Investigating the Combined Effects of Alcohol Expectancies and Subjective Response on Future Drinking: An Interaction Approach

by

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A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Arts

Approved February 2020 by the
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ARIZONA STATE UNIVERSITY

May 2020

ABSTRACT

Past research suggests that both Alcohol Expectancies and Subjective Response are strong predictors of drinking. However, most studies do not account for the shared variance or relations between the two. Social cognitive and expectancy theories suggest that cognitions may distort reality, creating a discrepancy between expected and subjective effects. Only one study has tested the effects of such discrepancies (Morean et al., 2015), but that study was cross-sectional, making it impossible to determine the direction of effects. As such, the present study sought to test prospective associations between expectancy-subjective response interactions and future drinking behavior. Participants (N=448) were randomly assigned to receive alcohol (target blood alcohol alcohol =.08 g%) or placebo, with 270 in the alcohol condition. Alcohol expectancies and subjective response were assessed across the full range of affective space of valence by arousal. Hierarchical regression tested whether expectancies, subjective response, and their interaction predicted follow-up drinking in 258 participants who reached a blood alcohol curve of >.06 (to differentiate blood alcohol curve limbs). Covariates included gender, age, drinking context, and baseline drinking. High arousal subjective response was tested on the ascending limb and low arousal subjective response on the descending limb. High arousal positive expectancies and subjective response interacted to predict future drinking, such that mean and low levels of high arousal positive subjective response were associated with more drinking when expectancies were higher. High arousal negative expectancies and subjective response also interacted to predict future drinking, such that high levels of high arousal negative subjective response marginally predicted more drinking when expectancies were lower. There were no interactions between low arousal positive or low arousal negative expectancies and subjective response. Results suggest that those who expected high arousal positive subjective response but did not receive many of these effects drank more, and those who did not expect to feel high arousal negative subjective response but did in fact feel these effects also drank more. The results suggest that challenging inaccurate positive expectancies and increasing awareness of true negative subjective response may be efficacious ways to reduce drinking.

ACKNOWLEDGMENTS

I would like to thank my family, friends, and mentors for helping me through the process of obtaining my Master's Degree. More specifically, I would like to thank my loving mom for providing me guidance and unwavering support, my dad for his constant encouragement, and my brothers for always believing in me. I would also like to thank my co-mentors Drs. William Corbin and Laurie Chassin for providing me such enriching feedback on this project and for guiding me through my first years as a graduate student. In addition, I would like to thank Dr. Samantha Anderson for her support and for inspiring my passion in quantitative methods. Lastly, I would like to thank many friends, especially Maddie Styhl, Jessica Hartman, Juan Hernandez, Emma Lecarie, Sarah Curci, Jennifer Somers, and Austin Blake for supporting me through this process, and for always being a shoulder to lean on.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Alcohol misuse is a major public health concern, as it is the third leading cause of preventable death in the U.S. and is associated with a variety of health-related problems (Center For Disease and Control Prevention, 2013). A growing body of literature has begun to explore the effects of heavy episodic drinking, which is linked to a variety of problematic outcomes such as risky sexual behavior, drunk driving, physical injuries, sexual assault, and Alcohol Use Disorder (AUD) development (e.g., Wechsler et al., 1994; Wechsler, Dowdall, Davenport, & Castillo, 1995; Chassin, Pitts, & Prost, 2002; Perkins, 2002; Gmel, Rehm, & Kuntsche, 2003; Testa, VanZile-Tamsen, Livngston, & Koss, 2004; Gmel, Kuntsche, & Rehm, 2011; Bergen, Shults, Beck, & Qayad, 2012; Rehm, Shield, Joharchi, & Shuper, 2012). Sacks, Gonzalez, Buchery, Tomedi, and Brewer (2015) found that heavy drinking accounted for over three-quarters of the economic burden of alcohol misuse, and recent research suggests that rates of heavy drinking continue to rise (Grant et al., 2015).

Given the economic, social, and physical burden of heavy drinking, researchers have sought to identify risk factors related to heavy drinking (Courtney & Polich, 2009; Kuntsche, Kuntsche, Thrul, & Gmel, 2017). Positive expectancies about the effects alcohol (e.g., increasing sociability, tension reduction) and feeling more stimulant (e.g., excited, euphoric) and less sedative (e.g., inactive, tired) subjective effects during alcohol use are two of many consistent predictors of alcohol use (e.g., Jones, Corbin, & Fromme, 2001; Wiers, Van Woerden, Smulders, & De Jong, 2002; King, de Wit, McNamara, & Cao, 2011). Although both expectancies and subjective response (SR) predict risk for heavy drinking, very few studies have investigated their collective or interactive effects.

This is surprising given the interplay between expectancies and SR, particularly the discrepancy between anticipated and actual effects, may influence drinking behavior.

Better understanding how over- or underestimating alcohol effects, (particularly positive effects), predict drinking may inform intervention efforts. For example, expectancy challenge interventions (Darkes & Goldman, 1998), which seek to lower positive expectancies, may be well suited to those who overestimate the positive effects of alcohol. Alternatively, pharmacological treatments, which seek to dampen the positive physiological effects of alcohol (Volpicelli, Alterman, Hayashida, & O'Brien, 1992), may be better suited to those who exhibit both high positive expectancies and SR. Before attempting to individualize interventions based on patterns of expectancies and SR, it is critical to examine their collective and interactive effects on drinking outcomes. Thus, the present study sought to assess how expectancy-SR interactions relate to future drinking, using novel measures of expectancies/SR in the context of an innovative alcohol challenge study.

Alcohol Outcome Expectancies

Alcohol expectancies represent learned associations about how alcohol will affect an individual, both physically and psychologically. Alcohol expectancies are usually conceptualized through a social learning perspective (Rotter, Chance, & Phares, 1972; Bandura, 1977). Social learning theory posits that there are constant interactive relations among cognitions, behaviors, and environments in predicting human behavior. The interplay among the three create a reciprocal determinism, such that both person- (cognitions and behaviors) and environment-level influences affect one another (Bandura, 1977). Expectancies serve a cognitive function in social learning, as they represent conditioned responses based upon both direct and indirect experience. Particularly for alcohol, both direct exposure to alcohol and indirect exposure to alcohol cues/content, through media messages or older peers, can lead to the formation of and changes in expectancies.

Alcohol expectancy formation is seen as young as 2nd and 3rd grade (Dunn & Goldman, 1996; Dunn & Goldman, 1998). More specifically, Dunn & Goldman (1998) found that children who drank more heavily were more likely to endorse positive expectancies (e.g., happy, relaxed) than those who drank less or not at all. Non-drinking children were more likely to endorse negative expectancies (e.g., sad, sleepy). This general trend was found as grade level increased, with positive expectancies rising year by year (Dunn & Goldman, 1996; Dunn & Goldman, 1998; Bekman, Goldman, Worley, & Anderson, 2011). This pattern of findings is intriguing given the lack of knowledge and direct experience with alcohol's true effects for most individuals at this age, and the generally negative experiences that are common during early drinking experiences (Morean, Peterson, & L'Insalata, 2019).

There are a variety of reasons that positive expectancies may develop and endure even if one has no drinking experience or does not feel the positive effects he/she expects. First, adolescents receive alcohol-related content from a number of sources. Past studies have documented a link between peer and parental alcohol use and positive alcohol expectancy formation (Ennet & Bauman, 1991; Abrams & Niaura, 1987). More specifically, Martino, Collins, Ellickson, Schell, & McCaffrey (2006) found that peer alcohol use was associated with positive expectancies in 8th grade drinkers and that alcohol use by a close adult led to more positive alcohol expectancies in 8th graders. Several other studies have documented links between parental alcohol use and positive expectancies (e.g., Brown, Creamer & Stetson, 1987; Mann, Chassin, & Sher, 1987;

Colder, Chassin, Stice, & Curran, 1997; Waddell et al., in press). Thus, adolescents experience positive framing of alcohol by peers, and positively evaluate alcohol use by authority figures (e.g., close adults, parents). Indirect avenues of information, such as media depictions, also provide a salient outlet for adolescents to absorb alcohol-related content. Media has been referred to as a "super peer," (Elmore, Scull, & Kupersmidt, 2017) and frames substance use as positive and substance users as "cool" and happy (Primack, Dalton, Carroll, Agarwal, & Fine, 2008; Grube & Wallack, 1994; Aitken, Eadie, McNeill, & Scott, 1988; Casswell, 1995). Thus, alcohol desirability in media and alcohol-related movie content are both significant predictors of positive alcohol expectancies (Austin & Knaus, 2000; Austin, Pinkleton, & Fujioka, 2000; Dal Cin et al., 2009). These findings fit into the broader Media Cultivation Theory (Morgan & Shanahan, 2010), which suggests that constant, biased, positive portrayals of alcohol in the media can overpower information from other socializing agents, such as parents or teachers, who may provide a more accurate and two-sided portrayal of alcohol effects.

Taken together, both interpersonal (i.e., peer and parental) and media influences predict positive alcohol expectancies, suggesting the importance of indirect contact with alcohol in expectancy formation. Once expectancies are developed, they are further shaped by drinking experience. Smith, Goldman, Greenbaum, & Christiansen (1995) investigated the reciprocal relationship between drinking and positive expectancies and found that higher positive expectancies were associated with heavier drinking, which was associated with stronger positive expectancies and heavier drinking at a 1 year follow up. Aas, Leigh, Anderssen, and Jakobsen (1998) also found that positive expectancies predicted drinking initiation among seventh graders, and drinking initiation led to higher expectancies. These studies suggest that alcohol and expectancies have a reciprocal relationship. Rather than temporally preceding expectancies, growth in drinking may serve a strengthening role in positive expectancy development. Sher, Wood, Wood, & Raskin (1996) investigated the trajectory of expectancies and alcohol use among college students and found that freshman alcohol use predicted higher expectancies four years later, but higher expectancies during freshman year also predicted alcohol use at follow up. Sher et al. (1996) also showed that mean levels of positive alcohol expectancies decreased over the course of college, with the most significant drop in the last two years of assessments. Although these decreases were statistically significant, overall rating of positive expectancies still remained relatively high. These findings suggest a general trend toward lessening positive expectancies, except for those who continue drinking heavily at follow up. These findings are in line with models of maturing out (Labouvie, 1996; O'Malley, 2004; Lee & Sher, 2017), which suggest that alcohol involvement peaks during the beginning of college and then naturally dips toward the end of college and as young adults begin taking on new adult roles (Dawson, Grant, Stinson, & Choi, 2006; Lee, Chassin & Villalta, 2013; Lee, Chassin, & MacKinnon, 2015).

