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Work Stress and Alcohol Use: Developing and Testing a Biphase Self-Medication Model

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Abstract

This study developed and tested a moderated-mediation model of work stress and alcohol use, based on the biphase (stimulant and sedative) effects of alcohol and the self-medication and stress-vulnerability models of alcohol use. The model proposes that exposure to work stressors can increase both negative affect and work fatigue, and that these two sources of strain can subsequently motivate the use of alcohol. However, the relations of negative affect and work fatigue to alcohol use are conditional on the joint moderating effects of alcohol outcome expectancies and gender. Data were collected from a national probability sample of 2,808 U.S. workers. Supporting the model, the results indicated that work stressor exposure was conditionally related via negative affect to heavy alcohol use among both men and women holding strong tension reduction alcohol expectancies and to after work alcohol use among men holding strong tension reduction alcohol expectancies. Also, work stressor exposure was conditionally related via work fatigue to both heavy alcohol use and workday alcohol use among men holding strong fatigue reduction alcohol expectancies. The results have application in the identification of individuals at higher risk of problematic alcohol use and are relevant to workplace safety and to the design of appropriate interventions.

Keywords

alcohol; work stress; negative affect; work fatigue; workplace; employee

Introduction

The excessive or ill-timed use of alcohol among the workforce is an important social and organizational issue because it is prevalent; can lead to compromised health, role performance and safety on and off the job; and has associated costs for employees, employers and society (Bouchery, Harwood, Sacks, Simon, & Brewer, 2011; Cherpitel, 2007; Frone, 2013; Normand, Lempert, & O'Brien, 1994; Rehm, Taylor, & Room, 2006). Especially relevant is heavy alcohol use, workday alcohol use, and alcohol use initiated shortly after leaving work. National studies of the U.S. workforce reveal that the 12-month prevalence rates are 26% for consuming 5 or more drinks per day, 30% for drinking to

intoxication, 23% for experiencing a hangover, and 38% for initiating alcohol use within two hours of leaving work (Frone, 2013). Because most adults spend a majority of their waking time in formal employment, developing a better understanding of how the work environment influences dysfunctional alcohol use is important for the development of more effective workplace interventions.

Although past research has explored several work-related causes of employee alcohol use, the largest body of research over the past three decades has focused on work stress (Frone, 1999, 2013). The general premise of this research has been that exposure to work stressors (i.e., negative work experiences) will increase alcohol use as a form of self-medication. Alcohol is used to self-medicate presumably because it can reduce negative affect resulting from exposure to work stressors. However, this widely-held belief has received inconsistent research support (Frone, 1999, 2013; Siegrist & Rodel, 2006). Perhaps the most important shortcoming in this body of research is the common use of simple cause-effect models that merely hypothesize an overall direct relation between various work stressors and some assessment of alcohol use. However, from a developing literature on stress and alcohol, it is becoming clear that there is no simple direct relation between stressors and alcohol use (e.g., Anthenelli & Grandison, 2012; Frone, 1999; Greeley & Oei, 1999). Instead, the relation between stressors and alcohol use is complex, involving intervening processes, moderating processes, and differentiation among multiple alcohol use outcomes. The development of more complex moderated-mediation models may result in a better understanding of how and for whom stressor exposure results in dysfunctional alcohol use (Anthenelli & Grandison, 2012; Frone, 1999, 2013; Greeley & Oei, 1999). Therefore, the general goal of this study is to develop and test a broader, biphasic self-medication model of work stress and alcohol use that extends prior research by incorporating multiple intervening variables, multiple moderating variables, and multiple alcohol use outcomes.

Pharmacological Effects of Alcohol

All psychoactive drugs are classified into a smaller set of general categories representing various pharmacological effects (e.g., Frone, 2013). The main categories are narcotic analgesics, depressants, stimulants, hallucinogens, and cannabis. A specific psychoactive substance gets categorized into one of the general categories according to its primary pharmacological effect. However, these classifications do not tell the whole story because psychoactive drugs often have more than one pharmacological effect, and individuals may use a psychoactive substance for more than one of its effects depending on the context of use. Therefore, before developing the model of work stress and alcohol use, it is useful to understand some pharmacological effects of alcohol.

Although alcohol is primarily classified as a central nervous system depressant having sedative/anxiolytic effects, it can have stimulant effects as well (e.g., Addicott, Marsh-Richard, Mathias, & Dougherty, 2007; Hendler, Ramchandani, Gilman, & Hommer, 2011; Wise & Bozarth, 1987). For a given maximum blood alcohol concentration (BAC), there is a corresponding BAC curve. The curve begins with a BAC of zero, which increases as time and consumption proceeds. Once consumption ends, BAC will continue to rise to some maximum level, and then begin to fall over time until it reaches zero. Therefore, there are

ascending and descending limbs of a BAC curve. Every level of BAC (e.g., .05%) below the maximum BAC achieved (e.g., .10%) occurs twice—once as BAC is rising and once as BAC is falling. Research shows that the effects of alcohol can differ depending on whether BAC levels are rising or falling. For example, alcohol has a predominant stimulant effect during the ascending limb of the BAC curve, and a predominant sedative/anxiolytic effect during the descending limb of the BAC curve (e.g., Addicott et al., 2007; Hendler et al., 2011; Holdstock & de Wit, 1998). This variation in the pharmacological effects of alcohol across the ascending and descending limbs of the BAC curve is referred to as alcohol's *biphasic effects*. Finally, individual differences exist in the extent to which the stimulant vs. sedative/anxiolytic effects of alcohol use are experienced (Hendler et al., 2011; Holdstock & de Wit, 1998).

