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Alcohol Use in College Students as a Function of Reinforcement Sensitivity, Life Events, and Affect

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ALCOHOL USE IN COLLEGE STUDENTS AS A FUNCTION OF
REINFORCEMENT SENSITIVITY, LIFE EVENTS, AND AFFECT

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ALCOHOL USE IN COLLEGE STUDENTS AS A FUNCTION OF
REINFORCEMENT SENSITIVITY, LIFE EVENTS, AND AFFECT

by

HYOUNG SUK LEE, M.A.

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Abstract

Mood has been commonly viewed as an important determinant of drinking, but studies of positive and negative affect and alcohol use have reported inconsistent results. It has been suggested that the relationship between negative affect and heavy drinking or drinking problems depends on individual vulnerability dimensions such as personality. Gray's Reinforcement Sensitivity Theory (RST) may provide a particularly useful framework in studies about alcohol use, connecting personality, motivational processes, and responses to environmental stimuli. In past studies, the sensitivity of Gray's Behavioral Activation System (BAS) has been linked to alcohol use, but results have been less consistent for the Behavioral Inhibition System (BIS). The aim of this study was to test the relationships among the BAS/BIS, life events, affect, and alcohol use in college students. Considering the methodological limitations in previous studies, two studies were performed. In Study 1, 317 college students who reported alcohol use in the previous 6 months completed self-report measures of the BAS/BIS, life events, affect, and alcohol use (e.g., frequency of alcohol use, alcohol-related problems). BAS sensitivity was significantly related to heavy drinking, but not to drinking problems. Conversely, BIS sensitivity was positively and significantly associated with drinking problems, but negatively with heavy drinking. In the path analysis, the path from the BAS to heavy drinking was significant, and the path from the BAS to drinking problems was marginally and indirectly significant via the path from heavy drinking to drinking problems. Conversely, the path from the interaction between the BIS and negative life events to drinking problems was indirectly significant via negative affect, and the path from the interaction between the BIS and negative life events to heavy drinking problems was marginally and negatively significant via negative affect. In Study 2, 134 college students who showed either BAS or BIS dominance were recruited and randomly assigned to the reward or punishment task. The BAS-dominant subgroup assigned to the reward task and the BIS-dominant subgroup assigned to the punishment task showed higher urge to drink than other subgroups. The BAS-dominant subgroup assigned to the reward task did not show a higher

positive urge to drink than other subgroups, while the BIS-dominant subgroup assigned to the punishment task showed a higher negative urge to drink than other subgroups. The results lend correlational and experimental support to the idea that both BAS and BIS sensitivity are related to alcohol use. Further, this study clarified differential paths to alcohol use for the BAS and BIS: BAS sensitivity motivates drinking in response to reward, while BIS sensitivity enhances vulnerability to drinking in response to negative affect.

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Chapter 1: Introduction

1.1 ALCOHOL USE IN COLLEGE STUDENTS

Alcohol use in college students is a major public health concern because it has led to a variety of negative consequences. Thus, researchers have attempted to understand the variables that may predict alcohol use in college students, including psychological variables. Compared to the population in general, college students have been regarded as a unique group of individuals in terms of drinking patterns and risk factors related to alcohol use (Ham & Hope, 2003). For example, many college students are involved in frequent heavy drinking, which is not maintained during the rest of their lives (Weingardt, Baer, Kivlahan, Orberts, Miller, & Marlatt, 1998). In other words, heavy drinking and alcohol-related problems are most prevalent in emerging adulthood, but they decrease rapidly after the late twenties (Bachman, O'Malley, Schulenberg, Johnston, Bryant, & Merline, 2002; Grant, Dawson, Stinson, Chou, Dufour, & Pickering, 2004). This phenomenon, often called “maturing out” or “developmentally limited alcoholism,” suggests that heavy drinking and alcohol-related problems in college students decline over time as they experience developmental transitions into adult roles such as employment and family obligations (Winick, 1962; Zucher, 1987).