Although alcohol researchers have linked expectancies with a variety of drinking outcomes at a variety of ages, the strength of relations appears to depend upon the particular drinking outcome. In adolescence, expectancies are associated with frequency of drinking but are more strongly associated with quantity (for a review, see Jones et al., 2001). For example, Fromme & D'Amico (2000) found that all dimensions of positive expectancies, except for sexual enhancement, were related to quantity of consumption, whereas only sociability expectancies were related to frequency. In contrast, Fromme & D'Amico (2000) found that expectancies for cognitive and motor impairment (i.e., negative expectancies) were related to less drinking frequency but not quantity. Positive expectancies (but not negative expectancies) have also been linked to quantity of consumption in college and community samples. (McMahon, Jones & O'Donnell, 1994; Bogart, Yeetman, Sirridge, & Geer, 1995; Werner, Walker, & Green, 1995; Sher et al., 1996; Lee, Greeley & Oei, 1999; Baer, 2002; Ham & Hope, 2003).

Other studies have suggested that expectancies are more related to growth in drinking than quantity of consumption (Carey, 1995; Leigh, 1989; Mooney, Fromme, Kivlahan, & Marlatt, 1987). There is also literature suggesting that alcohol expectancies predict alcohol-related problems and alcohol dependence (Kilbey, Downey, & Breslau, 1998; Turrisi, Wiersma, & Hughes, 2000; Lewis & O'Neil, 2000). Despite positive expectancies showing a direct link to drinking behavior and problems, the effects of negative expectancies are much less consistently supported (Southwick et al., 1981, Mann, Chassin, & Sher, 1987; Collins, Lapp, Emmons, & Isaac, 2000; Jones et al., 2001). Although effects are more consistent for positive than negative expectancies, recent studies suggest that level of arousal (low vs. high) may be more critical than valence (positive, negative) in understanding relations between expectancies and drinking outcomes.

Morean, Corbin, and Treat (2012) developed the Anticipated Effects of Alcohol Scale (AEAS) to assess expectancies across the full valence by arousal affective space including: High Arousal Positive (HIGH+), High Arousal Negative (HIGH-), Low Arousal Positive (LOW+), and Low Arousal Negative (LOW-) effects. They found that HIGH+ expectancies (e.g., social, talkative) were positively related to all indices of heavy drinking and problems and that HIGH- expectancies (e.g., aggressive, rude) were positively related to binge drinking and problems. In contrast, they found that LOW+ (e.g., relaxed, calm) and LOW- expectancies (e.g., woozy, wobbly) were related to less drinking and problems. Follow-up studies corroborated these findings in high school students (Morean et al., 2016), emphasizing the unique effect of arousal in assessing positive and negative expectancies. Taken together, these studies point to positive expectancies as a consistent risk factor for heavy drinking and problems whereas results for negative expectancies have been mixed and may depend on level of arousal.

Subjective Response

In-the-moment subjective response to alcohol also serves as a risk factor for alcohol use and related problems. Subjective response (SR) can be defined as individual differences in one's subjective state due to a combination of pharmacological and expected effects of alcohol (Morean & Corbin, 2010). Many researchers use an alcohol challenge paradigm to assess SR, which consists of bringing a participant into a lab or simulated bar, administering a fixed or open dose of ethanol, and observing their SR via questionnaires assessing acute changes in mood, emotions, and feelings (Sayette, Breslin, Wilson, & Rosenblum, 1994). Subjective response was first conceptualized predominantly as acute changes in mood and the amount of alcohol needed to achieve intoxication (Mayfield, 1968; Judd et al., 1977; Schuckit, 1980). Subsequent research identified specific domains of SR, namely stimulation and sedation (Martin, Earleywine, Musty, Perrine, & Swift, 1993). Theoretical models focused on SR for intoxication and SR for stimulation and sedation differ in their predictions about relations between SR and drinking outcomes.

The Low-Level of Response (LLR) Model (e.g., Schuckit, 1984; Schuckit, 2009) purports that individuals who are at highest risk for AUD (i.e., those with a family history of alcoholism) will feel less acute alcohol effects. This in turn may lead those with a LLR to drink more, increasing risk for developing a higher tolerance, more withdrawal symptoms, and alcohol dependence (Schuckit, 2009). Schuckit (1984) was one of the first to explore this model by investigating sensitivity to fixed doses of alcohol in men who had a family history of AUD (i.e., at-risk) versus controls. Schuckit (1984) found that family history positive men reported less intensity of effects than did controls two hours after peak BAC, corresponding to the descending limb of the BAC curve. Research from this lab also found that men with a positive family history showed smaller increases in body sway (Schuckit, 1985; Schuckit & Gold, 1988), and less alcohol-related physical bodily changes in cortisol and hormone responses (Schuckit, Gold, & Risch, 1987; Schuckit, 1988) to alcohol. These seminal findings led to a large-scale longitudinal study, where a LLR predicted more alcohol use, alcohol-related dysfunction, and development of an AUD at 8 year, 10 year, 15 year, 20 year, and 25 year follow ups (Schuckit, 1994; Schuckit, 1998; Schuckit & Smith, 1996; Schuckit, 1998; Schuckit & Smith, 2000; Schuckit, Smith, Anderson, & Brown, 2004; Trim, Schuckit, & Smith, 2009).

In addition to predicting alcohol use and problems prospectively, Schuckit & Smith (2000) demonstrated that a LLR mediated the relation between family history and AUD development, and that a LLR did not interact with other risk factors (e.g., behavioral under control, coping, positive expectancies, and drinking environment) to predict AUD development. Trim et al. (2009) found that, even when accounting for the main effects of typical drinking, age of onset, and BMI, a LLR still predicted development of an AUD at 10, 15, 20, and 25 year follow-ups. Both of these studies point to a LLR as an independent and prospective risk factor for heavy alcohol use and problems.

Although prior studies have provided evidence in support of the LLR model, it has also been subject to criticism. First, studies from other labs have not always supported the findings of Schuckit and his colleagues. For example, O'Malley & Maisto (1985) found mixed findings when comparing family history positive and negative participants on a variety of measurements related to SR, and other studies have also failed to find that a low level of response is related to risky/family history of drinking (Moss, Yao, & Maddock, 1989; Newlin & Thompson, 1991; 1999; Morzorati, Ramchandani, Flury, Li, & Connor, 2002). Secondly, longitudinal findings supporting the LLR have been largely within men, leading researchers to question how the LLR plays out in women. Eng, Schuckit, & Smith (2005) found that daughters of alcoholics showed similar patterns of a LLR to sons of alcoholics, but other researchers have failed to reach similar conclusions (Evans & Levin, 2003). Lastly, most of the research on the LLR model has focused on negative, sedative effects, such as being "dizzy," or "confused." Although blunted sedative effects may lead to more consumption and related problems, these effects represent only a subset of alcohol effects that may confer risk for problem drinking (Morean & Corbin, 2010).

In 1990, Newlin & Thompson (1990) proposed the Differentiator Model (DM) as a competing model to the LLR model. Rather than focusing solely on negative aversive effects, oftentimes measured well after peak intoxication (e.g., Schuckit et al., 2005), the DM examines both positive stimulant effects, and negative sedative effects, in relation to risk factors and drinking outcomes. More specifically, the DM suggests that those at highest risk for future drinking and problems may be more sensitive to the positive stimulant effects, and less sensitive to the negative sedating effects of alcohol. These disparate aspects of SR are also thought to differ across the Blood Alcohol Curve (BAC), with increased stimulation on the ascending limb and decreased sedation on the descending limb. Although support for this model was not found initially (Pollock, 1992), specific measures of positive, stimulant measures were not available at the time (Quinn & Fromme, 2011). However, Martin, Earleywine, Musty, Perrine, & Swift (1993) validated a measure (Biphasic Alcohol Effects Scale; BAES) assessing stimulant effects (e.g., elated, energized) and sedative effects (e.g., inactive, difficulty concentrating) shortly thereafter (Martin et al., 1993). Martin et al. (1993) found that responses significantly differed across the BAC curve, with more stimulating responses on the ascending limb and more sedative response on the descending limb; similar results were found for men and women (Martin et al., 1993).

Although the DM has been less studied than the LLR, it has received partial research support from a variety of studies. For example, Erblich et al. (2003) found that family history positive students exhibited a stronger rise in stimulation from baseline but did not differ from those without a family history on change in sedation. Additionally, Thomas, Drobes, Voronin, and Anton (2004) found increases in stimulation from baseline in those with an AUD relative to social drinkers with no increases in sedation. Holdstock, King & De Wit (2000) found that heavy drinkers in one sample reported more stimulation and less sedation across both the ascending and descending curve, but only found evidence for elevated stimulation in heavier drinkers in the other sample. In a lab self-administration study, Corbin, Gearhardt, & Fromme (2009) found that, while a priming dose of alcohol increased rates of both stimulation and sedation, stimulant but not sedative effects predicted ad-libitum consumption. More comprehensively, King, Houle, De Wit, Holdstock, & Schuster (2002) found full support for the DM, with higher stimulation on the ascending and lower sedation on the descending limb in heavier drinkers compared to social drinkers.