Biphasic Self-Medication Model of Work Stress and Alcohol Use

The hypothesized biphasic self-medication model is shown in Figure 1. The model proposes that exposure to work stressors can increase both negative affect and work fatigue, and because of the biphasic pharmacological effects of alcohol, both negative affect and work fatigue can motivate the use of alcohol in an effort to regulate these two sources of strain. Further, the model proposes that the strength of the second stage relations between the intervening variables (negative affect and work fatigue) and alcohol use is conditional on the joint moderating effects of specific alcohol outcome expectancies and gender. For the purpose of discussion, the model can be broken down into the two indirect paths linking work stressor exposure to alcohol use.

Work Stressor Exposure→Negative Affect→Alcohol Use

Based on the sedative/anxiolytic effects of alcohol, general tension-reduction (Conger, 1956; Greeley & Oei, 1999), affect regulation (Cooper, Frone, Russell, & Mudar, 1995; Kober, 2014), and negative reinforcement (McCarthy, Curtin, Piper, & Baker, 2010) models of alcohol use (collectively referred to as self-medication models), suggest that alcohol is used to reduce (self-medicate) elevated negative affect resulting from exposure to stressors. In other words, an indirect relation is proposed where work stressor exposure causes elevated negative affect, which then causes increased alcohol use. In this context, negative affect refers to various unpleasant emotional states that include sadness/depression, anxiety/fear, and anger/hostility.

Moving beyond simple cause-effect models of work stress and alcohol, several studies have explored the intervening role of negative affect. Although some research has found that work stressors were indirectly related to alcohol use via heightened negative affect (e.g., Frone, Barnes, & Farrell, 1994; Vasse, Nijhuis, & Kok, 1998; Wolff, Rospenda, Richman, Liu, & Milner, 2013), several other studies have failed to support the intervening role of negative affect (e.g., Armeli, Tennen, Affleck, & Kranzler, 2000; Bamberger & Bacharach, 2006; Cooper, Russell, & Frone, 1990; Kawakami, Araki, Haratani, & Hemmi, 1993). So this body of past research suggests that work stressors are consistently related to higher levels of negative affect, but the relation between negative affect and elevated alcohol use has not been consistently observed.

Although the incorporation of negative affect as an intervening process in work stress—alcohol use models is an important improvement, it may not go far enough (Cooper et al., 1990; Cooper, Russell, Skinner, Frone, & Mudar, 1992; Frone, 1999; Kober, 2014). The stress-vulnerability model of alcohol use proposes that exposure to stressors will motivate alcohol use as self-medication only among individuals with certain characteristics that put them at higher risk of stressor-induced alcohol use (Cooper et al., 1992). In other words, individual vulnerability factors moderate the relation between stressor exposure and alcohol use. Two important vulnerability factors are positive alcohol outcome expectancies and gender (Cooper et al., 1992).

The first moderator proposed in the stress-vulnerability model of alcohol use is alcohol outcome expectancies. Alcohol outcome expectancy theory proposes that individuals develop beliefs regarding the anticipated effects of alcohol on behaviour, moods and emotions that are learned either through direct or vicarious experience; and that these outcome expectancies then motivate individuals to use or not use alcohol (Leigh, 1989; Oei & Baldwin, 1994; Patel & Fromme, 2010). Individuals hold a number of specific expectancies regarding the positive and negative outcomes of alcohol use. Positive alcohol expectancies involve outcomes such as sexual enhancement, physical and social pleasure, increased social assertiveness, aggression and power, and relaxation and tension reduction (e.g., Brown, Christiansen, Goldman, 1987). Cooper et al. (1992) proposed that the relation between stressors and alcohol use should be stronger among individuals who believe that alcohol can ameliorate negative affect.

A second moderator proposed in the stress-vulnerability model of alcohol use is gender. In general, men are more likely to consume alcohol than women (e.g., Frone, 2013; Hughes, Wilsnack, & Kantor, 2016; Nolen-Hoeksema, 2004). There are two processes that can explain this gender difference and may make men more likely than women to consume alcohol in response to work stress. The first process leading to gender differences in alcohol use is biological. Although genetics plays a role in drinking behaviour for men and women, some evidence exists that men may be more genetically predisposed to use alcohol than women (Hughes et al., 2016). Additionally, men have proportionately less body fat and more body water than women for a similar body weight (e.g., Frone, 2013; Hughes et al. 2016; Nolen-Hoeksema, 2004; Mumenthaler, Taylor, O'Hara, & Yesavage, 1999). The effect of this difference is that for a given dose of alcohol, men will obtain lower blood alcohol levels and may be less likely to experience psychomotor and cognitive impairment and symptoms of hangover than women (Frone, 2013; Hughes et al. 2016; Nolen-Hoeksema, 2004; Mumenthaler et al., 1999; Verster et al., 2010). These differential effects may allow higher levels of alcohol use in men compared with women, both in general and in response to work stressors. The second process leading to gender differences in alcohol use is environmental. Compared to women, men have been socialized to externalize distress, perceive fewer social sanctions associated with drinking, and perceive alcohol use as part of their gender role (Cooper et al., 1992; Hughes et al. 2016; Nolen-Hoeksema, 2004). Therefore, these gender differences may result in men being more likely to increase drinking in response to work stressor exposure than women.

The stress-vulnerability model of alcohol use further considers the joint moderating effect of alcohol outcomes expectancies and gender. Research testing the stress-vulnerability model has shown that broadly-assessed positive alcohol expectancies and gender jointly moderate the relation between broadly-assessed negative life events and alcohol use, such that this relation was positive only among men holding strong positive alcohol expectancies (Armeli, Carney, Tennen, Affleck, & O'Neil, 2000; Cooper et al., 1992). So negative life events lead to increased alcohol use among men who also believe that alcohol can reduce the negative affect typically associated with the experience of negative life events.

As shown in Figure 1, integrating the self-medication and stress-vulnerability models of alcohol use suggests that (a) work stressor exposure is positively related to negative affect and (b) negative affect is positively, but conditionally related to alcohol use among men holding strong tension-reduction alcohol expectancies. Although individuals hold expectancies regarding a number of positive outcomes associated with alcohol use, expectancies regarding alcohol's ability to promote relaxation and tension reduction seem most central to the relation between negative affect and alcohol use.