One difficulty with investigating alcohol use in college students is the lack of an agreement about what kind of alcohol use is regarded as problematic (Clements, 1999). However, problematic alcohol use has generally been defined based on either drinking frequency and quantity or alcohol-related negative consequences (Baer, 2002). Many researchers investigating alcohol use in college students have administered self-reported questionnaires about quantity or frequency of drinking. These studies have employed the terms “binge drinking” or “heavy drinking” (Ham & Hope, 2003). In general, binge drinking or heavy drinking is

operationally defined as at least 4 (for women) or 5 (for men) consecutive drinks in one sitting (Wechsler, Dowdall, Davenport, & Rimm, 1995). The concept of the “standard drink” is used in the definition of binge drinking: one standard drink is generally defined as a 12-oz. beer, a 4-oz. glass of wine, a 12-oz. wine cooler, or a 1.25-oz. shot of liquor (Wechsler, Lee, Kuo, & Lee, 2000). Although the specific period of time in which the episodes of binge drinking have occurred varies among studies (e.g., Wechsler, Lee, Kuo, & Lee, 2000; Vik, Carrello, Tate, & Field, 2000), authors have generally agreed that 4 or 5 standard drinks in one sitting is a criterion of binge drinking. However, the quantity and frequency of alcohol use are not sufficient to determine whether alcohol use is problematic. This is because high amounts of alcohol use have not necessarily been related to high levels of alcohol-related problems (White & Labouvie, 1989). Further, the psychological predictors of the quantity or frequency of alcohol use are different from those of alcohol-related problems (Cooper, Agocha, & Sheldon, 2000). Thus, standardized definitions and measures of negative consequences of alcohol use in college students have recently been used in studies, either with or without measures of the quantity or frequency of alcohol use. For example, the diagnostic criteria for alcohol use disorders in the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV; American Psychiatric Association, 1994) are frequently used to define and assess alcohol-related negative consequences in college students (e.g., legal problems that are related to substance use, physically risky alcohol use such as drinking while driving, and absences from work or school due to alcohol use). Overall, it is optimal to take into consideration both the quantity or frequency of alcohol use and alcohol-related negative consequences in studies investigating problematic alcohol use in college students (Ham & Hope, 2003).

Young adults or college students have shown the highest rates of alcohol use and the greatest percentage of alcohol-related problems. According to reports, over two out of every five college students (44%) reported binge drinking episodes in the previous 2 weeks (Wechsler et al., 2002), and the percentage increased to 84% when the period of time in which the binge drinking episodes has occurred is extended to the previous 90 days (Vik, Carrello, Tate, & Field, 2000). Further, approximately 6 percent of college students have been diagnosed as alcohol dependent, and approximately 44 percent of students reported at least one symptom of either abuse or dependence (Knight et al., 2002). Many college students reported alcohol-related negative consequences such as the incidence of blackout, reduction of the number of hours spent studying per day, missing a class, and lower grades (Jenny, Powell, & Wechsler, 2003; Wechsler, Lee, Kuo, & Lee, 2000). Binge drinking or alcohol-related negative consequences in college students not only place their own health at risk, but also they jeopardize others' well-being: approximately 46 percent of the people killed in crashes involving drinking young adult drivers are persons other than the drinking driver (Hingson, Heeren, Winter, & Wechsler, 2005). Thus, even though a trend of slight improvement in heavy drinking has been reported in college students (O'Malley & Johnston, 2002), heavy or problematic alcohol use in college students still warrants a major public health concern.

1.2 MOTIVATIONAL MODEL FOR ALCOHOL USE

Over the last decade, research has focused on the identification and understanding of specific reasons that underlie alcohol use, including binge drinking or problematic drinking. The effects of mood alteration have been commonly viewed as important determinants of drinking behavior (Colder, 2001; Pandina, Jahnsen, & Labouvie, 1993). In this conceptualization of alcohol use, positive and negative reinforcements are emphasized (Cox & Klinger, 1988; 1990;

Rock & Kambouropoulos, 2007; Stewart, de Wit, & Eikelboom, 1984; Stewart, Hall, Wilkie, & Birch, 2002). In other words, an individual's decision to use alcohol is based on whether one expects mood alteration from alcohol use, and the two primary types of mood alteration that might be desired from alcohol use are increased positive affect (i.e., positive reinforcement) and decreased negative affect (i.e., negative reinforcement).