In the most wide-ranging test of the LLR and DM model to date, Quinn & Fromme (2011) meta-analyzed alcohol administration studies that tested tenets of both models, parsing apart studies that focused on family history versus drinking patterns. The general findings of the article lent support to both models, providing unique perspectives on the risk conferred from subjective response. More specifically, Quinn & Fromme (2011) found that children of alcoholics reported significantly less global subjective response, lending overwhelming evidence for the LLR model; the most robust finding was across sedative effects on the descending limb of the BAC curve. Additionally, this effect was most prevalent in men, with the power in prediction significantly decreased when adding studies with daughters of alcoholics. In contrast, evidence for the DM was found when predicting drinking patterns, with heavier drinkers reporting more stimulation and less sedation; the most pronounced difference was for stimulation on the ascending limb of the BAC curve. Despite recent studies suggesting that peak BAC may be the optimal time to identify individual difference in both stimulation and sedation (King et al., 2011; 2014; 2016), evidence to support this argument is based on a relatively limited literature.

Although the DM expanded the range of effects examined in SR models, some have argued that the most commonly used measure in DM studies (the BAES) neglects potentially important aspects of SR. Because stimulant effects assessed by the BAES are primarily high in arousal, and sedating effects are largely low arousal, the BAES does not capture either high arousal negative or low arousal positive effects. LOW+ effects may represent effects relevant to the tension reduction model of alcohol use (Levenson, Sher, Grossman, Newman, & Newlin, 1980), whereas HIGH- effects may better inform research on specific relations between aggressive, dominant effects and specific alcohol-related problems. To address this gap in the literature, Morean, Corbin, and Treat (2013) developed and validated the Subjective Effects of Alcohol Scale (SEAS) to capture SR across the full valence by arousal affective space (see earlier description of the parallel measure of expectancies; AEAS). Morean et al. (2013) found that stronger HIGH+ and HIGH- effects were related to alcohol problems. When looking at incremental effects, Morean et al. (2013) found that stronger HIGH+ and HIGH- coupled with weaker LOW+ effects conferred the highest risk for heavy drinking. The one other study to date that measured drinking patterns from the affective space model of SR found that HIGH+ effects loaded onto an overall stimulation factor, which predicted heavier drinking (Quinn & Fromme, 2016). Although this area of research is in its infancy, studies to date suggest the potential importance of assessing SR across arousal as well as valence dimensions.

Expectancy-Subjective Response Discrepancies

Though alcohol expectancies and subjective response have received substantial attention in the alcohol literature, they have seldom been examined together in single studies. According to reciprocal determinism (Bandura, 2004; 2012), expectancies and SR would both affect one another, with expectancies strengthening as one feels a particular subjective effects. Along these lines, expectancies and SR should theoretically become highly correlated with drinking experience. However, the relationship between the two is not this simple. Bandura (2012)'s Social Cognitive Theory posits that cognitions about an event/behavior can provide an inaccurate portrayal of reality. As stated previously, media depictions and peer influences can lead to much higher positive expectancies of alcohol than are actually exhibited. Thus, alcohol expectancies may misrepresent one's actual SR when under the influence. Moreover, prior work suggests that inaccurate beliefs are related to both substance use and gambling behavior (Shoal & Giancola, 2005; Michalczuk, Bowden-Jones, Verdejo-Garcia, & Clark, 2011). Motivational and goal-directed behavior theories posit that one may seek to attain expected appetitive HIGH+ effects, leading to heavier drinking when alcohol does not produce the desired effects (Eccles & Wigfield, 2002). Although such discrepancies may have important implications for treatment, few studies have addressed this issue.

In the earliest such study to our knowledge, Fromme & Dunn (1992) found that participants expected more positive and negative alcohol effects than they actually received from alcohol. However, this study used a target dose of only .04 g% (half the legal limit for intoxication), used a non-validated measure of SR, and did not account for social manipulation (which was an aim of the study). More recently, a study by Wall, Thrussell, and Lalonde (2003) used a real bar setting to investigate discrepancies. Participants were asked to rate their expectancies at the beginning of the night, report how many drinks they planned to drink, and then report their SR at the end of the night after drinking. Wall et al. (2003) found only one significant discrepancy, with participants expecting more risk/aggression than actually experienced. This study also had methodological limitations including use of a non-validated measure of SR, and inconsistencies between participants' bar tabs and the number of drinks they reported consuming (i.e., participants bought more drinks than they reported). Additionally, participants were not told to imagine a specific dose when assessing expectancies, leading to further difficulties in interpreting discrepancies.

A critical limitation in both of the early studies on expectancy-SR discrepancies was the lack of a validated SR measure. This is a bit surprising as the Anticipated-Biphasic Alcohol Effects Scale (A-BAES) and BAES (i.e., the most widely used SR measure) are well-validated and have been available for over 25 years. The only study to look at relations between A-BAES and BAES scores was conducted quite recently and found that anticipated stimulation and sedation were correlated with their respective lab-derived SR measures, with correlations ranging from .47 to .60 (Fridberg, Rueger, Smith, & King, 2017). Although these correlations are significant, they do not suggest that A-BAES and BAES are capturing the same construct as the shared variance was less than 40%. This study did not explicitly examine the extent to which expected effects over-estimated actual effects.

The recent development of the AEAS and SEAS has provided the opportunity to examine expectancy-SR expectancies across both valence and affective dimensions using matched doses and limbs of the BAC curve. Using these new measures, Morean, Corbin, & Treat (2015) tested the accuracy of AEAS subscales in relation to actual SR. With one exception (Low+ effects on the descending limb), they found significant discrepancies between expectancies and subjective response across every subscale and on both limbs of the BAC curve. Consistent with the findings of Fridberg et al. (2017) using the BAES, Correlations between AEAS and SEAS subscales were significant (rs = .47-.62) but suggested that expectancies and SR represent separate constructs. Morean et al. (2015) also found that expectancy-SR discrepancies were related to drinking outcomes. Specifically, overestimating HIGH- effects was associated with greater binge drinking and alcohol problems, whereas overestimating HIGH+ effects was associated with more drinking and driving. Overestimating LOW- effects (ascending) was related to less binge drinking and alcohol problems, whereas overestimating LOW+ (ascending) was only related to less drinking and driving (Morean et al., 2015). Consistent with the results of the Morean et al. (2013) study, the results suggest that over-estimation of high arousal effects is associated with increased risk, whereas over-estimation of low arousal effects is associated with decreased risk.

With respect to high arousal effects, the finding that overestimating HIGH- effects lead to more binge drinking and problems is consistent with operant conditioning (Skinner, 1963; McLeod, 2007). If one expects to have undesirable effects, such as being aggressive or demanding (HIGH-), these effects may be looked at as punishing effects of use. However, if one expects to have these effects, but does not actually experience them, then they have avoided the aversive outcomes thought to be associated with alcohol use. This lack of punishment may then lead to further drinking within a drinking session resulting in hazardous levels of use and related problems.

In contrast, the theoretical underpinnings of the relation between discrepancies for HIGH+ effects and drinking and driving are less apparent. Morean et al. (2012) asserted that overestimating HIGH+ effects may be associated with less perceived impairment, which could lead to drinking and driving. Alternatively, this pattern of findings could be understood in light of Goal Setting and Expectancy Theories (Campbell, & Pritchard, 1976; Klein, 1991). These theories suggest that expectancies and attractiveness of expectancies lead to goal directed behavior and motivation to realize expectations. Thus, strong expectancies for HIGH+ effects may lead to more drinking, through the attractiveness of HIGH+ effects and the expectancy for these effects, even in the absence of the experience of these effects. In fact, the lack of actual HIGH+ effects may be experienced as a thwarting of goals, leading to a strengthening of goal-directed behavior (e.g., further consumption). This pattern of results is also consistent with the phenomenon of chasing in pathological gambling behavior. Research on gambling behavior asserts that individuals chase after effects and/or stimuli that are appetitive (Lesieur, 1979; Breen &

Zuckerman, 1999; Cronce & Corbin, 2010). When one loses money (i.e., their goal is thwarted), he/she is motivated to win the money back, thus chasing after this goal.

The results of Morean et al. (2015) provide support for the potential value of discrepancy research, and its implications for interventions. However, there are several limitations of this study that make it difficult to draw definitive conclusions. First, the findings are cross-sectional making it hard to establish temporal precedence. Second, no index of typical quantity of consumption was included as a dependent variable. Although binge drinking is a heavy drinking outcome, it may not mean as much in the context of the current measurement design. More specifically, the expectancy measure used in this study asked participants to imagine that they had 4-5 drinks, which is by definition a binge drinking episode. Intuitively, overestimating these effects relative to SR would lead to drinking above and beyond the binge threshold. Thus, it is important to look at typical quantity of consumption, which accordingly could be higher than the 4-5 drink quantity. Lastly, the use of discrepancy scores without expectancy and SR main effects ignores variations along the continuum of effects. For example, if someone has an expectancy value of 8 and an SR value of 5, he/she would have the same discrepancy as someone who has an expectancy value of 5 and an SR value of 2. Thus, these two people would be considered identical in models without main effects, though the discrepancy might be experienced quite differently for these two individuals. In light of studies linking expectancies to changes in drinking, this main effect is vital to fully comprehend and interpret discrepancy models.

Moreover, discrepancy models between expectancies and SR are important to both experimental and clinical research due to their vital clinical implications. Two salient interventions for heavy drinking and AUD are expectancy challenges and pharmacotherapy. More specifically, efficacious expectancy challenges target high arousal positive expectancies by showing participants that the effects attributed to alcohol are oftentimes expectancy-derived rather than a result of alcohol's pharmacological effects (Darkes & Goldman, 1993). Use of naltrexone, a medication that blunts the rewarding effects of alcohol, has also shown efficacy in reducing alcohol use and related problems (O'Malley et al., 2015). Better understanding the interactive effects of expectancies and SR may better inform researchers and clinicians when deciding between these interventions. For example, someone who has high expectancy for HIGH+ effects that are supported by elevated level of HIGH+ effects under alcohol may benefit more from naltrexone. In contrast, someone who has strong HIGH+ expectancies but has a relatively low level of HIGH+ SR under alcohol (i.e., a significant discrepancy) may benefit more from expectancy challenge. This treatment would help reduce unrealistic expectancies for reward under alcohol which should lead to consequent decreases in alcohol use.

