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The Mediating Role of Depression in the Relationship between Anxiety Sensitivity and Alcohol Dependence

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Abstract

Background—Many studies have reported that Anxiety Sensitivity (AS) is positively associated with alcohol use or other alcohol-related variables. More recent mediator and moderator models have shown promise in elucidating mechanisms within this relationship; the literature to date suggests that the relationship between AS and alcohol is likely mediated by problematic coping motives. However, few studies have considered the effects of depression within the AS – alcohol use relationship, despite a strong body of evidence linking AS to subsequent depression and depression to subsequent alcohol use problems, independently. Therefore, the current study assessed depression as a potential mediator of this relationship.

Method—Participants were 418 sequential admissions to a substance abuse treatment facility. A mediation analysis using bootstrapping was utilized in order to estimate indirect effects of AS on alcohol dependence through depression.

Results—Results reveal an indirect effect suggesting that the effects of anxiety sensitivity on alcohol dependence are mediated by symptoms of depression. More specifically, the effects of AS total score and AS somatic sensations on alcohol dependence were mediated by symptoms of depression. Lastly, a dual mediator model demonstrated that both depression and problematic coping uniquely mediate the relationship between AS and alcohol dependence.

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William V. Lechner took the lead on developing the conceptualization for the paper, conducting the relevant statistical analyses, and preparing the manuscript. Julia M. Shadur and DeMond M. Grant provided statistical guidance and aided in manuscript preparation. Anne N. Banducci aided in interpretation of results and manuscript preparation. Melanie Morse was extensively involved with data management and participated in generating new written material for the manuscript. Carl W. Lejuez worked closely with William Lechner and contributed extensively on paper conceptualization and manuscript preparation. All authors contributed to and have approved the final manuscript.

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Conclusions—While preliminary in nature, the current study provides evidence supporting the hypothesis that depression is an important factor to consider when examining the relationship between AS and alcohol dependence.

Introduction

A robust body of work has examined the relationship between anxiety sensitivity (AS) and problematic alcohol use in the past 20 years (see DeMartini, 2011 for a review). AS has been described as the fear of anxiety sensations (e.g., Reiss, Peterson, Gursky, & McNally, 1986) and has been linked to increased incidence of alcohol use disorders (Schmidt, 2007), increased alcohol consumption (Stewart, Peterson, & Pihl, 1995), and increased motivation to drink to cope (Conrod, Pihl, & Vassileva, 1998; Stewart, Karp, Pihl, & Peterson, 1997). Studies controlling for symptoms of state and trait anxiety have demonstrated that the relationship between AS and problematic alcohol use is not simply attributable to increased symptoms of anxiety alone (DeHaas, Calamari, & Bair, 2002; DeHaas, Calamari, Bair, & Martin, 2001). Thus, AS appears to be a unique and problematic predictor of alcohol use.

More recently, studies have examined mediator and moderator models in order to elucidate mechanisms within this relationship. Stewart and colleagues (2001) found that negative reinforcement based coping motives mediated the relationship between AS and alcohol consumption, and noted that gender may differentially affect the type of negative reinforcement based coping utilized. Whereas several studies have identified coping motives as an important variable within this relationship (Stewart, 2001; DeMartini, 2011), the moderating role of gender was not replicated in a subsequent study (Novak, 2003). Taken together, the literature to date indicates that the relationship between AS and problematic alcohol use is likely mediated by coping motives and also suggests that gender may be an important variable to account for.