In early approaches to alcohol use that emphasized reinforcement mechanisms, specifically, the notion of negative or withdrawal-like symptoms was emphasized (Ludwig & Wikler, 1974). Under the theory, the experiences of negative or withdrawal-like symptoms increase the probability of alcohol use in order to alleviate the negative or aversive states (i.e., negative reinforcement). This aversive motivation of alcohol use can also be influenced by a drive to "self-medication" or "tension reduction," in which increases in the desire to use alcohol may be due to the desire to alleviate pre-existing negative states such as anxiety (Cappell & Greeley, 1987; Goldman, Del Boca, & Darkes, 1999; Greeley & Oei, 1999; McCusker & Brown, 1991). However, a meta-analytic study documented that the desire to use alcohol often reflects positive or appetitive motivation rather than aversive motivation. That is, alcohol has psychological effects which increase the probability of alcohol use in order to promote positive or appetitive states (i.e., positive reinforcement), instead of relieving negative or aversive states (Carter & Tiffany, 1999). Specifically, repeated exposures to alcohol in the presence of certain external or internal stimuli cause a strong association between the positive effects of alcohol and the external or internal stimuli (Stewart, de Wit, & Eikelboom, 1984; Stewart & Eikelboom, 1987). As external or internal stimuli have been repeatedly presented with the positive effects of alcohol, they can finally lead similar positive or appetitive motivational states. Also, due to enhanced positive or appetitive motivation, stimuli associated with alcohol may directly

stimulate more alcohol use (Rock & Kambouropoulos, 2007). Due to the unclear processes involved in both negative or aversive motivation and positive or appetitive motivation, there is considerable debate in the literature regarding the relative importance of positive and negative reinforcement (Glautier, 1999; Rock & Kambouropoulos, 2007). Thus, increased alcohol use may reflect both repeatedly learned associations: between positive affect, alcohol use, and affect enhancement outcome; and between negative affect, alcohol use, and tension reduction outcome (Stewart, Hall, Wilkie, & Birch, 2002). In other words, some may want to use alcohol in the future expecting positive affect as they have been exposed to positive affect due to alcohol use; while others may try to drink in the future expecting decreases in negative affect because they have experienced the alleviation of negative affect due to alcohol use.

Supporting this concept, a motivational model of alcohol use that concentrates on the role of the mood alteration in determining alcohol use was proposed (Cooper, 1994; Cox & Klinger, 1988; 1990). For the past couple of decades, the motivational model has been advanced in the literature and accumulated extensive support. In the motivational model, even though little agreement yet exists regarding the number and characteristics of motivational dimensions, two dimensions have been generally hypothesized. Valence (positive and negative) refers to the type of reinforcement one wants to obtain by alcohol use. An individual may drink to obtain a positive outcome or to avoid or escape a negative outcome. The other dimension, source (internal and external), refers to the aspect of the environment an individual wants to manipulate through alcohol use. The type of reinforcement may be related to the change in one's internal status (i.e., the management of emotional state) or in one's external status (i.e., social acceptance or approval). Crossing these two dimensions, four distinctive drinking motives have been identified: (1) enhancement motives (positive, internal reinforcement motives), (2) coping

motives (negative, internal reinforcement motives), (3) social motives (positive, external reinforcement motives), and (4) conformity motives (external, negative reinforcement motives). Each motive is related to alcohol use in order to enhance positive mood or well-being, reduce or regulate negative emotions, obtain positive social rewards, or avoid social censure or rejection, respectively. This classification is known to be relatively stable across cultures (Kuntsche, Knibbe, Gmel, & Engels, 2005; 2006; Kuntsche, Stewart, & Cooper, 2008).

Subsequent studies support the plausibility of this classification, including reports that different motives are related to specific patterns of alcohol use (Cooper, 1994; Cooper, Agocha, & Sheldon, 2000; Cooper, Russell, Skinner, & Windle, 1992; Read, Wood, Kahler, & Maddock, 2003; Simons, Gaher, Correia, Hansen, & Christopher, 2005). The two internal motives (enhancement and coping motives) have been shown to be related to heavy drinking and alcohol-related negative consequences. In studies, enhancement motives were related to drinking with same-sex friends, at parties, and in bars. Also, they positively and directly predicted heavy drinking and indirectly predicted drinking problems via heavy drinking. On the contrary, coping motives were associated with solitary drinking at home, not with friends or family. Also, they directly and indirectly predicted both heavy drinking and drinking problems. Social and conformity motives have usually been excluded from the studies about heavy drinking or drinking problems because they are related to light, infrequent, and non-problematic drinking or they are not significantly related to alcohol use at all. Further, enhancement motives involve alcohol use to increase positive affective states or emotional experiences, and thus they were most often associated with positive affect or related traits such as extraversion and sensation seeking. On the other hand, coping motives involve heavy drinking or drinking problems to escape or avoid the situations in which the regulation of negative emotions is needed, and thus