Proposed Study and Hypotheses

The current study addresses important gaps in the literature by using innovative, matched measures of expectancies and SR (the AEAS and SEAS) to investigate the effects of expectancies, SR, and their interactions on typical drinking quantity one year later. Importantly, this is the first study to a) examine both main effects and interactions between expectancies and SR using matched measures that cover the full affective space of alcohol effects (i.e., High Arousal Positive (HIGH+), High Arousal Negative (HIGH-), Low Arousal Positive (LOW+), and Low Arousal Negative (LOW-), and b) prospectively test the effect of this interaction on later drinking behavior. This is a secondary analysis of data from a placebo-controlled alcohol challenge study with a longitudinal follow up.

Given the focus on interactions between expectancies and actual SR under alcohol, only data from participants who received alcohol were included in the present analyses. In line with the DM, we examined the effects of HIGH+ and HIGH- expectancies and SR on the ascending limb, and effects of LOW+ and LOW- expectancies and SR on the descending limb. Because the study also randomized participants to drink in one of four contexts, (group bar, group lab, solitary bar, solitary lab) we assessed the extent to which drinking context impacts ratings of SR and expectancies on later drinking outcomes by including both physical and social context as covariates in analytic models.

Based on prior research, it is hypothesized that expecting more HIGH- effects but subjectively receving few HIGH- effects will lead to future heavy drinking; we expect this pattern for HIGH+ effects as well. Although we hypothesize the same effect for both HIGH- and HIGH+ interactions, we expect different underlying dynamics. More specifically, in line with operant conditioning, we anticipate that those who expect negative stimulating effects but do not experience them will continue drinking because of the absence of these negative (punishing) effects. This specific hypothesis is also corroborated by Morean et al. (2015)'s cross-sectional results. We do not expect main effects of HIGH- expectancies or SR, as past research has found that HIGH- effects are more related to alcohol problems than drinking behavior (Morean et al., 2012; 2013; 2015).

Expecting but receiving little HIGH+ effects is hypothesized to lead to more drinking based on the pursuit of goal-directed behavior. We expect that participants will continue drinking in an effort to chase after appetitive effects (i.e., HIGH+). We also anticipate main effects of both HIGH+ expectancies and SR based on previous literature (Morean et al., 2012; 2013; 2015). Lastly, based on Morean et al. (2015), we anticipate that expecting but not receiving many LOW- effects will lead to less drinking. We also anticipate a main effect of LOW- SR. We do not anticipate significant prediction from the interaction or main effects of LOW+ SR or expectancies, given the lack of consistent alcohol effects on LOW+ SR in prior studies. We considered hypotheses of LOW+ effects exploratory due to conflicting theory and past research. In line with operant conditioning, one would expect the same findings for HIGH+ and LOW+ as both are positive. Previous research found that LOW+ effects were protective against alcohol problems only (Morean et al., 2015), and thus we considered the LOW+ quadrant exploratory. Due to past research support supporting our hypotheses for LOW- effects, this was not considered exploratory.

The current study will test the following hypotheses:

- A priori: Expecting but not receiving HIGH+ effects on the ascending limb will lead to increases in drinking over a one-year period. In this model, we also expect HIGH+ expectancy and SR main effects.
- A priori: Expecting but not receiving HIGH- effects on the ascending limb will lead to increased drinking over a one-year period.
- A priori: Expecting but not receiving LOW- effects on the descending limb will lead to decreased drinking over a one-year period. In this model, we also expect a LOW- SR main effect.
- Exploratory Test: An interaction between LOW+ expectancies and SR will not be related to changes in drinking over a one-year period.

CHAPTER 2

METHODS

Original Study

The proposed study used data from an ongoing study investigating how social and physical context influence individual ratings of subjective response. The study collected baseline data during an initial session. Participants then returned to the lab for an alcohol challenge. Participants completed two web-based follow-ups over a one-year period (6- and 12-month assessments).

Participants

Participants were recruited via flyers posted around the Arizona State University campus, the Tempe community, and through online listervs (e.g. Craigslist) and advertisements (e.g., Facebook). After an initial phone screen, 547 participants came into the lab for a baseline assessment, and 448 met eligibility for the alcohol challenge session. Participants were deemed eligible if they endorsed binge drinking (4+ drinks for women, 5+ for men) at least once in the past month. Exclusion criteria included past-month alcohol dependence, a past-month depressive or anxiety disorder, serious mental illness or medical conditions, use of psychotropic or pain medicine, negative reactions to alcohol, daily marijuana use, past treatment seeking for alcohol problems, and pregnancy/nursing. A total of 270 participants in the larger sample were in the alcohol condition. Due to the current study’s nature, participants in the placebo condition were excluded from analyses. Twelve of the participants in the alcohol condition reported a peak BAC under .06. These 12 cases were excluded from the analyses. Thus, 258 participants provided data for the present analyses. Participants were 21-25 years old, 42.6% female, and represented the general racial (66.1% Caucasian) and ethnic (26.1%

Hispanic/Latinx) composition of the community. For a full list of demographics see Table 1. A total of 232 (90%) participants reported data at either or both of the follow-ups. Participants who did not report follow-up drinking had significantly higher levels of HIGH+ SR ($t = -2.28$, $p < .03$).

Procedure

All procedures were approved by the Arizona State University Institutional Review Board for human subjects (Protocol #1210008481). Participants first completed a telephone or online screening asking basic questions about alcohol, drug use, and mental/physical health, and potential contraindications to alcohol consumption (e.g., negative reactions to alcohol). If deemed eligible, participants were scheduled to come into the lab for a baseline survey/interview session. During this session participants were administered the Alcohol Use Disorders and Associated Disabilities Interview Schedule-IV (AUDADIS-IV; Grant et al., 2003) and a battery of questionnaires, including the Timeline Follow-Back (TLFB; Sobell & Sobell, 1992) and self-reported alcohol expectancies. If participants did not meet criteria for a past-month alcohol use disorder, mood, or anxiety disorder, and did not report contraindications to alcohol consumption, they were scheduled to attend an alcohol challenge session on a weekday between 4-6 p.m. Participants were asked not to consume alcohol 24 hours prior to coming into the lab and not to consume any food or caffeine 4 hours before the session.

Before arriving at the alcohol challenge session, participants were randomly assigned to one of four conditions crossing physical (bar vs. lab) and social (solitary vs. group) contexts (group bar, group lab, solitary bar, and solitary lab). Participants who were assigned to the simulated bar setting (either alone or in a group) entered a custom-built bar and lounge area with bar stools, neon lights, upbeat music, and glassware/alcohol bottles on shelves for decoration. In contrast, the lab setting consisted of several computer screens, filing cabinets, and other office-related decorations. Participants in the solitary lab context were in small individual rooms to allow for simultaneous data collection with up to three participants. Participants in the group lab context were in a larger lab setting with four computer terminals. In both cases, the laboratory setting was devoid of alcohol-related cues. Within each of the drinking contexts, participants were randomized (either individually or by group) to an alcohol or placebo condition. To adequately power analyses examining relations between SR and later drinking outcomes, randomization to alcohol and placebo conditions was done at a 6 (alcohol) to 4 (placebo) ratio.

Of the 258 participants included in the current analysis, 26.4% were in the group bar (N=68), 24% in the group lab (N=62), 25.2% in the solitary bar (N=65), and 24.4% in the solitary lab (N=63). Upon arrival for the lab study, research assistants verified that participants were between the ages of 21-25 and reviewed the consent document completed at the first session with the participant. Baseline BAC was tested to ensure a .00 g% BAC, and female participants were administered a pregnancy test and asked to confirm negative (not pregnant) results. Research participants then used computer algorithms (Curtin & Fairchild, 2003) to prepare mixed drinks with fixed amounts of vodka, cranberry juice, lemon-lime soda, and lime juice to dose each participant to a BAC of .08 g%. Alcohol dose was individualized per participant gender and weight and then combined with a mixer at a 3 (mixer) to 1 (alcohol) ratio.

Participants were then served three drinks and told they had six minutes to consume each one, with a 1-minute break after each drink. After drink consumption, BAC readings were taken every 10 minutes until a .06 g% was reached, at which time ascending limb assessments of SR began. Descending SR measurements were given when descending limb BAC measurements matched the ascending limb BAC (i.e., if ascending measures were given at .064 g%, descending limb measures were given as close as possible to a .064 g% BAC). After completing all study assessments, participants were held in the lab until their BAC fell below a .03g%, at which time they were debriefed, paid, and provided transportation home. Participants were re-contacted 6 and 12 months later and asked to provide web-based assessments of drinking, adult role transitions, internalizing symptoms, and several other constructs via Qualtrics. They also completed an online Timeline Followback at each follow-up. After finishing each assessment, participants were thanked and compensated.

Measures

Measures were administered either at baseline (i.e., expectancies, alcohol use, demographics), during alcohol administration (i.e., SR), or at follow up (i.e., expectancies, alcohol use). A full list of descriptive statistics can be found in Table 2 and bivariate correlations among predictor variables and outcomes can be found in Table 3.

Demographics. Age and gender were assessed at baseline.

Alcohol Use. Baseline and follow-up alcohol use data was assessed via the Timeline Followback (TLFB; Sobell & Sobell, 1992). Participants reported on the frequency, quantity, and amount of time spent drinking for each of the past 30 days. The baseline TLFB was administered in person by a research assistant, and the follow-up TLFBs were completed via a web-based calendar. In both cases, standard drink charts were provided to ensure participants had the same definition of a standard drink. The TLFB shows strong validity across younger adult (r =.86-.97) and alcohol-dependent populations (r = .73-1.0) and is positively correlated with other measures of heavy drinking (Sobell &

Sobell, 1992; Carey, Carey, Maisto, & Henson, 2004). Drinking quantity (i.e., drinks per drinking day) was used as a baseline covariate but also as the criterion at follow up. TLFB scores were measured at both 6- and 12-month follow ups and were averaged across the two to obtain a more reliable measure of alcohol use across the 12-month period. If a participant reported at only one time point, then that drinking quantity was used rather than estimating 12 month drinking and averaging to cut back on estimation of missing data. There was significant stability in drinking over time, although there was also substantial change between baseline and mean 6-month/12-month drinking quantity (r = .54, p < .001).

