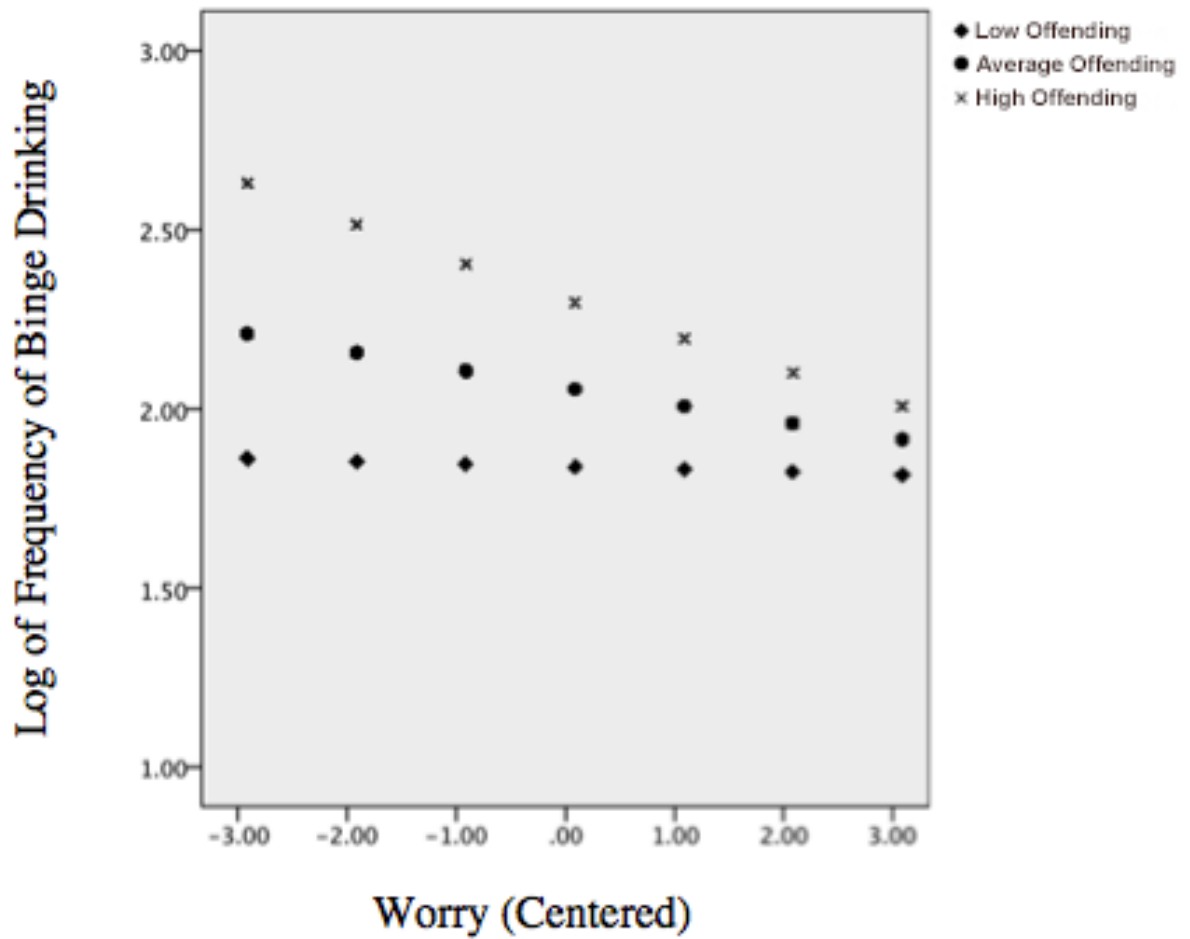
Figure 3: Significant interaction between worry and self-reported offending behavior predicting frequency of binge drinking.

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APPENDIX A

REVISED CHILDRENS MANIFEST ANXIETY SCALE

Revised Children's Manifest Anxiety Scale

Physiological Anxiety (Yes or No)

1. I have trouble making up my mind
2. Often I have trouble getting my breath
3. I get mad easily
4. It is hard for me to get to sleep at night
5. Often I feel sick to my stomach
6. I am tired a lot
7. My hands feel sweaty
8. I have bad dreams
9. I wake up scared some of the time
10. I wiggle in my seat a lot

Worry (Yes or No)

1. I get nervous when things do not go the right way for me
2. I worry a lot of the time
3. I am afraid of a lot of things
4. I worry about what my parents will say to me
5. I worry about what other people think about me
6. My feelings get hurt easily
7. I worry about what is going to happen
8. My feelings get hurt easily when I am fussed at
9. I worry when I go to bed at night
10. I am nervous
11. I often worry about something bad happening to me.