While several studies have identified the role of coping motives within this relationship, few have considered the role of depression despite strong evidence linking AS to subsequent depression (Grant et al. 2007; Muris et al. 2001; Zavos, Rijsdijk, & Eley 2012) and depression to subsequent alcohol use problems (e.g. Gilman, 2001; Hartka et al, 1991), independently. While further research is needed to understand the mechanisms linking AS and depression, it has been posited that problematic cognitive styles common in individuals with high AS, such as rumination, may lead to depression (Zavos, 2012). Similarly, research regarding the link between depression and later problematic alcohol use is continually progressing; to date this link has been attributed to several potential mechanisms including negative reinforcement, increased reward sensitivity, and increased cognitive dyscontrol (Christie, 1988; Abraham, 1999). Taken together, independent studies have found causal relationships between AS and subsequent depression, and depression and subsequent alcohol use. Thus, there is a clear rationale for including depression into a model examining the relationship between AS and problematic alcohol use. It may be that a propensity for problematic coping is not the only pathway or the most important pathway to focus on when considering the link between AS and alcohol use. It is possible that the onset of depression following symptoms of AS may be equally or more important in predicting subsequent alcohol problems.

Despite the aforementioned research, relatively little attention has been given to depression within the specific field of literature examining the AS – alcohol use relationship. Two studies have considered the role of negative affect, a construct related to but not equivalent to depression, within the AS – alcohol use relationship (Saunders, 1993; Howell, 2010). One study found that primed negative affect resulted in greater alcohol consumption, regardless of participant AS levels (Saunders, 1993). A second study found that the association between AS and alcohol use remained even after controlling for levels of negative affect as measured by the PANAS (Howell, 2010). In sum, these studies yield mixed results regarding the role of negative affect within the relationship between AS and alcohol. Moreover, these studies examine a construct related to, but not commensurate with depression.

Therefore, the current study proposes to examine the role of symptoms of depression assessed with a widely used and psychometrically valid measure of depression. Given the evidence demonstrating that AS can lead to subsequent depression and that depression can lead to subsequent alcohol use problems, we believe a model examining symptoms of depression as a mediator within the AS – problematic alcohol use relationship could provide a meaningful extension to the current literature. Additionally, previous studies have demonstrated the importance of including negative–reinforcement-based coping into a model examining this relationship (Conrod, Pihl, & Vassileva, 1998; Stewart, Karp, Pihl, & Peterson, 1997). Therefore, the current study conducted additional analyses examining depression and problematic coping as dual-mediators to determine if depression uniquely mediates this relationship, above and beyond the known mediating role of problematic coping. Additionally, alcohol dependence was selected as the primary outcome variable for its ability to capture impairment and dysfunction above and beyond other measures of alcohol consumption such as frequency or amount of drinks consumed.

Lastly, we explored the specific indirect effects of three lower order factors of AS, including fear of somatic sensations, fear of cognitive dyscontrol, and fear of socially observable anxiety symptoms (see Zinbarg, 1999 for review) as they relate to alcohol use. These three sub-factors are hierarchically arranged within the single factor of general AS (Deacon, 2006). Studies examining the correlates of these lower order factors demonstrate varying psychological associations with each factor (Zinbarg, Barlow, & Brown, 1997; Taylor, Koch, Woody, & McLean, 1996; Blais et al., 2001; McWilliams, Stewart, & MacPherson, 2000). Specifically, cognitive dyscontrol and somatic sensations have demonstrated the strongest associations with symptoms of depression (Blais et al., 2001; Taylor, Koch, Woody & McLean, 1996, Grant, 2007). We hypothesized that symptoms of depression and problematic coping would both independently mediate the relationship between total AS and alcohol dependence. Additionally, based on the associations established in previous literature we hypothesized that the relationship between the lower order factors of cognitive dyscontrol (Blais et al., 2001) and somatic sensations (Grant, 2007) and alcohol dependence would be mediated by depression, whereas fear of socially observable symptoms of anxiety would not be mediated by symptoms of depression.

Method

Patients ($n = 418$) were sequential admissions into an inpatient substance use treatment facility in Washington, D.C. from 2007 to 2010. At the time of admission into the treatment center, participants were required to submit a negative urine drug screen. Those with positive drug screens had to complete a detoxification program and evidence no acute pharmacological effects of drug use before they were admitted to the facility; there was great variety in the detoxification programs used across participants, but most included medical assistance over several days. Inpatient treatment typically ranged from 28 to 180 days and was dependent on the patients' treatment funding sources. Patients were only permitted to leave the facility for scheduled appointments such as psychiatric and primary care appointments. Drug testing occurred on a weekly basis and any use was grounds for immediate removal from the center. Because patients were assessed early in their treatment, none had been removed from treatment at the time of assessment. Intake assessments were conducted by doctoral level graduate students and senior research staff with patients during their first week at the inpatient substance use treatment center.