they were associated with negative affect or related traits such as neuroticism and avoidant coping (Chassin, Flora, & King, 2004; Comeau, Stewart, & Loba, 2001; Cooper, Agocha, & Sheldon, 2000; Kassel, Jackson, & Unrod, 2000; Read, Wood, Kahler, Maddock, & Palfai, 2003; Simons, Gaher, Correia, Hansen, & Christopher, 2005; Theakston, Stewart, Dawson, Knowlden-Loewen, & Lehman, 2004; Yokoyama, Nishikitani, & Araki, 1999). A few studies measured social motives that were mostly associated with moderate drinking, but they did not consider personality or other psychosocial factors except expectancies (Read, Wood, Kahler, Maddock, & Palfai, 2003). However, considering the studies about the relationship between social support and personality or other psychosocial variables (Ashton, Lee, & Paunonen, 2002; Larsen & Augustine, 2008; Lucas, Diener, Grob, Suh, & Shao, 2000; von Dras & Siegler, 1997), social motives are expected to be associated with positive affect or positive affective traits (e.g., extraversion, emotion-focused coping). This can be supported by the argument that social motives are conceptually and statistically overlapping with enhancement motives (Read, Wood, Kahler, Maddock, & Palfai, 2003).

However, different from studies that administered measures of drinking motives, studies that explored positive and negative affect in relation with or as an antecedent of alcohol use have reported inconsistent results. These studies assessed positive and negative affect independently from drinking motives, and authors tested whether temporal or trait-like positive and negative affect predict short- or long-term alcohol use. In some studies, positive affect or change in positive affect was not related to enhancement motives, quantity or frequency of drinking, or drinking problems (Caspi et al., 1997; Cooper, Frone, Russell, & Mudar, 1995; Stein, Goldman, Del Boca, 2000; Tod, Armeli, & Tennen, 2009). In one study (Stein, Goldman, & Del Boca, 2000), positive cognition and positive affect were directly compared in terms of the extent to

which they predicted alcohol consumption: increased positive affect was not related to alcohol consumption, while increased positive cognition was associated with a high level of alcohol consumption. Related to positive affect or enhancement motives, authors suggested that the reinforcement for alcohol drinking is not positive affect itself, but expectancy of positive outcomes. In this view, often called the “expectancy model,” alcohol expectancies acquired experiences with alcohol use are stored in memory templates that are activated by alcohol-related stimuli. In the future, when alcohol-related stimuli are registered in sensory systems and thus stimulate memory templates, stored information for drinking behaviors and positive outcomes encourage alcohol use (Goldman, Darkes, & Del Boca, 1999; Goldman, Del Boca, & Darkes, 1999; Stein, Goldman, & Del Boca, 2000). According to this view, positive events such as activities with peers that have been paired with alcohol use, rather than positive affect, may facilitate alcohol use in the future. Supporting this, alcohol expectancies or positive events were significantly related to alcohol use (Armeli, Todd, & Mohr, 2005; Rafnsson, Jonsson, & Windle, 2006; Windle & Windle, 1996). Further, even non-affective cues involving pleasant emotions and pleasant times with others activated a drive to use alcohol in drinkers with enhancement motives (Carrigan, Samoluk, & Stewart, 1998; Stewart, Hall, Wilkie, & Birch, 2002).

The relationship of negative affect or negative reinforcement with alcohol use has been also questioned by some researchers who have pointed out inconsistencies in studies (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Mohr, Armeli, Tennen, & Todd, 2010). Notably, in some studies that included stress variables to assess negative affect, emotional distress was unrelated to heavy drinking or drinking problems, and, moreover, alcohol use was lower on days with events perceived as relatively more stressful (Armeli, Carney, Tennen, Affleck, & O’Neil, 2000; Armeli, Todd, & Mohr, 2005; Park, Armeli, & Tennen, 2004; Rutledge & Sher, 2001;

Steptoe & Wardle, 1999). Explaining this inconsistency in the literature, it has been suggested that there is great variation in the degree to which college students actually use alcohol as a way to deal with negative affect or distressing environment (Greeley & Oei, 1999). Thus, the relationship between negative affect and heavy drinking or drinking problem depends on vulnerability dimensions such as coping and personality (Armeli, Todd, & Mohr, 2005; Ham & Hope, 2003). For example, heavy drinking was associated with expectancies for the positive effects of alcohol interacting with avoidant drinking dispositions (Catanzaro & Laurent, 2004).