Only two studies have provided a partial test of the proposed conditional indirect relation between work stressor exposure and alcohol use via negative affect. Cooper et al. (1990) found that work stressor exposure was positively related to negative affect, but that negative affect was not related to alcohol use or alcohol problems. Moreover, there was no moderating effect of broadly-assessed positive alcohol expectancies on the relation between negative affect and both alcohol use and alcohol problems. A potential limitation of that study was the use of a broad measure of positive alcohol expectancies rather than a more specific measure of tension-reduction expectancies. The positive alcohol expectancy measure included items assessing expected outcomes of alcohol use involving social and physical pleasure, sexual enhancement, aggression and power, and social expressiveness, in addition to expectancies regarding tension reduction. Therefore, the excess meaning in the positive alcohol expectancy measure may have undermined the likelihood of finding the hypothesized moderating effect of alcohol expectancies on the relation between negative affect and both alcohol use and problems.

In contrast, Wolff et al. (2013) used a narrower measure of tension-reduction alcohol expectancies, and found that work-family conflict was positively related to negative affect and that negative affect was significantly and positively related to heavy alcohol use only among individuals who held strong tension-reduction expectancies. Therefore, those results support a conditional indirect relation of work-family conflict to heavy alcohol use via negative affect only among individuals holding strong tension-reduction expectancies. However, neither Cooper et al. (1990) nor Wolff et al. (2013) explored the potential joint moderating effect of tension reduction expectancies and gender on the relation between negative affect and alcohol use within the context of a work stress model.

Work Stressor Exposure→Work Fatigue→Alcohol Use

Prior research on work stress and the use of alcohol for self-medication was based on the assumption that alcohol is used for its sedative/anxiolytic effects. In contrast, no attention has been paid to the potential use of alcohol for its stimulant effects. According to

Conservation of Resources (COR) theory (Hobfoll, 1989; Shirom, 2003), exposure to work stressors can lead to the depletion of physical, mental, and/or emotional energy resulting in work fatigue, which represents an unpleasant state of extreme tiredness and reduced functional capacity (Frone & Tidwell, 2015). It is expected that individuals are motivated to reduce fatigue and regain lost energy (Hobfoll, 1989; Shirom, 2003). One potential means of reducing work fatigue and regaining lost energy is to self-medicate with alcohol for its stimulant effect. Although research supports a positive relation between work stressor exposure and work fatigue (Alarcon, 2011; Lee & Ashforth, 1996; Nixon, Mazzola, Bauer, Krueger, & Spector, 2011), no research has explored the relation of work fatigue to alcohol use. Nonetheless, building from COR theory and the self-medication and stress-vulnerability models of alcohol use discussed earlier, Figure 1 shows a conditional indirect effect where (a) work stressor exposure is positively related to work fatigue and (b) work fatigue is positively, but conditionally related to alcohol use among men holding strong fatigue-reduction alcohol expectancies. Fatigue reduction expectancies represent beliefs that alcohol use can increase energy. To date, no research has explicitly assessed and explored the effects of alcohol expectancies regarding fatigue reduction.

Study Hypotheses

Based on the biphasic self-medication model of work stress and alcohol use shown in Figure 1, the following six hypotheses were tested:

Hypothesis 1a	Work stressor exposure will be positively related to negative affect.
Hypothesis 1b	Negative affect will be positively related to employee alcohol use among men who hold strong tension-reduction alcohol expectancies.
Hypothesis 1c	Work stressor exposure will be positively and indirectly related to employee alcohol use via negative affect among men who hold strong tension-reduction alcohol expectancies.
Hypothesis 2a	Work stressor exposure will be positively related to work fatigue.
Hypothesis 2b	Work fatigue will be positively related to employee alcohol use among men who hold strong fatigue-reduction alcohol expectancies.
Hypothesis 2c	Work stressor exposure will be positively and indirectly related to employee alcohol use via work fatigue among men who hold strong fatigue-reduction alcohol expectancies.

Method

Sample and Study Design

The 2,975 study participants took part in a random telephone survey called the National Survey of Work Stress and Health. The population from which the study participants were

sampled was all non-institutionalized adults, ages 18–65 years, who were employed in the civilian labour force, and who resided in households in the 48 US contiguous states and the District of Columbia. Data were collected by 29 extensively trained interviewers using computer-assisted telephone interviewing (CATI) stations from December 2008 to April 2011. To be eligible for participation in this [the present?] study, individuals had to be (1) 18–65 years old, (2) residing in a household in the 48 contiguous states and the District of Columbia, (3) currently employed in the civilian labour force, and (4) working at least one hour per week. Within a household with more than one eligible individual, the next birthday method was used to select at random one individual for participation in the study (e.g., Potthoff, 1994). Of all selected eligible individuals, 47% participated in the study. On average, the interview lasted 55 minutes and participants were paid \$25.00 (USD) for their time. Participants were excluded from the present analyses if they were missing data on any of the variables used to test the proposed model. This resulted in a final sample of 2,808 participants.

Sampling Weights

For all analyses, the participants are weighted according to standard procedures for sample survey data to generalize to the target population defined earlier (e.g., Korn & Graubard, 1999; Levy & Lemeshow, 1999). The sampling weights account for the initial selection probability for the reached telephone number, the number of different telephone lines through which the household could be reached, and the number of eligible adults in the household. The weights were further adjusted for differential nonresponse and were post-stratified to population totals obtained from the Current Population Survey.