The assessments served two purposes: (1) to provide diagnostic information to treatment staff at the center, and (2) to gather data for the current study. Patients were invited to participate in research following the intake assessment and were provided details regarding how information collected during the assessment would be used. Data for the current study includes only cases where informed consent was obtained from patients following the assessment (<5% of patients declined to provide informed consent). The study protocol was reviewed and approved by the University of Maryland Institutional Review Board.

Measurements

Alcohol Dependence Diagnosis (SCID-IV; First et al., 1995)—Information regarding alcohol dependence diagnosis was garnered using the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders IV (SCID-IV; First et al., 1995).

The Anxiety Sensitivity Index (ASI; Reiss, Peterson, Gursky, & McNally, 1986)—The ASI is a 16-item self-report measure of fear of or sensitivity to anxiety. Questions are rated on a 5-point scale ranging from “very little” to “very much” and assess beliefs regarding potential negative implications associated with anxiety (e.g., “It is important for me not to appear nervous”, “When I feel pain in my chest, I worry that I’m going to have a heart attack”). The ASI has demonstrated adequate test–retest reliability ($r = .71$) (Reiss et al., 1986). The internal consistencies (coefficient alpha) in the current study were .84, .80, and .74 for the somatic sensations, fear of cognitive dyscontrol, and fear of socially observable anxiety symptoms subscales, respectively.

The Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977)—The CESD is a 20-item self-report measure of depressive symptoms. Questions are phrased as self-statements (e.g., “I had crying spells”, “I thought my life had been a failure”) and respondents use a 4-point scale to rate how frequently each item related to them over the past week. The CES-D has been shown to have good internal consistency in non-clinical as

well as clinical populations (.85 and 0.90, respectively) (Radloff, 1977); internal consistency (coefficient alpha) in the current study was .81. The CES-D correlates strongly with the Beck Depression Inventory ($r = 0.87$) (Santor, Zuroff, Ramsay, Cervantes, & Palacios, 1995).

The Ways of Coping Checklist (WCCL; Folkman & Lazarus, 1985)—The WCCL is a 13-item self-report measure assessing problem and emotion focused coping. Questions are phrased as self-statements (e.g., “When I encounter a stressful situation I try to make myself feel better by drinking...” “, and respondents use a 4-point scale to rate how frequently each item related to them. The WCCL has adequate psychometric properties and has been demonstrated to correlate with lifetime and daily incidence of negative events ($r = .88$, $p < .001$) (Forsythe & Compas, 1987). Internal consistency (coefficient alpha) for the current study was .84.

Analytic Strategy and Model Building Approach

The completed questionnaires and diagnostic interviews were carefully reviewed and checked for completeness or obvious errors before data entry. Data were double entered into SPSS (versions 14–18 over the course of the study) so that potential inconsistencies or inaccuracies could be easily detected and resolved. Mediation analysis using bootstrapping with replacement (Preacher & Hayes, 2008) was utilized in order to estimate the indirect effects of AS on alcohol dependence via depression and problematic coping. Bias-corrected bootstrapping with 1,000 bootstrap samples was chosen for its ability to maximize the power to detect mediation (Fritz & MacKinnon, 2007; Hayes & Scharkow, in press; Preacher & Hayes, 2008). A series of mediation analyses were conducted using the SPSS PROCESS macro with bootstrapping which allows for non-normality (Preacher & Hayes, 2008). This modeling technique estimates simultaneous regression analyses and generates confidence intervals that correct for bias in estimating the indirect effects. An indirect effect is determined to be statistically significant if the confidence interval does not contain zero.