Alcohol Expectancies. The Anticipated Effects of Alcohol Scale (AEAS; Morean et al., 2012) was used to measure expectancies. The AEAS includes 22-items that assess expectancies across four quadrants of affective space (HIGH+, HIGH-, LOW+, LOW-). The AEAS asks each participant to rate the extent to which he/she believes he/she will feel specific effects immediately after and 90 minutes after drinking 4/5 drinks (depending on gender, respectively) in a 2-hour period. Alcohol administration pradigms have shown that, when dosed to a .08%g BAC, BAC measurements will typically reach a BAC of .06%g 'Immediately after' or shortly after consumption, and will descend back to .06%g about '90 minutes later'. As such, we used each conceptualization respectively to correspond to ascending and descending limb measurements. This imagined BAC relates to approximately a .08%g BAC. Scores are calculated as the mean across subscale items at each time-point. All four subscales of the AEAS had adequate internal consistency (a = .73-.95) across both limbs. Only items that were also on the parallel subjective response scale (see description of the SEAS below) were included to allow for direct comparison between expectancies and SR. Table 4 shows all of the initial AEAS items and the ones removed to create identical measures of expectancies and SR.

Subjective Response. The Subjective Effects of Alcohol Scale (SEAS; Morean et al., 2013) was used to assess SR. The SEAS matches the format of the AEAS, breaking SR into four affective quadrants. The SEAS asks participants to rate the extent to which they feel effects "right now," and participants completed these items at matched BACs on the ascending and descending limbs of the blood alcohol curve. This allowed us to match SR to the ascending and descending limbs measures of the AEAS. Each of the items on the SEAS matches items on the AEAS, allowing for direct comparisons between the two. The SEAS had good internal consistency (*a* = .79-94) across both limbs of the BAC curve. SEAS scores were calculated by averaging item scores within each subscale at each time-point.

Power Analysis. Power Analysis was conducted using G*Power 3 (Faul, Erdfelder, Lang & Buchner, 2007). For the test of a two-way interaction between expectancies and SR including all covariates, the sample size is adequately powered (> .80) to detect a small to medium effect size (f^2= .038).

Data Analytic Plan

Preliminary Analyses. Before conducting primary analyses, all variable distributions were examined for outliers and were transformed as necessary to meet assumptions of normality. Outliers were winsorized by replacing any value more than 3 SD away from mean with a value of one higher than the highest value within the distribution (Tabachnick & Fidell, 2007).

Multicollinearity. All continuous variables were mean-centered in analyses to reduce nonessential multicollinearity (Cohen, Cohen, West, & Aiken, 2003). Zero-order correlations, Variance Inflation Factors (VIF), and Tolerance were examined for all variables to investigate potential problems with multicollinearity.

Primary Analyses. The primary analyses used Path Analysis via MPlus (Muthen & Muthen, 2017) to run a series of regression models. Determination of adequate model fit was based on guidelines set forth by Hu & Bentler (1999), who suggested Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values close to .95, Root Mean Square Error of Approximation (RMSEA) values close to .06, and Standardized Root Mean Square Residual (SRMR) values close to .08. However, we did not use firm cutoffs for model fit, as research calls into the question the broad generalization of Hu & Bentler (1999)'s cut offs beyond their specific study design (e.g., McNeish, An, & Hancock, 2018). Given the number of predictor variables, allowing all predictors to covary resulted in oversaturated models that did not allow examination of model fit. Thus, an initial model allowing all predictors to covary was tested, and non-significant interactions were set to zero to allow for examination of model fit. Full Information Maximum Likelihood (FIML) was used to handle missing data from participants who reported partial or no data on variables at baseline or follow ups.

In each model, drinks per drinking day (a mean score of the 6- and 12-month follow up drinking) was regressed on the interaction and main effects of expectancies and SR within each quadrant of affective space (analyzed separately). All analyses included baseline scores on the outcome (i.e., drinking quantity), age, sex, physical context, and social context as covariates. Research has indicated that both physical and social context can affect SR in a variety of ways (Corbin et al., 2012; Sayette et al., 2012), and thus each was included to account for these effects. Each context variable was dummy coded. Sex was also dummy coded, and age was entered as a continuous variable. An abundance of research shows that age and gender relate to alcohol use (Mooney et al., 1987; Wilsnack et al., 2009), justifying their inclusion as covariates.

In line with the DM, we tested effects of HIGH+ and HIGH- expectancies and SR on the ascending limb, and effects of LOW+ and LOW- expectancies and SR on the descending limb. Significant interactions were probed by estimating simple regression equations at 1 SD above the mean, at the mean, and 1 SD below the mean of the moderator (Aiken & West, 1991). For models where 1 SD below the mean fell outside of the actual distribution of scores (i.e., HIGH- and LOW-), we examined appropriate data points in each variable to estimate similar distances above and below the mean. Separate models were run without the interaction term to report on unobscured main effects of SR and expectancies.

CHAPTER 3

RESULTS

Descriptive Statistics and Multicollinearity: Alcohol use at baseline and follow-up both had outliers (i.e., values more than 3 standard deviations from the mean) and each were given a score of one higher than the highest score than the rest of the distribution (Tabachnick & Fidell, 2007). With the censoring of these outliers, distributions were generally within reasonable limits of normality (skewness of roughly 1.5 or less and kurtosis of roughly 2.0 or less). Although each matched domain of expectancies and SR were significantly correlated, they were moderate in magnitude. No correlation was greater than r = .41, and no variable had a VIF greater than 2 or a tolerance less than 0.5. Bivariate correlations are presented in Table 3. Both Follow-Up and Baseline drinking were correlated with male gender and with weaker LOW- expectancies. Follow-Up drinking was correlated with stronger LOW+ expectancies and baseline drinking was correlated with lower LOW- SR on the descending limb.

High Arousal Positive Effects. Analysis of the fully saturated model suggested allowing freely varying correlations between HIGH+ SR and expectancies, HIGH+ SR and social context, HIGH+ SR and baseline drinking, HIGH+ SR and sex, and sex and baseline drinking. After dropping the non-significant correlations among predictors, the model provided excellent fit to the data (X^2= 17.82, p = .88, RMSEA= .00 (.00, .02), CFI=1.0, TLI=1.03, SRMR=.04).

Follow-up drinking was predicted by age, sex, and baseline drinking, such that younger participants (*b* = -.15, *p* < .049) men (*b*= -.49, *p* = .041), and heavier drinkers at baseline (*b* = .47, *p* < .001) drank more at follow-up. Follow-up drinking was marginally predicted by both HIGH+ SR and expectancies, although in different directions. HIGH+

expectancies marginally predicted more follow-up drinking (*b* = .12, *p* = .068) whereas HIGH+ SR marginally predicted less follow-up drinking (*b* = -.08, *p* = .094). The interaction between HIGH+ expectancies and SR was also significant (*b* = -.05, *p* = .01). Post-hoc probing of this interaction found significant simple slopes for HIGH+ expectancies at both the mean (*b* = .12, *p* = .041) and 1 SD below the mean (*b* = .22, *p* = .001) for HIGH+ SR (Figure 1). Regions of significance testing suggested that the slope for HIGH+ SR became significant at the .05 alpha level under a value of .12 (Regions of Significance = [.12, .8.73]) (Figure 2). Thus, for individuals at mean and low levels of HIGH+ SR, as expectancies increased, follow-up drinking levels increased, as hypothesized (See Figures 1 and 2). For a full list of parameter estimates see Table 5.

High Arousal Negative Effects. Analysis of the fully saturated model suggested allowing freely varying correlations between HIGH- SR and expectancies, HIGH- SR and the interaction term, HIGH- SR and age, HIGH- SR and sex, HIGH- expectancies and the interaction term, the interaction term and physical context, and sex and baseline drinking. After dropping the non-significant correlations among predictors, the model provided excellent fit to the data (X^2= 21.426, p = .61, RMSEA= .00 (.00, .04), CFI=1.0, TLI=1.01, SRMR=.04).

Follow-up drinking was marginally predicted by sex, such that men drank more (*b*=-.45, *p*= .068), and by baseline drinking (*b*=.47, *p* < .001), such that heavier drinkers drank more at follow-up. Follow-up drinking was not significantly predicted by either HIGH- SR or expectancies. However, the interaction between the two predicted follow-up drinking (*b*= -.12, *p*= .041). To probe this interaction, we estimated marginal means for 1 SD above the mean, at the mean, and at zero. Due to the low number of individuals who endorsed HIGH- effects, 1 SD below the mean would be outside the range of the data. However, the log-transformed value for zero (-.86) is roughly .84 SD below the mean, representing a close comparison to 1 SD above the mean. Post-hoc probing found a marginally significant simple slope for HIGH- expectancies at high levels of SR (b= -.12, p=.07) but not for mean levels (b= .01, p= .94) or low levels (b=.11, p= .30) of SR (Figure 2). Regions of significance testing suggested that the slope for HIGH- SR became significant at a .05 alpha level at a value of 2.26 (Regions of Significance = (-9.18, 2.26) (Figure 4), further indicating the marginal significance of the simple slope for high levels of HIGH- SR.

Low Arousal Positive Effects. Analysis of the fully saturated model suggested allowing freely varying correlations between LOW+ SR and expectancies, LOW+ expectancies and sex, the interaction term and sex, and baseline drinking and sex. After dropping the non-significant correlations among predictors, the model provided excellent fit to the data (X^2= 27.11, p = .35, RMSEA= .02 (.00, .05), CFI=.98, TLI=.99, SRMR=.04).

Follow-up drinking was marginally predicted by age (b= -.16, p= .06), such that younger participants reported more drinking at follow-up, and by baseline drinking (b= .47, $p < .001$), such that heavier drinkers at baseline drank more at follow-up. There was also a main effect of LOW+ expectancies, with stronger LOW+ expectancies predicting more drinking (b= .12, p = .04). Drinking was not predicted by LOW+ SR, although the effect was in the opposite direction (b= -.08, p = .12). No significant interaction emerged between LOW+ expectancies and SR ($b < .001$, p = .99). For a full list of parameter estimates see Table 7.