Participant Characteristics

The respondent (i.e., population) characteristics are described with weighted means and percentages. Of the participants, 53% were male. Furthermore, 69% were White, 13% were Black, 9% were Hispanic, and 9% were members of other racial/ethnic groups. The average age of the participants was 41 years. In terms of highest level of education, 0.4% did not attend high school; 3.8% attended high school but did not graduate; 19.0% graduated from high school or obtained a GED; 3.0% attended trade, technical, or vocational training beyond high school; 20.0% attended some college; 9.0% received an Associate's degree; 23.4% received a Bachelor's degree; 2.9% attended some graduate school; 14.0% received a Master's degree; and 4.6% received a doctoral level degree. In terms of occupation, 83% of participants were in white-collar occupations and 17% were in blue-collar occupations. The participants worked on average 41 hours per week and had held their present job for an average of 6 years. Median family income was \$68,000 (USD).

Measures

Descriptive statistics for and correlations among all study variables are provided in Table 1. Each of the variables is describe below.

Work stressor exposure—Six work stressor measures were averaged to compute an index of overall work stressor exposure. Workload (three items) and work pace (three items) were assessed by adapting commonly used items (Hurrell & McLaney, 1988; Lisle, van

Veldhoven, & Moors, 1998; Spector & Jex, 1998). An example workload item is *During the past 12 months, how often did you have too much work to do?* An example work pace item was *During the past 12 months, how often did your job require you to hurry your work?* Role conflict was assessed with three items—two items from Peterson et al. (1995) and one item from House, Schuler, and Levanoni (1983). An example item is *I often receive conflicting requests from two or more people at work*. Role ambiguity was assessed with four items developed by House et al. (1983). An example item is *My job has clear goals and objectives* (reverse scored). Emotionally unpleasant work was assessed with two items developed for this study. An example item is *During the past 12 months, how often did your job put you in emotionally unpleasant or disturbing situations?* Emotional work demands were assessed with three items adapted from Kristensen, Hannerz, Høgh, and Borg (2005). An example item is *During the past 12 months, how often was your work emotionally demanding?* The response anchors for workload, work pace, emotionally unpleasant work, and emotional work demands ranged from 0 (never) to 4 (everyday). The response anchors for role conflict and role ambiguity ranged from 1 (strongly disagree) to 4 (strongly agree). Internal consistency reliability for the individual work stressor measures was .86 for workload, .81 for work pace, .85 for role conflict, .82 for role ambiguity, .80 for emotionally disturbing work, and .79 for emotional demands.

An overall composite work stressor measure was created by averaging scores on all six work stressor variables for two primary reasons. First, the composite measure provides a broader and more holistic representation of exposure to work stressors. Also, using multiple stressor measures as indicators of an overall work demands construct is an approach used almost exclusively among researchers testing the Job Demands-Resources model (e.g., Demerouti, Bakker, Nachreiner, & Schaufeli, 2001; Huynh, Xanthopoulou, & Winefield, 2014). Second, the general goal of this paper is testing two processes that explain how and for whom work stressor exposure is related to alcohol use. Therefore, using a composite work stressor measure allowed these processes to be tested, while simplifying the analyses by minimizing the number of conditional indirect effects to be estimated and presented. The internal consistency reliability for the overall work stressor composite was .90.

Negative affect—Negative affect was assessed by asking how often the participants experienced each of nine negative emotions, representing sadness/depression (depressed, sad, gloomy), anxiety/fear (nervous, anxious, worried), and anger/hostility (hostile, furious, angry) during the prior 12 months. The emotion adjectives were taken from the Brunel mood scale (Terry & Lane, 2003) and the PANAS-X (Watson & Clark, 1994). The response anchors ranged from 0 (never) to 3 (often). Internal consistency reliability was .83 for negative affect.

Work fatigue—Overall work fatigue experienced during the past 12 months was assessed by averaging 18 items from the Three-Dimensional Work Fatigue Inventory (Frone & Tidwell, 2015). The items capture work-related physical, mental, and emotional fatigue. Example items include: *During the past 12 months, how often did you feel physically exhausted at the end of the workday?*; *During the past 12 months, how often did you feel mentally exhausted at the end of the workday?*; and *During the past 12 months, how often*

did you feel emotionally exhausted at the end of the workday? The response anchors ranged from 0 (never) to 4 (everyday). Internal consistency reliability for overall work fatigue was .96.

Alcohol outcome expectancies—Three items each were used to assess alcohol expectancies related to tension reduction and fatigue reduction. The tension reduction expectancy items were developed by Frone (2003). The items were: *Drinking alcohol makes me less tense*, *Drinking alcohol helps me to unwind*, and *Drinking alcohol helps me to relax*. The fatigue reduction expectancy items were developed for the present study. The three items were: *I feel like I have more energy after drinking*, *Drinking alcohol can make me more energetic*, and *Drinking alcohol increases my energy when I'm tired*. The response anchors ranged from 1 (strongly disagree) to 4 (strongly agree).

The factor structure of the alcohol expectancy items was assessed with confirmatory factor analysis taking into account sampling weights and the ordinal indicator variables. A one-factor model provided a very poor fit to the data: χ^2 ($df=9$, $N=2,808$) = 974.04, $p<.001$; CFI = .94; TLI = .89; and RMSEA = .195 (90% CI [.185, .206]). In contrast, the expected correlated two-factor model provided an excellent fit to the data: χ^2 ($df=8$, $N=2,808$) = 14.35, $p=.07$; CFI = 1.00; TLI = 1.00; and RMSEA = .017 (90% CI [.000, .031]). Further supporting the two-factor model, all items loaded highly and significantly (all p values < .001) on their respective factors. The average standardized loading was .88 (range .80 to .93) for tension reduction expectancies and .86 (range .82 to .94) for fatigue reduction expectancies. The two dimensions of alcohol expectancies were moderately correlated ($r=.59$, $p<.001$). Finally, the two measures exhibited high internal consistency reliability – .87 for tension reduction expectancies and .83 for fatigue reduction expectancies.