We followed a model building strategy that allowed us to examine depression as a unique mediator of the relationship between AS and alcohol dependence. We first estimated four models to test the indirect effects of AS (total score) as well as the three lower order AS scores (somatic sensations, fear of cognitive dyscontrol, and fear of socially observable anxiety symptoms) on alcohol dependence via depression, controlling for the direct effects of coping and gender on alcohol dependence. In our second model building step, we re-estimated the models in which depression had mediated the relationship between AS and alcohol dependence, and in this final set of models we included both depression and coping motives as dual-mediators to determine if depression remained a unique mediator even while controlling for the co-mediating effect of coping motives. Thus, four primary models were completed with depression as the mediator, and up to four secondary models were completed to test depression and problematic coping as dual-mediators of the relationship between AS and alcohol dependence.

Results

Preliminary Analyses

Mean scores for key variables and zero-order correlations between all continuous variables can be found in Table 1. As predicted, all lower order indices of ASI were strongly correlated with one another (see Table 1); thus, to account for high multicollinearity among predictor variables we continued with the planned model building approach whereby mediation was tested across separate models corresponding to ASI (total score) and the three lower order ASI factors.

Participants

The mean age of the sample was 43 ($SD = 10.5$). The majority of the sample was male (71.1%) and court-mandated to treatment (59.1%). The majority of the sample consisted of African Americans (89.2%), followed by Caucasians (4.8%), Hispanics (1.2%), American Indian/Alaskan Natives (1.2%), and individuals identifying as “other” (3.6%). The mean score on the Anxiety Sensitivity Index was 26.1 ($SD = 13.3$) with scores ranging from 0 to 64, the mean score on the Center for Epidemiological Studies Depression scale was 9.95 ($SD = 6.18$) with scores ranging from 0 to 26, and the mean score on the Ways of Coping Checklist was 19.65 ($SD = 7.93$) with scores ranging from 0 to 39.

Tests of Mediation

It was hypothesized that symptoms of depression would mediate the relationship between indicators of AS (total score and three lower order factors) and alcohol dependence. The first set of four mediation models included testing the direct effect of ASI on alcohol dependence via depressive symptoms, controlling for the direct effects of gender and problematic coping on alcohol dependence. We ran four separate models, each with a different indicator of ASI (model 1: total score, model 2: somatic sensations, model 3: fear of cognitive dyscontrol, and model 4: fear of socially observable anxiety symptoms). Depression did not mediate the relationship between fear of cognitive dyscontrol and alcohol dependence (model 3) or the relationship between fear of socially observable anxiety symptoms and alcohol dependence (model 4), as evidenced by confidence intervals for the indirect effects that contained zero for these two mediation models (model 3: 95% CI $[-.0002, 0.056]$; model 4: 95% CI $[0.00, 0.03]$). However, consistent with our hypotheses, depression was a significant mediator of the relationship between AS (total score) and alcohol dependence (model 1: indirect effect = .006, $SE = .003$; 95% CI $[0.001, 0.015]$) and also between AS (somatic sensations) and alcohol dependence (model 2: indirect effect = 0.008, $SE = 0.005$, 95% CI $[0.0009, 0.019]$), even when controlling for the direct effects of problematic coping and gender. In these models, greater anxiety sensitivity was associated with greater symptoms of depression which, in turn, was associated with increased odds for being diagnosed with alcohol dependence.

Lastly, we re-estimated models 1 and 2 with problematic coping as a co-mediator to determine if the mediating effect of depression still holds above and beyond the mediating effect of problematic coping, while controlling for the direct effect of gender. In both models, depression and problematic coping both emerged as significant and unique

mediators of the relationship between AS (total score) and alcohol dependence (model 1: depression indirect effect = 0.009, $SE=0.004$, 95% CI [0.0007, 0.018]; problematic coping indirect effect = 0.007, $SE=0.004$, 95% CI [0.0008, 0.017]) and between AS (somatic sensations) and alcohol dependence (model 2: depression indirect effect = 0.011, $SE=0.006$, 95% CI [0.002, 0.024]; problematic coping indirect effect = 0.008, $SE=0.005$, 95% CI [0.001, 0.02]). In these models, greater anxiety sensitivity was associated with greater symptoms of depression and poorer coping strategies which, in turn, were both uniquely associated with increased odds for being diagnosed with alcohol dependence.