Low Arousal Negative Effects. Analysis of the fully saturated model suggested allowing freely varying correlations between LOW- SR and expectancies, LOW- SR and the interaction term, LOW- SR and sex, LOW- SR and baseline drinking, LOW-expectancies and social context, LOW- expectancies and baseline drinking, the interaction term and sex, the interaction term and physical context, and sex and baseline drinking. After dropping the non-significant correlations among predictors, the model provided excellent fit to the data (X^2= 27.95, p = .18, RMSEA= .03 (.00, .06), CFI=.93, TLI=.97, SRMR=.05).

Follow up drinking was marginally predicted by sex (*b*= -.44, *p* = .058) such that men drank more at follow-up than women, and by baseline drinking (*b*= .45, *p* < .001), such that heavier drinkers at baseline drank more at follow-up. There was a marginally significant effect of LOW- expectancies but not LOW- SR. Having stronger expectancies for LOW- effects marginally predicted less follow-up drinking (*b*= -.09, *p* = .10). No significant interaction emerged between LOW- expectancies and SR (*b*= - .01, *p* = .85). For a full list of parameter estimates see Table 8.

CHAPTER 4

DISCUSSION

The present study tested interactions between Alcohol Outcome Expectancies (AOEs) and Subjective Response (SR) to alcohol in predicting follow-up drinking. This study is one of the few that has tested relations between AOEs and SR, and it is the first to test their interaction in the longitudinal prediction of drinking. While other studies have tested discrepancies (i.e., difference scores) between AOEs and SR (Morean et al., 2015), this is the first study to include main effects of AOEs and SR when considering their interactive effects on drinking. This study is also one of the few to test expectancies and SR within the same model, isolating the unique effects of each and parsing out their shared variance within an additive risk framework. Study hypotheses, results, and future directions are discussed below.

The first aim of the study was to examine the interaction between HIGH+ AOEs and SR as a prospective predictor of drinking quantity across two equally spaced assessments over a 12-month period. We hypothesized an interaction between the two, such that stronger HIGH+ AOEs would be associated with greater drinking among those with lower, but not higher, levels of HIGH+ SR. A significant interaction was identified for HIGH+ effects, suggesting that, for those at low and average levels of HIGH+ SR, stronger HIGH+ AOEs were associated with heavier drinking. This finding matches our hypothesis, and fits within the theory of goal-directed behavior and the phenomenon of chasing. Individuals who expect but do not acutely experience HIGH+ effects may be more motivated to achieve such effects, as an individual's expectations likely guide him/her to anticipate that drinking will cause such effects. In other words, an individual with unmet expectancies may attempt to chase appetitive HIGH+ effects by continuing to drink, whereas an individual whose expectancies are met by their SR may be satisfied and not feel the need to continue drinking.

This finding has direct treatment implications. As stated earlier, two potential prevention efforts to lower heavy drinking are Naltrexone and Expectancy Challenge interventions. Since those who expected but did not acutely experience HIGH+ effects drank more heavily (than those with weaker expectancies), an expectancy challenge may be the most effective intervention for these individuals. Presumably, if expectancies were reduced, drinking would also decrease, as has been shown in expectancy challenge efficacy studies (e.g., Scott-Sheldon et al., 2012). In contrast, individuals who experience elevated levels of HIGH+ SR, regardless of their expectancy levels, may not be optimal candidates for an expectancy challenge. Since expectancy challenges seek to reveal unrealistic positive expectancies, one who has elevated levels of HIGH+ SR would presumably not benefit from an expectancy challenge. Instead, these individuals may benefit most from naltrexone or other pharmacotherapies, which seek to blunt the positive, reinforcing effects of alcohol. Because expectancies are partially formed and adjusted from direct experiences with alcohol (e.g., Smith et al., 1995; Sher et al., 1996), reductions in HIGH+ SR could provide a dual effect on both expectancies and drinking. Future research should investigate how baseline expectancies and SR predict outcomes in studies that examine naltrexone as an approach to reduce drinking. Although extant research suggests that naltrexone is effective in reducing alcohol use (e.g., King et al., 2011; 2016; Morean et al., 2013) it is important to note that, in the present study, HIGH+ SR was not a significant predictor of drinking. Thus, the current study did not support HIGH+ SR as a risk factor in need of intervention (i.e., naltrexone), a topic that will be considered further below.

The second aim of the study was to examine the interaction between HIGH- AOEs and SR as a prospective predictor of drinking quantity. Similar to HIGH+ effects, we hypothesized an interaction, such that stronger HIGH- AOEs would be associated with heavier drinking at follow-up among those with weaker but not stronger HIGH- SR. Although the same pattern was predicted, the underlying theory for this hypothesis was different. We hypothesized this effect based on the idea that low HIGH- SR would reflect a lack of punishment, particularly in the presence of strong expectations for these effects, thereby promoting further consumption. The results partially supported this hypothesis.

There was a significant interaction for HIGH- effects, but the nature of the interaction was not as predicted. The simple slope for HIGH- AOEs was negative and marginally significant at high levels of HIGH- SR and was not significant at moderate or low levers of HIGH- SR. Figure 2 suggests that, for individuals who experienced strong HIGH- SR, weaker expectancies were associated with heavier drinking. One potential explanation for such findings is s failure to learn from past experience. If someone does not expect to feel HIGH- effects, pre-existing expectancies may overpower and block new learning experiences (i.e., recognition of acute negative effects), leading to a continued lack of HIGH- expectancies and consequent heavy drinking. Although many studies suggest that drinking experience is a proximal predictor of subsequent alcohol expectancies (e.g., Smith et al., 1995; Sher et al., 1996), these studies have predominately focused on positive rather than negative expectancies. Thus, it is possible that negative effects of alcohol do not lead to learned associations in the same way as positive effects. Alternatively, the findings might be explained through a similar chasing phenomenon as HIGH+ effects. If someone feels negative effects from alcohol but does not expect to feel these effects (i.e., he/she likely expected to feel positive effects), he/she may be motivated to continue drinking to move past these negative effects.

Yet another possible explanation is that strong HIGH- effects are associated with drinking to cope with negative affect. The drinking motives literature suggests that those who drink to cope have considerably more problems related to drinking compared to other drinkers (e.g., Merrill et al., 2014). As such, unexpected HIGH- effects could induce a state of negative affect, which could motivate continued drinking in an effort to cope with these negative affective states. Motivational theories suggest that coping drinkers expect that drinking will compensate for acute negative affect, and the present results are at least consistent with this notion. Since these individuals did not expect to feel HIGH- effects, the acute experience of feeling these effects may induce a momentary state of negative affect, activating coping motivation and negative reinforcement drinking (e.g., Corbin et al. 2020). Although this is a plausible explanation, it is important to note that the measure of HIGH- effects used in the current study assesses subjective effects such as aggressive, demanding, and rude, rather than typical negative affective states (e.g., depression, anxiety) that are known determinants of drinking. Therefore, to fully assess this assertion, one would need to include drinking motivation within these models. As such, future research should look at the interplay between motives, expectancies, and SR in predicting drinking and related problems.

Additionally, although the simple slope for HIGH- AOEs at low levels of HIGH- SR was not statistically significant, the graphic depiction in Figure 2 is consistent with the hypothesized interaction. Although not statistically significant, the figure shows that stronger HIGH- AOEs were positively related to alcohol consumption at low levels of HIGH- SR. Thus, there was some indication for the hypothesized interaction, despite the lack of statistical significance. Future research should replicate these findings and look at other factors that may affect this interaction.

The last aims were to test the same interaction framework for LOW+ and LOW- effects. We hypothesized an interaction where those who expected but did not acutely experience LOW- effects would drink less. Although conceptually one might predict the same pattern of findings as for HIGH- effects, prior research suggests that greater discrepancies for LOW- may predict less rather than more drinking (Morean et al., 2015). In the current study, the interaction between LOW- SR and LOW- AOES did not significantly predict later drinking behavior.

No specific hypotheses were articulated for LOW+ effects given the lack of overall alcohol effects on LOW+ response in prior studies (Morean et al., 2015), but the interaction was tested to be thorough in evaluating all aspects of AOEs/SR. Neither the main effect of LOW+ SR, or the interaction between LOW+ AOEs and SR predicted later drinking behavior. While inconsistent with the theoretical model that unmet positive expectancies will lead to goal directed behavior and unmet negative expectancies will be experienced a lack of punishment, high arousal effects may be more vivid, and provide a larger difference from baseline subjective experiences than low arousal effects. Thus, it is possible that individuals feel lower arousal effects such as "relaxed" before initiating drinking, reducing the experience of alcohol-induced LOW+ effects following alcohol consumption.

In addition to examining interactions between AOEs and SR, the current study was one of the few to simultaneously examine main effects of both AOEs and SR on drinking behavior. This approach allowed us to test how each confers risk for drinking above and beyond the other. Most studies conceptualize SR as a combination of both expected and pharmacological alcohol effects, so controlling for the effects of AOEs provides a better estimate of the unique impact of SR. In all models, expectancies tended to be the stronger prospective predictor of drinking, particularly for HIGH+ and LOW+ effects. This suggests that expected positive effects are associated with drinking even when controlling for SR, whereas SR is less consistently linked with later drinking when accounting for effects of AOEs. This suggests that expectancy challenges may be a more beneficial and efficient way to reduce drinking than pharmacotherapy, at least for moderate to heavy drinking young adults.

The lack of unique effects of SR when controlling for AOEs was perhaps most surprising for HIGH+ effects, given consistent support for relations between HIGH+ SR and later drinking outcomes in prior research (e.g., King et al., 2011). HIGH+ AOEs were marginally related to more drinking, and HIGH+ SR was marginally related to less drinking, when they were included as simultaneous predictors. Bivariate correlations were in the expected direction although nonsignificant for HIGH+ expectancies, whereas HIGH+ SR was almost entirely uncorrelated with drinking. This suggests that the pattern of findings for HIGH+ SR was not solely a function of the additional predictor variables in the models.