Alcohol use—Three dimensions of alcohol use were assessed with items used in prior research (e.g., Frone, 2013). Heavy drinking was assessed by averaging three items assessing the frequency over the past 12 months of drinking five or more drinks within two hours (if male)/four or more drinks within two hours (if female); drinking to intoxication; and drinking enough to experience a hangover. Workday drinking was assessed by averaging two measures – one measure represented the frequency during the past 12 months of drinking during the workday and the other measure represented the typical number of drinks consumed when drinking during the workday. After work drinking was assessed by averaging two items – one item assessed the frequency during the past 12 months of initiating drinking within two hours of leaving work and the other item assessed the typical number of drinks consumed when drinking after work. Response anchors for the five alcohol items assessing frequency of drinking ranged from 0 (never) to 5 (6 to 7 days a week). The two items assessing quantity of alcohol consumed used open-ended responses. Internal consistency reliability was .80 for heavy drinking, .89 for workday drinking, and .79 for after work drinking.

Covariates—Several covariates were included in the analyses to control for possible confounding: gender (0 = women, 1 = men), race (0 = White, 1 = minority), age (in years), years of formal education (10 ordinal response options), total family income, occupation (0 = white collar, 1 = blue collar), and number of weekly work hours.

Data Analysis

All analyses described below were conducted using Stata (Version 14, Stata Corporation, 2015) because it allowed the use of sampling weights in all analyses and the use of robust standard errors that are adjusted for nonnormality and heteroscedasticity.

Stage 1 main effects—To test the Stage 1 relations between work stressor exposure and the intervening variables, both negative affect and work fatigue were regressed on the set of covariates and work stressor exposure.

Stage 2 moderator and conditional effects—The moderator effects involving the Stage 2 relations from negative affect and work fatigue to the alcohol outcomes were tested using hierarchical regression analysis. For each alcohol outcome, the predictors were entered in three steps. On Step 1, the following main effects entered the equation: all covariates, tension reduction (TRE) and fatigue reduction (FRE) alcohol expectancies, work stressor exposure, negative affect (NA), and work fatigue (WF). On Step 2, the following two-way interactions entered the equations: Gender x TRE, Gender x FRE, NA x Gender, WF x Gender, NA x TRE, and WF x FRE. Finally, on Step 3, the following three-way interactions entered the equations: NA x TRE x Gender and WF x FRE x Gender.

In the case of significant interactions involving negative affect or work fatigue, two sets of conditional effects were estimated (e.g., Edwards & Lambert, 2007; Hayes, 2013). First, the conditional direct effects from the intervening variables to the alcohol outcomes were estimated at low (1 *SD* below the mean) and high (1 *SD* above the mean) values on the alcohol expectancy measures for men and women. Second, the conditional indirect effects from work stressor exposure to the alcohol outcomes were estimated at low (1 *SD* below the mean) and high (1 *SD* above the mean) values on the alcohol expectancy measures for men and women. Because the sampling distribution of indirect effects (i.e., a product of two coefficients) is nonnormal, the significance of each conditional indirect effect was based on bias-corrected bootstrap confidence intervals using 5,000 bootstrap samples (e.g., Edwards & Lambert, 2007; Hayes, 2013).

Results

Stage 1 Main Effects

Stage 1 regression analyses revealed that, after controlling for the seven covariates, work stressor exposure was positively related to both negative affect ($b = .23, p < .001$) and work fatigue ($b = .70, p < .001$). These results support Hypotheses 1a and 2a, respectively.

Stage 2 Moderator and Conditional effects

The Stage 2 moderator analyses are presented in Table 2 and the conditional direct and indirect effects are reported in Tables 3 to 5. These results are discussed below separately for each alcohol outcome.

Heavy alcohol use—Although the Step 3 results in Table 2 revealed that the three-way interaction involving negative affect, tension-reduction expectancies and gender was not

significant, the Step 2 results revealed a significant two-way interaction between negative affect and tension-reduction expectancies predicting heavy alcohol use. The conditional direct effects in Table 3 reveal that the relation of negative affect to heavy drinking was only positive and significant among individuals holding strong tension-reduction expectancies. Consistent with this finding, the conditional indirect effects in Table 3 show that work stressor exposure was only indirectly related to heavy alcohol use via negative affect among individuals holding strong tension-reduction expectancies. Although these results do not strictly support Hypotheses 1b and 1c, they lend partial support in that tension-reduction expectancies moderated the direct effect of negative affect and the indirect effect of work stressor exposure to heavy alcohol use, which did not differ for men and women.

The Step 3 results in Table 2 support the anticipated three-way interaction between work fatigue, fatigue reduction expectancies and gender. The conditional direct effects in Table 3 reveal that the relation of work fatigue to heavy alcohol use was only positive and significant among men holding strong fatigue-reduction expectancies. Consistent with this finding, the conditional indirect effects in Table 3 show that work stressor exposure was only indirectly related to heavy alcohol use via work fatigue among men holding strong fatigue-reduction expectancies. These results support Hypotheses 2b and 2c.

Workday alcohol use—The Step 3 results in Table 2 do not support a three-way interaction involving negative affect, tension reduction expectancies and gender. Thus, Hypotheses 1b and 1c were not supported with regard to workday alcohol use. Furthermore, the Step 2 results in Table 2 failed to reveal any two-way interactions involving either tension-reduction expectancies or gender with negative affect.

The Step 3 results in Table 2 support the anticipated three-way interaction between work fatigue, fatigue reduction expectancies and gender. The conditional direct effects in Table 4 reveal that the relation of work fatigue to workday alcohol use was only positive and significant among men holding strong fatigue-reduction expectancies. Consistent with this finding, the conditional indirect effects in Table 4 show that work stressor exposure was only indirectly related to heavy alcohol use via work fatigue among men holding strong fatigue-reduction expectancies. These results support Hypotheses 2b and 2c.