Discussion

This is the first study to our knowledge to demonstrate a relationship between elevated anxiety sensitivity, elevated depressive symptoms, and alcohol dependence. This work demonstrates that the relationship between anxiety sensitivity and alcohol dependence is mediated by depressive symptoms, even when controlling for coping motives and gender. This is in line with work by Cox and colleagues (2001a, b) demonstrating that AS underlies depression, as well as with multiple studies demonstrating a relationship between AS and problematic alcohol use (see DeMartini, 2011 for a review). Similar to prior work, we also demonstrated a relationship between AS and alcohol dependence through problematic coping (Stewart, 2001). Our results help to elucidate the relationships between these three constructs and suggest that depressive symptoms are an important component of the relationship between AS and alcohol dependence.

Our findings also suggest that subcomponents of anxiety sensitivity differentially impact alcohol dependence through depressive symptoms and coping motives. Partially supporting our hypotheses, fear of somatic sensations but not cognitive dyscontrol was associated with alcohol dependence through depressive symptoms. Although these findings are important and novel, it is necessary to explore why they emerged, based on prior findings.

There is a robust body of work that has attempted to better understand the relationship between subcomponents of AS and depressive symptoms. Prior research suggests that the relationship between AS and depressive symptoms is primarily explained by fear of cognitive dyscontrol (e.g. Zinbarg, Brown, Barlow, & Rapee, 2001; Cassin & Rector, 2012; Schmidt, Lerew, & Joiner, 1998; Taylor, Koch, Woody, & McLean, 1996), where individuals interpret perceptions of cognitive dyscontrol as a precursor to depressive episodes (Cox, Taylor, & Enns, 1999; Cox, Enns, Freeman, & Walker, 2001). Importantly, however, another body of research demonstrates relationships between fear of somatic sensations and social fears with depressive symptoms (e.g. Rodriguez et al., 2004; Grant, Beck, & Davila, 2007; McWilliams, Becker, Margrat, Clara, & Vriendt, 2007). Indeed, Grant and colleagues (2007) demonstrated that fear of somatic symptoms at baseline significantly predicted depressive symptoms 12 months later, while fear of cognitive dyscontrol and social fears were not significant. Relatedly, social fears have been shown to predict depressive symptoms (Tull & Gratz, 2008; Grant, Beck, Farrow, & Davila, 2007), with the suggestion that avoiding social interactions because of these fears limits the potential for reinforcing social interactions, thereby increasing the likelihood of depressive symptoms (Viana & Rabian, 2009). As findings regarding the relationship between

depressive symptoms and subcomponents of AS have been mixed, it will be necessary in future work to further explore why these various components might be differentially associated with depressive symptoms, as well as to explore how and why these components then predict problematic alcohol use.

This work suggests that anxiety sensitivity more broadly, and somatic concerns more specifically, are associated with depressive symptoms and alcohol dependence. Here, it appears that individuals with fears of somatic sensations experience elevated levels of depressive symptoms. Perhaps because of their desire to avoid these somatic sensations, as well as their elevated depressive symptoms, alcohol appears to be a solution to escape from both problems. It is possible that interventions targeting anxiety sensitivity, with particular attention to somatic symptoms, would impact depressive symptoms and problematic alcohol use.