It is important to note that the analyses in the current study did not employ placebo controls, and thus answer a different question than many past studies of relations between SR and drinking outcomes (King et al., 2011; Quinn and Fromme, 2016). Due to the study question at hand, we excluded placebo participants, who are needed to make firm assertions about alcohol-induced HIGH+ SR. Including placebo participants provides control for environmental, and social factors that may affect SR, whereas expectancies control for within-person anticipated effects. Thus, the two constructs answer different fundamental questions and could lead to different results. Therefore, the present study cannot necessarily differentiate between alcohol-induced versus situational/placebo HIGH+ SR, potentially explaining the lack of a HIGH+ SR main effect. Future research is needed to replicate and fully understand relations between expectancies, SR, and drinking.

Another interesting finding with respect to AOE main effects is that controlling for LOW+ SR strengthened the effect of LOW+ AOEs on drinking behavior. LOW+ AOEs were positively but not significantly correlated with later drinking behavior in the bivariate correlations, but were a significant predict of later drinking in the multivariate regression model. This suggests that alcohol effects may actually serve to suppress the link between LOW+ AOEs and drinking behavior. Past studies have not found alcohol (compared to placebo) effects on LOW+ SR (e.g., Corbin et al., 2015), so the relative lack of LOW+ SR effects under alcohol may serve to reduce the impact of strong expectancies for LOW+ effects. These findings suggest that challenging inaccurate HIGH+ expectancies, while also bringing awareness to social and contextual factors that may lead to LOW+ effects, rather than alcohol itself, may be efficacious ways to reduce drinking.

Overall, the present findings provide a novel contribution to the literature. As stated above, interactions between AOEs and SR have direct implications for determining which drinking interventions are likely to be most effective for which individuals. The findings suggest that those with unrealistic AOEs for HIGH+ effects may benefit most from an expectancy challenge. Additionally, our findings indicate that increasing awareness of acute negative alcohol effects, particularly for those who acutely experience HIGH- effects, could result in less drinking. As such, the present study suggests that intervention efforts that target negative expectancies (trying to increase rather than decrease them) could also be helpful in preventing heavy alcohol use. Lastly, the present study is one of the few studies to account for both dose-dependent expectancies and SR within the same model, parsing apart the shared variance between the two when predicting drinking.

While the present study provides several important findings and has numerous strengths, it must be interpreted in light of limitations. First, the current study included social drinkers between the ages of 21-25, and excluded participants who either did not endorse at least occasional binge drinking or had a diagnosable AUD. As such, the sample was very homogeneous with respect to typical drinking patterns, which could limit variability in drinking and generalizability beyond the current sample. Heavier drinkers might be expected to have more positive expectancies and SR when binge drinking, reinforcing drinking as a means to enhance and/or cope with negative affect. Therefore, these findings may not extend to those who binge drink very rarely/not at all. Future studies should replicate these findings in heavier and lighter drinking samples though it is unethical to give an intoxicating dose of alcohol to participants who are relatively alcohol naive.

Second, the present study relied on self-report drinking, expectancies, and SR rather than objective measurements. However, previous research has suggested that self-report alcohol use does not differ from collateral reports (Babor et al., 2000; LaForge et al., 2005). Nonetheless, future research could use Ecological Momentary Assessment coupled with biosensor data to a) obtain more ecologically valid data and b) compare subjective to objective alcohol response measurements (e.g., physiological arousal) to ensure accuracy.

Third, the present analyses came from a larger study focused on contextual influences on SR. As such, participants were randomly assigned to four contexts (solitary lab, solitary bar, group lab, group bar), which could have impacted the pattern of results. While the analyses controlled for effects of context, there is reason to believe that contextual effects could affect a variety of SR patterns (Corbin et al., 2012) in ways that may not be adequately addressed by covarying context main effects. For example, there is reason to believe that the interaction between AOEs and SR could depend on social or physical context, given prior research suggesting that SR is sensitive to both physical and social contexts (Corbin et al., 2015; Corbin et al., under review). Although outside the scope of the present study, future research should replicate the present findings within a single context and/or investigate the moderating role of contextual/environmental factors.

Despite the aforementioned limitations, this is the first study to our knowledge that has used an interaction framework to investigate the combined effects of expectancies and SR in predicting later drinking behavior. In addition, we are aware of only one other study (Morean et al., 2015) that has examined AOE/SR discrepancies for the full range of alcohol effects. Our analyses suggest that those who expected to but did not experience strong HIGH+ effects drank more than those with weaker HIGH+ expectancies, and those who did not expect but felt HIGH- effects drank more than those with strong HIGH- expectancies. Future research and replication is needed to confirm this pattern of findings, and fully understand underlying mechanisms and treatment implications. We hope the current study will generate interest in pursuing these additional research questions.

Table 1: Demographics

Variable	N	Mean (SD)
Age	**258**	22.25 (1.23)
Sex	**258**	
Male	148 (57.4%)	
Female	110 (42.6%)	
Race	**258**	
White/Caucasian	170 (65.9%)	
Black/African-American	20 (7.8%)	
Asian	28 (10.9%)	
American Indian/Native	4 (1.6%)	
Other	35 (13.6%)	
Missing	1 (.4%)	
Ethnicity	**258**	
Hispanic/Latinx	65 (25.2%)	
Non-Hispanic/Latinx	184 (71.3%)	
Missing	9 (3.0%)	

Table 2: Means, Standard Deviations, Skewness, and Kurtosis among study variables

	N	Mean	SD	Skewness	Kurtosis
BASELINE					
Drinking Quantity	255	4.62	2.74	4.23	34.06
Ascending Expectancies					
AEAS HAP	258	7.56	1.59	-.93	2.22
AEAS HAN	258	1.70	1.72	1.13	.70
Descending Expectancies					
AEAS LAP	256	5.83	2.02	-.11	-.50
AEAS LAN	256	2.6	2.22	.64	-.41
Ascending SR					
SEAS HAP	257	6.27	2.19	-.43	-.02
SEAS HAN	257	.64	1.20	2.86	9.34
Descending SR					
SEAS LAP	258	6.31	2.11	-.16	-.43
SEAS LAN	258	.95	1.47	2.12	4.81
FOLLOW UP					
Drinking Quantity	232	4.52	2.68	2.03	6.41
WINDZORIZED					
Baseline Drinking	255	4.62	2.24	1.20	1.79
Follow-Up Drinking	232	4.30	2.01	.98	1.10

Table 3: Bivariate Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.Baseline Drinking	--	.54**	-.28**	-.04	.06	-.06	.02	.04	-.01	-.16**	.12	.09	.08	-.12*
2. Follow-Up Drinking		--	-.23**	-.09	.02	-.11	.08	-.02	.11T	-.21**	.01	-.02	<.001	-.11
3. Sex			--	-.08	.04	-.02	.03	-.09	-.16*	.10	.20**	.17**	-.07	-.12
4. Age				--	-.06	.01	.03	.11†	.12†	.09	-.03	.16*	-.04	-.09
5. Phys Context					--	.02	-.11	.02	-.13*	-.07	-.06	-.07	-.13	-.05
6. Social Context						--	-.01	.10	-.04	.15*	.21**	.09	.08	.08
7. AEAS HAP(Asc)							--	-.01	.28**	.10	.26**	.10	.28**	.01
8. AEAS HAN(Asc)								--	-.13*	.30**	.12	.39**	-.06	.11†
9. AEAS LAP(Desc)									--	.04	.13*	.04	.36**	.02
10. AEAS LAN(Desc)										--	< .01	.12†	-.05	.21**
11. SEAS HAP(Asc)											--	.16*	.31**	.22**
12. SEAS HAN(Asc)												--	.04	.25**
13. SEAS LAP(Desc)													--	.10
14. SEAS LAN(Desc)														--

Note: ** P < .01, * P < .05, † P < .10

Table 4: AEAS, SEAS, and Matched Items

	AEAS Initial Items	SEAS Initial Items	Matched Items
High Arousal Positive (HIGH+)	Lively Talkative Funny Fun Happy Sociable Carefree Attractive Confident	Lively Talkative Funny Fun	Lively Talkative Funny Fun
High Arousal Negative (HIGH-)	Aggressive Demanding Rude Anxious Moody	Aggressive Demanding Rude	Aggressive Demanding Rude
Low Arousal Positive (LOW+)	Mellow Calm Relaxed	Mellow Calm Relaxed Secure	Mellow Calm Relaxed
Low Arousal Negative (LOW-)	Dizzy Wobbly Woozy Drunk Ill	Dizzy Wobbly Woozy	Dizzy Wobbly Woozy

Table 5: High Arousal Positive Model Analyses

	Main Effects Model				Interaction Model			
	Beta	SE	95% CI	Sig.	Beta	SE	95% CI	Sig.
Age	-.15	.08	(-.30, -.01)	< .05	-.13	.08	(-.28, .02)	< .09
Sex	-.50	.24	(-.97, -.02)	.04	-.54	.24	(-.94, -.07)	< .03
Social Context	-.22	.23	(-.67, .22)	.32	-.25	.22	(-.68, .19)	.27
Physical Context	.12	.22	(-.30, .55)	.57	.10	.22	(-.33, .52)	.66
Drinking Baseline	.47	.06	(.35, .58)	< .001	.47	.06	(.36, .58)	< .001
AEAS HAP	.12	.07	(-.01 .25)	< .07	.12	.06	(.01, .23)	.04
SEAS HAP	-.08	.05	(-.18, .01)	< .10	-.10	.05	(-.19, .01)	< .06
Interaction	--	--	--	--	-.05	.02	(-.09, -.01)	.01

Table 6: High Arousal Negative Model Analyses

	Main Effects Model				Interaction Model			
	Beta	SE	95% CI	Sig.	Beta	SE	95% CI	Sig.
Age	-.12	.08	(-.28, .03)	.12	-.13	.08	(-.29, .02)	.10
Sex	-.47	.25	(-.95, .02)	< .06	-.45	.25	(-.94, .02)	.07
Social Context	-.28	.22	(-.71, .16)	.22	-.32	.22	(-.74, .13)	.16
Physical Context	.09	.22	(-.33, .51)	.68	.06	.21	(-.40, .45)	.78
Drinking Baseline	.47	.06	(.36, .58)	< .001	.47	.06	(.36, .59)	< .001
AEAS HAN	-.03	.06	(-.14, .09)	.64	< .01	.07	(-.11, .12)	.94
SEAS HAN	-.09	.08	(-.25, .07)	.26	-.03	.11	(-.14, .14)	.82
Interaction	--	--	--	--	-.12	.08	(-.15, -.03)	.04