After work alcohol use—The Step 3 results in Table 2 support the anticipated three-way interaction between negative affect, tension-reduction expectancies and gender. The conditional direct effects in Table 5 reveal that the relation of negative affect to after work alcohol use was only positive and significant among men holding strong tension-reduction expectancies. Consistent with this finding, the conditional indirect effects in Table 5 show that work stressor exposure was only indirectly related to after work alcohol use via negative affect among men holding strong tension-reduction expectancies. These results support Hypotheses 1b and 1c.

The Step 3 results in Table 2 support the anticipated three-way interaction between negative affect, tension-reduction expectancies and gender. However, none of the conditional direct or indirect effects in Table 5 were statistically significant. Therefore, these results failed to support Hypotheses 2b and 2c with respect to after work alcohol use.

Discussion

The goal of this study was to develop and test a moderated-mediation model of work stress and alcohol use based on the biphasic effects of alcohol and the integration of self-medication and stress-vulnerability models of alcohol use. The model extended past research exploring negative affect as an intervening variable linking work stressor exposure and alcohol use by incorporating both tension-reduction expectancies and gender as moderator variables. Further, the model extended research on employee alcohol use by exploring work fatigue as an additional intervening variable linking work stressor exposure to alcohol use, and the moderating effects of fatigue reduction expectancies and gender.

The present results support the general conclusion that individuals may use alcohol to self-medicate the experience of negative affect and work fatigue resulting from exposure to work stressors. However, the indirect effects of work stressor exposure to alcohol use were conditional. The use of alcohol to self-medicate the experience of negative affect and work fatigue occurred among men who held strong outcome expectancies that alcohol use could reduce these forms of strain. The one exception to this pattern of results was that work stressor exposure was positively related to heavy alcohol use among both men and women holding strong tension-reduction expectancies. The moderating effect of tension reduction-expectancies on the relation between negative affect and heavy alcohol use in the present study supports the finding reported by Wolff et al. (2013), and extends it by showing that the moderating effect does not differ by gender.

The present results underscore the importance of using multiple alcohol outcome variables, especially those capturing the temporal context of use. Work stressor exposure was conditionally related to overall heavy alcohol use via both negative affect and work fatigue. However, only work fatigue conditionally mediated the relation of work stressor exposure to workday alcohol use and only negative affect conditionally mediated the relation of work stressor exposure to after work alcohol use. These differential effects support prior research showing that other workplace predictors, such as supervisor social control (Frone & Trinidad, 2012) and workplace alcohol use norms (Frone & Brown, 2010) show differential relations across alcohol use outcomes. Even if differential relations are not expected or observed, using a broad set of alcohol outcomes provides evidence that a given feature of the workplace has a consistent impact on employee alcohol use.

Strengths and Limitations

The present results should be interpreted within the context of the strengths and limitations of this study. In terms of strengths, this study used a large and broad probability sample of employed adults in the U.S., which would provide more variation in the key constructs than smaller convenience samples. Also, compared to most convenience samples, the present sample provided adequate statistical power to detect the hypothesized effects and provided more accurate estimates of population effect sizes (Ioannidis, 2008; Schmidt, 1992).

These strengths notwithstanding, because the present study collected data from a single source and was cross-sectional in design, method variance may have inflated some relations and causal conclusions cannot be drawn regarding the reported relations between predictors

and outcomes. However, the observed interactions are unlikely to be caused by method variance and are not consistent with reverse causal effects. Nonetheless, the proposed biphasic self-medication model of work stress and alcohol use should be tested using longitudinal panel and daily process designs. Although past research, described earlier, on the stress-vulnerability model of alcohol use focused on negative life events and did not incorporate intervening variables, the three-way interaction between negative life events, positive alcohol expectancies, and gender emerged in a cross-sectional study using a large ($N = 1,316$) general population probability sample of adults (Cooper et al., 1992) and in a small ($N = 88$) diary study of community adults assessed over 60 days (Armeli, Carney et al., 2000). A final limitation is that only landline telephone numbers were sampled. Failure to sample cell phone numbers could lead to some bias in the results. However, bias in the tested relations would only result if the relations differed across individuals who have a landline and those who only have a cell phone after the sampling weights adjusted the sample distributions on gender, age, and other characteristics. There is no reason to believe that the tested relations would depend on having or not having a landline per se.

Effect Size, Future Research, and Practical Implications

The interaction effects found in this study were modest in size. However, Frone (2015) noted that such modest effects are not surprising. Heavy and problematic alcohol use represents a complex phenotype because it is the result of many determinants, each having small individual effects (see Frone, 2013 for an overview). The quantitative genetics literature shows that approximately 50% of the population variance in heavy and problematic alcohol use is attributable to genetics (genotype) and 50% is attributable to non-shared (i.e., nonfamilial) environmental influences (see Frone, 2013, for a review). However, the molecular genetics literature has had limited success in identifying specific variants of genes (polymorphisms) that predict heavy drinking and alcoholism, and the few polymorphisms that have been located each account for very small percentages in the variance of heavy and problematic alcohol use (e.g., Agrawal & Bierut, 2012; Frone, 2013). In fact, Agrawal and Bierut (2012) pointed out that even though genetic differences account for 50% of population variation in alcohol dependence, less than 1% of the genetic variance has been explained so far.

We also should not expect anything different when considering the other 50% of population variation in heavy and problematic drinking attributable to the environment (Frone, 2015). Past research also supports the notion that alcohol use is a complex phenotype affected by many environmental determinants, each having modest individual effects. In other words, employee alcohol use is not simply a function of negative work experiences, alcohol expectancies and gender. It also may be affected by other demographic characteristics (age, education), positive work experiences, descriptive and injunctive workplace alcohol use norms, physical availability and opportunity to use alcohol at work, workplace social control, personality, and a multitude of potential interactions between these factors (see Frone, 2013, for a review). Further, there are many parallel and unique environmental causes of employee alcohol use that exist outside the workplace.