Overall, alcohol use is not determined only by affect or affective changes even though the relationship between alcohol use and affect is more specific to negative affect (Stewart, Hall, Wilkie, & Birch, 2002). In other words, the motivational model in which alcohol use is determined by mood alteration or expectancy of mood alteration is not enough to explain alcohol use. Subsequent studies have suggested that alcohol use is rather associated with positive events and negative affect, with some drinking to try to trigger positive events and others drinking to cope with their emotional reactions to negative events. Also, they have implied that some related variables explaining the individual differences in vulnerability or susceptibility to positive events and negative affect should be considered in models of alcohol use in order to fully explicate the relationship between events or affect and drinking (Rutledge & Sher, 2001).

1.3 PERSONALITY AND ALCOHOL USE

Personality variables can be used to predict alcohol use: some may be more vulnerable to heavy drinking or drinking problems due to a sensitivity to positive events, while the vulnerability of others may be due to a susceptibility to the experiences of negative affect. Actually, the relationship between personality and alcohol use has been tested. Relevant personality traits that have been quite well documented since the work of Eysenck (1951) are

extraversion and neuroticism. Extraversion is a normal personality dimension described by heightened activity, assertiveness, confidence, venturesomeness, and sociability. In contrast, neuroticism is characterized by high levels of emotional liability, hypersensitivity to criticism, self-doubt, alienation, and a tendency to dwell on the negative (Costa & McCrae, 1980; McRae & John, 1992). There has been a large amount of evidence that extraversion is related to positive affect and neuroticism is associated with negative affect. The extravert experiences greater benefits from pleasant situations and, specifically, pleasant social situations which increase positive affect and thus lead the extravert to approach pleasant stimuli more readily than the introvert. Persons with high neuroticism have specific styles of negative information processing or focus selectively on threats and unpleasant information in the neutral environments, promoting negative affect and motivating avoidance or withdrawal from aversive stimuli (Larsen & Augustine, 2008). Thus, many studies have suggested a direct relationship between affect personality constructs such as extraversion and neuroticism in the past.

Based on their relationship with positive and negative affect, extraversion and neuroticism have been frequently mentioned by authors investigating risky health behaviors such as alcohol use (Caspi, Begg, Dickson, Harrington, Langley, Moffitt, & Silva, 1997). Because both positive and negative affect are believed to be positively associated with alcohol use, it has been anticipated that both extraversion and neuroticism are also positively related to alcohol use. As expected, some studies have reported the positive relationship between extraversion and alcohol use (Grau & Ortet, 1999; Vollrath & Torgersen, 2002). Also, alcohol use to enhance positive affect has been shown to be related to high levels of extraversion (Cooper, Agocha, & Sheldon, 2000; Stewart & Devine, 2000; Theakston, Stewart, Dawson, Knowlden-Loewen, & Lehman, 2002). However, authors have especially focused on neuroticism or negative

emotionality, in the context of “self-medication” or “tension reduction.” It has been also reported that neurotic individuals have more difficulty in coping with stressors and negative affect such as anxiety and sadness, leading to heavy drinking or drinking problems (Ham & Hope, 2003; Kuntsche, Knibbe, Gmel, & Engels, 2006). Again, some studies have suggested a positive relationship between neuroticism or related psychological variables (e.g., anxiety and depression) and alcohol use (Chassin, Flora, & King, 2004; Lewis & O’Neill, 2000; Vollrath & Torgersen, 2002). Also, there has been strong evidence that alcohol use to cope with negative affect is associated with high levels of neuroticism (Cooper, Agocha, & Sheldon, 2000; Littlefield, Sher, & Wood, 2010; Loukas et al., 2000; Stewart & Devine, 2000; Stewart, Loughlin, & Rhyno, 2001). However, other studies have reported contradictory findings about the relationship between neuroticism and alcohol use. In short, other studies have reported that neuroticism or related psychological variables are not or are even inversely related to alcohol use (Bruch, Rivet, Heimberg, & Levin, 1997; Grau & Ortet, 1999; Lauriola, Russo, Lucidi, Violani, & Levin, 2005). To explain this inconsistency, some authors have suggested that persons with high levels of neuroticism and negative affect tend to exaggerate the chance of negative outcomes, thus they are unlikely to engage in risky health behaviors such as alcohol use (Lauriola, Russo, Lucidi, Violani, & Levin, 2005; Stöber, 1997). However, this does not clearly explain the positive relationship between neuroticism and alcohol use. Thus, in a recent review, it was concluded that, based on findings of both positive and negative relationships with alcohol use, neuroticism has a less clear relationship with drinking behavior than extraversion, and the influence of additional variables may have to be considered to understand inconsistent findings in the relationship between neuroticism and alcohol use in college students (Ham & Hope, 2003).