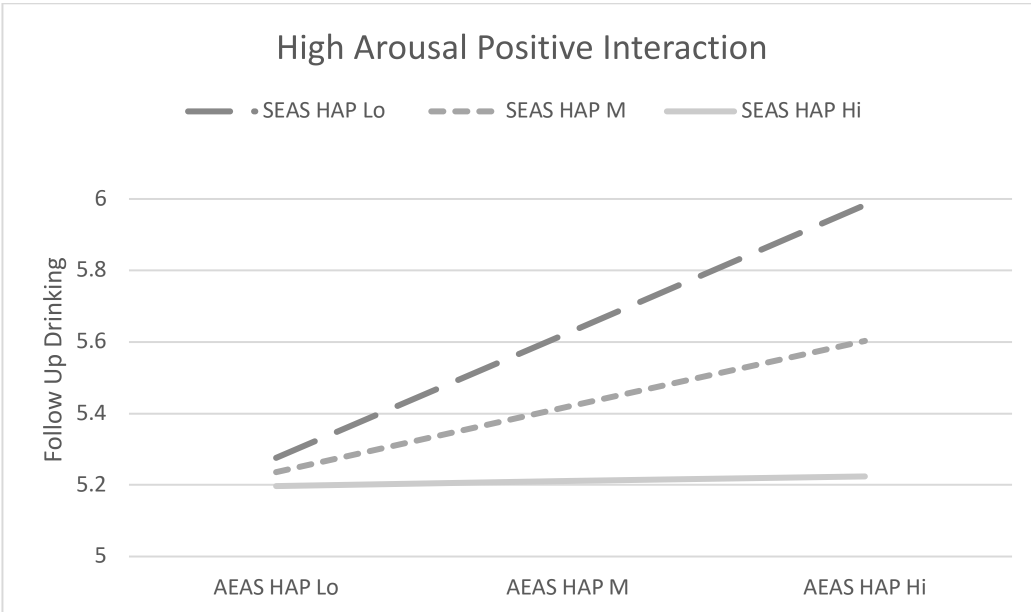
Table 7: Low Arousal Positive Model Analyses

	Main Effects Model				Interaction Model			
	Beta	SE	95% CI	Sig.	Beta	SE	95% CI	Sig.
Age	-.16	.09	(-.34, .01)	.06	-.16	.09	(-.34, .01)	.06
Sex	-.36	.23	(-.81, .09)	.12	-.36	.23	(-.81, .10)	.12
Social Context	-.25	.22	(-.68, .18)	.25	-.25	.22	(-.68, .18)	.26
Physical Context	.11	.22	(-.32, .54)	.61	.11	.22	(-.32, .54)	.62
Drinking Baseline	.47	.05	(.37, .57)	< .001	.47	.05	(.37, .58)	< .001
AEAS LAP	.12	.06	(.01, .24)	.04	.12	.06	(.01, .24)	.04
SEAS LAP	-.08	.06	(-.19, .02)	.12	-.08	.06	(-.19, .02)	.13
Interaction	--	--	--	--	< .01	.02	(-.05, .05)	.98

Table 8: Low Arousal Negative Model Analyses

	Main Effects Model				Interaction Model			
	Beta	SE	95% CI	Sig.	Beta	SE	95% CI	Sig.
Age	-.13	.09	(-.18, .03)	.15	-.13	.09	(-.30, .04)	.14
Sex	-.44	.23	(-.22, .01)	< .06	-.45	.23	(-.90, .01)	< .06
Social Context	-.24	.22	(-.17, .05)	.28	-.24	.22	(-.67, .19)	.28
Physical Context	.08	.22	(-.09, .13)	.72	.07	.22	(-.37, .50)	.76
Drinking Baseline	.45	.05	(.40, .60)	< .001	.45	.05	(.35, .55)	< .001
AEAS LAN	-.09	.05	(-.21, .02)	< .10	-.09	.05	(-.18, .02)	.10
SEAS LAN	-.06	.08	(-.15, .07)	.44	-.06	.08	(-.21, .10)	.47
Interaction	--	--	--	--	< -.01	.04	(-.08, .06)	.85

Figure 1: High Arousal Positive Interaction



49

Figure 2: High Arousal Positive Regions of Significance Test

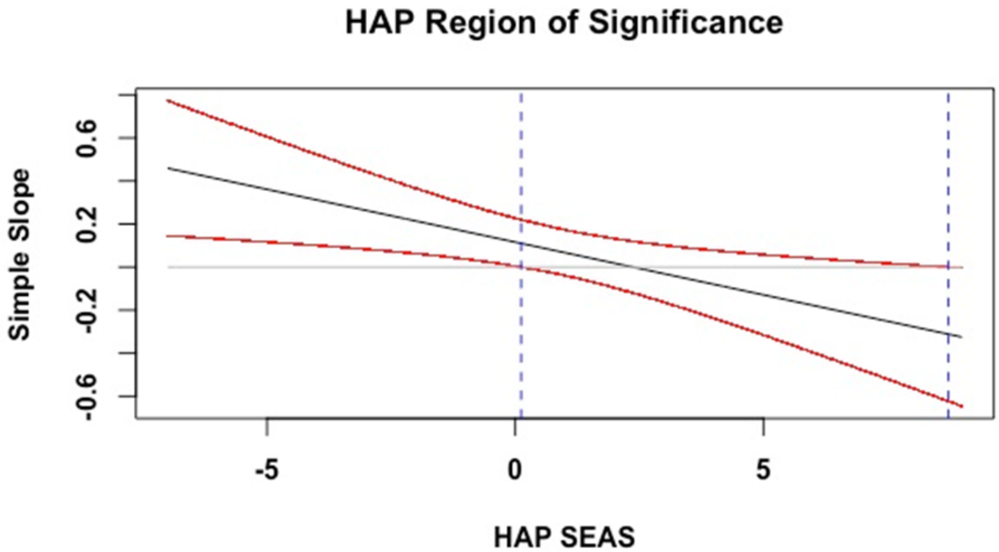


Figure 3: High Arousal Negative Interaction

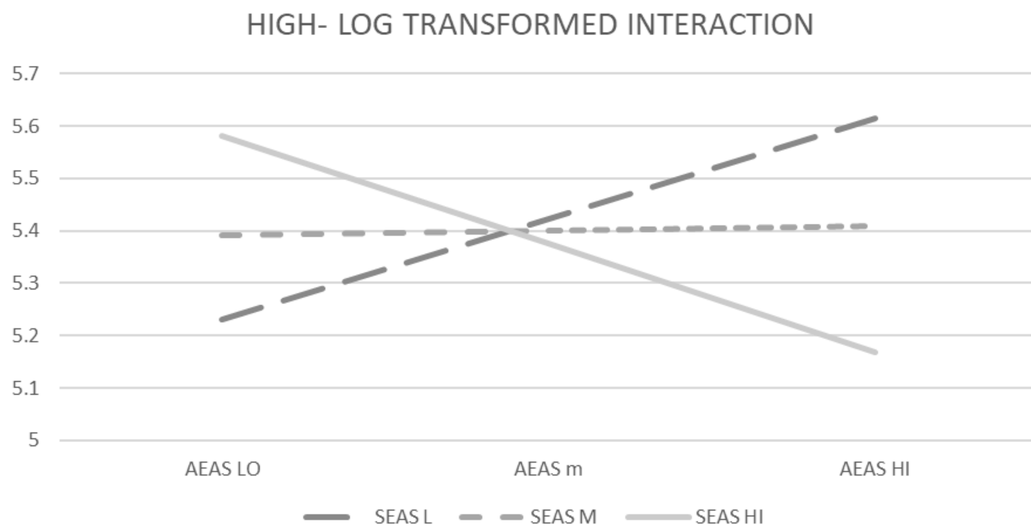
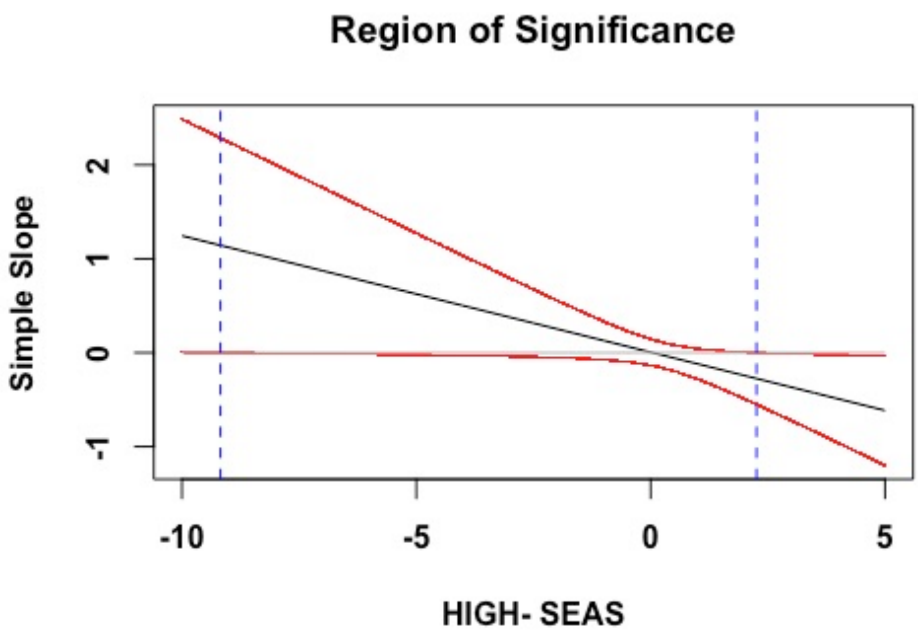


Figure 4: High Arousal Negative Regions of Significance Test



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