Although work stress, or any specific class of predictors, is not going to explain a large proportion of the variance in alcohol use in the overall population of employed adults, the goal of this research is to identify subgroups of individuals who are at higher risk of heavy and problematic alcohol use. Therefore, future research trying to explain employee alcohol use may need to develop even more complex models. For example, the present biphasic self-medication model could be expanded to incorporate variables that moderate the Stage 1 relations from work stress to negative affect and work fatigue. One possible Stage 1 moderator is the psychological salience of the work role (i.e., job involvement). Identity theory suggests that individual differences exist in the salience of a given role for self-definition and self-evaluation, and to the extent that the work role is psychologically salient, negative work experiences may have a stronger impact on employee outcomes such as negative affect and work fatigue (e.g., Burke, 1991; Frone, Russell, & Cooper, 1995; Thoits, 1991). It may also be important to begin exploring genetic variants that might moderate the Stage 1 and 2 relations proposed in the model (i.e., gene-by-environment interaction; see Anthenelli & Grandison, 2012), either alone or in conjunction with the other moderators in the proposed biphasic self-medication model.

Despite the fact that more systematic, and increasingly comprehensive, research on the causes of employee alcohol use needs to be conducted, the present findings have two primary practical implications. First, workplace interventions aimed at reducing exposure to work stressors or helping employees to manage negative affect and work fatigue may reduce dysfunctional alcohol use. However, because the relations of work stressors, negative affect, and work fatigue are *conditionally related* to dysfunctional alcohol use depending on the level and type of alcohol expectancies and gender, such interventions may have an important, yet circumscribed (i.e., conditional) impact on employee alcohol use. This observation may help explain the lack of evidence that stress and coping-based workplace interventions reduce levels of employee alcohol use (Frone, 2013). Because not all individuals are expected to use alcohol in response to negative affect or fatigue, the present results suggest that an overall effect of workplace stress/coping interventions on alcohol use may not exist. Nonetheless, the present results suggest that these interventions may have an impact for males who hold strong tension-reduction or fatigue-reduction alcohol expectancies. Researchers need to be careful in how the effects of interventions are evaluated in order to avoid missing important effects in critical subgroups.

Second, the findings regarding workday alcohol use may be important in terms of workplace safety. To the extent that work fatigue, resulting from work stress and other causes, leads to alcohol use in an effort to reduce the fatigue among males with high fatigue-reduction expectancies, any resulting acute psychomotor or cognitive impairment may increase the possibility of workplace accidents and injuries. This suggests that employers need to be aware of this possibility and develop general strategies to reduce work fatigue-induced alcohol use during the workday. Employers need to have explicit policies against drinking during the workday. Moreover, these policies need to explicitly address alcohol use during lunch breaks, which is primary time during which alcohol is consumed during the workday (Frone, 2013). But even if policies regarding workday alcohol use and impairment are in place, Bell, Mangione, Howland, Levine, and Amick (1996) found that managers report a variety of barriers to detecting and intervening in cases of employee alcohol misuse. These

barriers include organizational norms and signals from top management that the organization should be tough on illicit drug use, but that a tough stand on alcohol use is not important. Other strategies to reduce fatigue-related workday alcohol use include educating employees about proper sleep and the effects of fatigue. Also, companies need to address more functional ways of reducing work fatigue, such as assessing workloads and other stressor exposures and building in rest breaks during the workday that are optimal in terms of frequency and length for a given job and work shift (e.g., Caruso, 2012; Tucker, 2003).

Conclusion

Despite interest in work stress and alcohol use that dates back at least three decades, few researchers have attempted to develop comprehensive moderated-mediation models. The model developed and tested in the present study is the only one to have incorporated multiple mediator variables, multiple moderator variables, and multiple alcohol outcome variables. The results highlight the importance of developing more complex models of employee alcohol use. Until the nature of the complex relation between work stress and alcohol use is understood, the development and evaluation of workplace interventions designed to reduce employee alcohol use by targeting the work stress process will be impeded.

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Figure 1.
The Hypothesized Biphase Self-Medication Model of Work Stress and Alcohol Use.

Table 1

Descriptive Statistics and Correlations for All Variables.

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Work stressor exposure	2.09	0.70	----													
2. Tension-reduction Expectancies	2.63	0.88	.07	----												
3. Fatigue-reduction Expectancies	1.50	0.62	.01	.43	----											
4. Negative affect	1.46	0.53	.29	.12	.03	---										
5. Work fatigue	1.59	0.98	.50	.12	.06	.41	----									
6. Heavy alcohol use	0.42	0.66	.07	.37	.29	.11	.12	----								
7. Workday alcohol use	0.08	0.35	.04	.12	.13	.05	.05	.23	----							
8. After work alcohol use	0.98	1.25	.09	.41	.24	.10	.09	.55	.25	----						
9. Gender (men)	0.53	0.50	.01	.10	.15	-.15	-.11	.15	.10	.18	----					
10. Race (minority)	0.31	0.46	-.05	-.04	.01	-.10	-.03	-.05	-.08	-.13	.02	----				
11. Age	40.98	12.64	.08	-.07	-.17	-.02	-.03	-.30	.00	-.03	-.03	-.12	----			
12. Education	5.89	2.25	.17	.01	-.10	.05	.03	-.12	.10	.08	-.04	-.12	.22	----		
13. Family income (USD)	68,000 ^a	116,566	.10	.05	-.05	.02	.04	-.02	.07	.10	.06	-.07	.18	.26	----	
14. Occupation (blue-collar)	0.17	.37	-.10	.02	.06	-.07	-.06	.10	-.04	-.02	.31	.04	-.05	-.37	-.11	----
15. Weekly work hours	40.59	12.14	.28	.01	-.10	.02	.16	-.04	.09	.12	.21	-.06	.19	.21	.21	.03

Note: $N = 2808$. Correlations with absolute values greater than .04 are significant at $p < .05$.

^aMedian family income is reported.

Table 2

Stage 2 Regression results.