Sensation seeking is another personality variable that has been frequently related to heavy drinking, especially in appetitive situations (Ham & Hope, 2003; Kambouropoulos & Staiger, 2004). Sensation seeking, defined as a personality factor that refers to the desire for intense and novel experiences (Zuckerman, 1994), has been positively related to heavy drinking and drinking problems (McCabe, 2002; Skeel, Pilarski, Pytlak, & Neudecker, 2008; Wills, Windle, & Cleary, 1998). However, this positive relationship between sensation seeking and alcohol use has only been consistently replicated for men, especially Anglo-American males (Baer, 2002). In other demographic subgroups such as women and Black males, sensation seeking may not be a strong predictor of alcohol use. Due to this limitation, further research must be conducted to determine if sensation seeking is relevant to explain alcohol use in college students (Ham & Hope, 2003).

Overall, like the relationship between affect and alcohol use, a direct relationship between personality and alcohol use has not always been consistently found. Considering that alcohol use is not determined only by affect, studies investigating the relationship between personality and alcohol use may not be appropriate if they are just based on the affective characteristics of personality factors. Also, the inconsistent findings regarding personality and alcohol use may be partly because drinking patterns vary across time, while personality is by definition relatively stable and not particularly sensitive to variation in life-events and affect (Armeli, Todd, & Mohr, 2005; Park, Armeli, & Tennen, 2003). Thus, moderating or mediating variables should be also included in studies on personality and alcohol use. However, moderation or mediation has rarely been tested in studies.

1.4 REINFORCEMENT SENSITIVITY THEORY (RST)

The inconsistency in studies investigating motives or affect in relation to alcohol use may be explained by considering variables that reflect individual differences in sensitivity to the

rewarding effects of alcohol use (Wilkie & Stewart, 2005). It has been proposed that some individuals should be particularly sensitive to the negatively reinforcing effects of alcohol, while others should be particularly susceptible to the positively reinforcing effect of alcohol (Verheul, van den Brink, & Geerlings, 1999). It stands to reason that motives, life events, or affect act as a proximal influence on alcohol use through which more distal impacts such as personality are mediated (Kuntsche, von Fisher, & Gmel, 2008; Littlefield, Sher, & Wood, 2010). Gray's Reinforcement Sensitivity Theory (RST; Gray, 1970; 1982) may provide a particularly useful personality framework in which to understand studies about alcohol use. RST directly explains individual susceptibility to positive and negative reinforcement, and it emphasizes personality based on motivational processes and responses to environmental stimuli (Kambouropoulos & Staiger, 2004a; 2007).

Concepts of approach and avoidance motivation have been discontinuously utilized in a variety of academic disciplines, theories, and applied areas (Elliot, 2008). One of the traditional ways of studying approach and avoidance motivation is through personality dispositions: approach and avoidance motivation have been often understood in relation to trait (Larsen & Augustine, 2008). Recently, there is substantial interest in the distinction between approach and avoidance motivation as relevant theories, models, variables, and hypotheses are suggested. For example, RST has roused interest in the area of approach and avoidance motivation again since it presents theoretical explanations for why personality should link to affect (Larsen & Augustine, 2008).