The current findings must be considered within the context of several limitations. First, we did not randomly select participants for this study, nor are our participants representative of all individuals in inpatient substance use treatment programs. As our sample was primarily comprised of low SES African American inpatients, it will be important to replicate these findings in other samples. Second, we relied on self-report measures and semi-structured interviews to garner information about participants' anxiety sensitivity, depressive symptoms, coping motives, and alcohol use. However, this generally is standard within this field of work. Moreover, although biological verification of alcohol use may have provided important information about participants' use, within the context of this particular treatment setting requiring abstinence, it would have been impossible. Moreover, semi-structured interviews are the standard for diagnosing alcohol dependence. Finally, our data were cross-sectional, making it difficult to infer the directionality of the relationship examined. Thus, it is possible that the directionality of the relationship proposed here might change when examined longitudinally; indeed bidirectional relationships have been observed between AS and depressive symptoms (Zavos et al., 2012).

Within the context of these limitations, there are a number of important implications of our findings that underscore the importance of considering anxiety sensitivity and depressive symptoms in our understanding and treatment of alcohol dependence. First, these findings suggest that it may be important to consider the interrelationships between anxiety sensitivity and depressive symptoms when treating alcohol dependence. Prior work has targeted comorbid depression and alcohol dependence (e.g. Gamble et al., 2013; Han, Kim, Choi, Min, & Renshaw, 2013; Kay-Lambkin, Baker, Kelly, & Lewin, 2012), as well as comorbid anxiety and alcohol dependence (Baillie et al., 2013; Ciraulo et al., 2013; Kushner et al., 2013). However, it has not been explored whether targeting one of these components (e.g. AS) affects other components (e.g. depressive symptoms), or whether targeting both might produce the best outcomes. Second, our findings suggest that coping motives alone may not fully explain the relationship between AS and alcohol dependence, making it important to consider the role of depressive symptoms within this relationship. Third, our findings suggest that the various subcomponents of AS must be considered when attempting to understand how they are related to depressive symptoms and alcohol dependence. This too could have important treatment implications. Finally, our findings offer a number of

future directions to be explored in future work to expand our understanding of the factors leading to alcohol dependence.

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Highlights (mandatory)

Highlights consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point). See the following website for more information <http://www.elsevier.com/highlights>

- Effects of anxiety sensitivity on alcohol dep. were mediated by depression.
- Effects of AS Total and AS Somatic on alcohol dep. were mediated by depression.
- Dual mediator model shows depression & problematic coping uniquely mediate relationship.

Model 1:

Indirect effects through depression = 0.009, $SE=0.004$, 95% CI [0.0007, 0.018]
and problematic coping = 0.007, $SE=0.004$, 95% CI [0.0008, 0.017]

Model 2:

Indirect effects through depression = 0.011, $SE=0.006$, 95% CI [0.002, 0.024]
and problematic coping = 0.008, $SE=0.005$, 95% CI [0.001, 0.02]

Figure 1.

Depression and problematic coping as dual mediators of the relationship between anxiety sensitivity-total and alcohol dependence (model 1) and between anxiety sensitivity- somatic and alcohol dependence (model 2). Unstandardized path coefficients are presented. Significant coefficients are indicated by bold paths and * for $p < .05$ and ** for $p < .01$. All specific indirect effects through depression and problematic coping are significant.

Table 1

Zero order correlations between all continuous variables

	CESD Total M=9.95 (SD=6.18)	WCCL Total M=19.65 (SD=7.93)	ASI Total M=26.08 (SD=13.25)	ASI Social M=7.80 (SD=3.34)	ASI Cognitive M=4.27 (SD=4.11)	ASI Physical M=14.01 (SD=8.15)
CESD Total	1	--	--	--	--	--
WCCL Total	0.41**	1	--	--	--	--
ASI Total	0.37**	0.34**	1	--	--	--
ASI Social	0.23**	0.26**	0.71**	1	--	--
ASI Cognitive	0.44**	0.38**	0.80**	0.47**	1	--
ASI Physical	0.29**	0.25**	0.93**	0.51**	0.61**	1

Note. CESD= Center for Epidemiological Studies Depression Scale; WCCL= Ways of Coping Checklist; ASI= Anxiety Sensitivity Index

**
p < .01