Predictors	Heavy Alcohol Use	Workday Alcohol Use	After Work Alcohol Use
<i>Step 1: Main Effects</i>			
Gender (men)	.14 ***	.07 ***	.36 ***
TRE	.21 ***	.03 ***	.50 ***
FRE	.10 **	.05 *	.15 *
Work stressor exposure	.05	-.02	.01
Negative affect	.06	.02	.12 *
Work fatigue	.03	.01	.02
<i>R</i> ²	.25 ***	.05 ***	.23 ***
<i>Step 2: Two-Way Interactions</i>			
Gender x TRE	.04	.02	.21 ***
Gender x FRE	.14 *	.09	.25 *
Negative affect x Gender	-.02	.03	.20
Work fatigue x Gender	.05	.02	-.02
Negative affect x TRE	.10 ***	.03	.24 ***
Work fatigue x FRE	.04	.04 *	.03
<i>R</i> ²	.01 ***	.02	.02 ***
<i>Step 3: Three-Way Interactions</i>			
Negative affect x TRE x Gender	.07	.04	.28 **
Work fatigue x FRE x Gender	.13 *	.10 **	.24 *
<i>R</i> ²	.01 *	.01 *	.01 ***

Note: *N* = 2,808. Coefficients are unstandardized. FRE = fatigue reduction alcohol expectancies. TRE = Tension reduction alcohol expectancies. Coefficients for the following covariates are not shown in Step 1: race, age, education, family income, occupation, weekly work hours.

*
p < .05;

**
p < .01;

p < .001.

Table 3

Conditional Direct and Indirect Effects for Heavy Alcohol Use

Moderator	Conditional Direct Effects <i>b</i> M→Y (95% CI)	Conditional Indirect Effects <i>b</i> X→M→Y (95% BC CI)
PATH: Work Stressor Exposure (X)→Negative Affect (M)→Heavy Alcohol Use (Y)		
Low TRE (−1 <i>SD</i>)	−.01 (−.08, .06)	.00 (−.02, .01)
High TRE (+1 <i>SD</i>)	.17* (.07, .27)	.04* (.02, .06)
PATH: Work Stressor Exposure (X)→Work Fatigue (M)→Heavy Alcohol Use (Y)		
Female Low FRE (−1 <i>SD</i>)	.01 (−.03, .06)	.01 (−.02, .04)
Female High FRE (+1 <i>SD</i>)	−.02 (−.08, .04)	−.02 (−.06, .03)
Male Low FRE (−1 <i>SD</i>)	−.02 (−.09, .06)	−.01 (−.06, .04)
Male High FRE (+1 <i>SD</i>)	.11* (.02, .21)	.08* (.02, .15)

Note: *N*=2,808. Coefficients are unstandardized. BC = Bias corrected. CI = Confidence interval. FRE = fatigue reduction alcohol expectancies. TRE = Tension reduction alcohol expectancies. The bias corrected confidence intervals for the conditional indirect effects were based on 5,000 bootstrap samples.

* Denotes that the 95% confidence interval did not contain zero.

Table 4

Conditional Direct and Indirect Effects for Workday Alcohol Use

Moderator	Conditional Direct Effects <i>b</i> M→Y (95% CI)	Conditional Indirect Effects <i>b</i> X→M→Y (95% BC CI)
PATH: Work Stressor Exposure (X)→Work Fatigue (M)→Workday Alcohol Use (Y)		
Female Low FRE (−1 <i>SD</i>)	.01 (−.01, .02)	.01 (.00, .01)
Female High FRE (+1 <i>SD</i>)	−.01 (−.03, .01)	−.01 (−.02, .00)
Male Low FRE (−1 <i>SD</i>)	−.04 (−.08, .01)	−.03 (−.06, .01)
Male High FRE (+1 <i>SD</i>)	.07* (.01, .12)	.05* (.01, .09)

Note: $N=2,808$. Coefficients are unstandardized. BC = Bias corrected. CI = Confidence interval. FRE = fatigue reduction alcohol expectancies. TRE = Tension reduction alcohol expectancies. The bias corrected confidence intervals for the conditional indirect effects were based on 5,000 bootstrap samples.

* Denotes that the 95% confidence interval did not contain zero.

Table 5

Conditional Direct and Indirect Effects for After Work Alcohol Use

Moderator	Conditional Direct Effects <i>b</i> M→Y (95% CI)	Conditional Indirect Effects <i>b</i> X→M→Y (95% BC CI)
PATH: Work Stressor Exposure (X)→Negative Affect (M)→After Work Alcohol Use (Y)		
Female Low TRE (−1 <i>SD</i>)	−.08 (−.20, .03)	−.02 (−.05, .01)
Female High TRE (+1 <i>SD</i>)	.09 (−.10, .29)	.02 (−.02, .06)
Male Low TRE (−1 <i>SD</i>)	−.12 (−.28, .05)	−.03 (−.07, .01)
Male High TRE (+1 <i>SD</i>)	.55* (.26, .84)	.12* (.06, .20)
PATH: Work Stressor Exposure (X)→Work Fatigue (M)→After Work Alcohol Use (Y)		
Female Low FRE (−1 <i>SD</i>)	.08 (−.01, .17)	.05 (−.01, .12)
Female High FRE (+1 <i>SD</i>)	.05 (−.16, .06)	−.03 (−.11, .04)
Male Low FRE (−1 <i>SD</i>)	.09 (−.22, .03)	−.07 (−.16, .03)
Male, High FRE (+1 <i>SD</i>)	.08 (−.09, .25)	.06 (−.07, .18)

Note: *N*=2,808. Coefficients are unstandardized. BC = Bias corrected. CI = Confidence interval. FRE = fatigue reduction alcohol expectancies. TRE = Tension reduction alcohol expectancies. The bias corrected confidence intervals for the conditional indirect effects were based on 5,000 bootstrap samples.

* Denotes that the 95% confidence interval did not contain zero.