RST focuses on neuropsychological systems hypothesized to underlie personality dimensions; these systems are brain structures responsible for individual differences in the response to reinforcing events and the affective experience (Corr, 2008; Torrubia, Ávila, Moltó,

& Caseras, 2001). According to RST, extraversion, though Gray preferably used the term “impulsivity,” reflects the heightened response to cues of reward or relief from punishment (Larsen & Augustine, 2008). Extraversion is related to motivation caused by reward or pleasure, and thus extraverts have a tendency of approach toward novel situations. The behavioral approach system (BAS) is the hypothesized neurological substrate that underlies extraversion. Thus, the BAS is responsible for the sensitivity to appetitive stimuli such as rewards and incentives and it causes positive affect (Corr, 2008; Larsen & Augustine, 2008). Neuroticism, though Gray preferably used the term “anxiety,” refers to the high responsiveness to cues of punishment or frustration (Larsen & Augustine, 2008). Thus, neuroticism is related to avoidance of punishment, and thus neurotic persons tend to be inhibited or withdrawn, especially in unfamiliar situations. The behavioral inhibition system (BIS) is the hypothesized neurological substrate that underlies neuroticism. Thus, the BIS responds to aversive stimuli such as punishment and it generates negative affect (Corr, 2008; Larsen & Augustine, 2008). Gray (1987) added a third neurological substrate, the fight/flight system (FFS), which was hypothesized to respond to unconditioned aversive stimuli and underlie the emotions of rage and panic (Corr, 2008). The FFS is aligned with Eysenck’s personality construct of psychoticism. Later, it was revised to the Fight-Flight-Freeze System (FFFS), including conditioned aversive stimuli as well as unconditioned ones (Gray & McNaughton, 2000). However, this third system is less well understood (Corr, 2001; Jackson, 2003; Matthews & Gilliland, 1999), and attempts to assess it have failed (Jackson, 2001; Wilson, Barrett, & Gray, 1989). This is partly because of overlap between the concepts of the FFS or FFFS with the BAS or BIS; the FFFS is not clearly distinguished from the BIS, as both are hypothesized to be activated by unconditioned aversive stimuli (Corr, 2008), and psychoticism that was supposed to be related to the FFFS has been

proven to be predicted by the BAS (Jackson, 2002). Further, because the revised theory that includes the FFS or FFFS is mainly based on findings from animal studies, some specific details of Gray's theory have been regarded as inappropriate at the human level of analysis (Corr, 2008). Thus, researchers have so far hesitated to make hypotheses based on the revised theory. Rather, the two-factor model of RST that considers the BAS and BIS, but not the FFS or FFFS, has been usually adopted in studies, reflecting general motivational tendencies of approach and avoidance rather than the specifics in Gray's later work.

Clinical and laboratory observations that aim to identify the neurological substrates of basic dimensions of affect and affective style have focused on the asymmetric relations of behavioral approach/inhibition and affect with activity in anterior cortical regions (Davidson, 1994; Sutton & Davidson, 1997). Many studies that used measures of temporal or spatial resolutions of brain activity (e.g., electroencephalogram: EEG, functional magnetic resonance imaging: fMRI) have suggested that left prefrontal cortex is a biological substrate of behavioral approach and positive affect, while right prefrontal cortex is a biological substrate of behavioral inhibition and negative affect (Cacioppo & Gardner, 1999; Crost, Pauls, & Wacker, 2008; Nijs, Franklin, & Smulders, 2007; Harmon-Jones, 2003; Hass, Omura, Amin, Constable, & Canli, 2006; Santesso et al., 2008; Sutton & Davidson, 1997). More specifically, it was originally postulated that limbic circuits that activate the dopamine system to facilitate approach behavior function as the BAS in response to conditioned appetitive stimuli such as reward and nonpunishment; while the BIS is composed of a group of circuits including the hippocampus, subiculum, and septum and related structures in response to conditioned aversive stimuli such as punishment and nonreward, and extreme novelty and innate fear stimuli (Gray, 1987; Reuter et al., 2004). Recent studies have not supported the role of the brain regions proposed by the

original theory: the BAS was positively related to brain activities in the hippocampus-parahippocampus regions and insula of the left hemisphere; while the BIS was positively associated with those in the amygdala and thalamus, parts of limbic circuits of the right hemisphere (Canli et al, 2002; Reuter et al., 2004; Schienle et al., 2002). However, these studies administered emotional stimuli such as erotic and disgusting pictures, rather than more specific BAS and BIS stimuli such as approach and avoidance words. This points up a potential problem in measurement of BAS and BIS sensitivity: some negative emotional stimuli such as the words “angry” and “aggression” have been reported to have a property of approach, and thus should involve the BAS, from the viewpoint of an expressor (Adams, Ambady, Macrae, & Kleck, 2006; Horstmann, 2003; Putman, Hermans, & van Honk, 2004). Such challenges have prevented definitive linkages of the BAS and BIS to specific neurological substrate. From studies that have tried to reveal the brain regions related to the BAS and BIS, it can be only confirmed that the BAS and BIS asymmetrically involves the brain and suggested that the BAS and BIS are closely related to affectivity.

Many studies have suggested close relationships among BAS/BIS, personality such as extraversion/neuroticism, temperament such as novelty seeking/harm avoidance, and positive/negative affect. As conceptualized, it has been reported that the BAS is positively related to extraversion, novelty seeking, and positive affect, while the BIS is positively associated with neuroticism, harm avoidance, and negative affect (Carver, 2004; Ebstein, Benjamin, & Belmaker, 2003; Gable, Reis, & Elliot, 2000; Gerra, Zaimovic, Timpano, Zambelli, Delsignore, & Brambilla, 2000; Gomez, Cooper, & Gomez, 2000; Gomez & Gomez, 2002; Hansenne, Pinto, Pitchot, Reggers, Scantamburlo, Moor, & Ansseau, 2002; Heponiemi, Keltikangas-Järvinen, Puttonen, & Ravaja, 2003; Heubeck, Wilkinson, & Cologon, 1998;

Hewig, Hagemann, Seifert, Naumann, & Bartussek, 2005; Jackson, 2002, 2003; Jorm, Christensen, Henderson, Jacomb, Korten, & Rodgers, 1999; Mardaga & Hansenne, 2007; Ravaja, 2004; Smits & Boeck, 2006). Strong evidence of the approach and avoidance constructs and the relationships among variables come from factor analysis studies that included self-reported measures of personality, affective reactivity, and naturalistic affect (Elliot & Thrash, 2002; Smillie & Jackson, 2006; Zelenski & Larsen, 1999). Analyses in studies commonly extracted two factors: one representing approach sensitivity (loading reward sensitivity, reward expectancy, extraversion, positive emotionality, and BAS scales); and the other representing avoidance sensitivity (loading punishment sensitivity, harm avoidance, neuroticism, negative emotionality, and BIS scales) (Larsen & Augustine, 2008). According to the hierarchical model of approach-avoidance motivation, these variables related to the BAS and BIS work as instigators of approach and avoidance behavior (Elliot, 2006). Thus, the variables guide individuals to produce affective, cognitive, and behavioral responses to stimuli. Rusting and Larsen (1999) introduced empirical evidence that, among variables, the BAS and BIS lie on a higher order than extraversion and neuroticism in the dimension of personality and thus positive and negative affect.

1.4.1 APPLICATION OF BAS AND BIS CONCEPTS TO ALCOHOL USE IN COLLEGE STUDENTS

There are some issues in the studies administering the BAS and BIS concepts. The first one is the range of populations and variables in studies. There is a limitation in groups in which the BAS and BIS have been examined. As mentioned before, since the development of RST was based on animal studies, the characteristics of the BAS and BIS have been identified in a variety of animals, ranging from guppy to chimpanzee (Corr, 2008; Jones & Gosling, 2008). In human studies, because studies have heavily focused on affective variables, some studies extended and

applied the BAS and BIS to mentally ill populations such as manic, depressed, anxious, or hyperactive individuals (Harmon-Jones, 2003; Pastor et al., 2007; Segarra et al., 2007).

However, other populations such as college students in which the BAS and BIS may explain some characteristics have been rarely considered in studies.

Also, over a decade has passed since Gray proposed RST, but variables in the studies on the BAS and BIS are still limited to some personality and affective variables and the majority of studies are correlational. Actual behaviors that are potentially influenced and explained by the BAS/BIS and related variables have been included in some animal studies, but not often in human studies (Jones & Gosling, 2008). Recently, some researchers have initiated work on the relationship between the BAS/BIS sensitivity and some health behaviors. This link between the BAS/BIS and health behaviors is important for several reasons (Caspi et al., 1997). First, it may help to organize existing research findings about the development of health behaviors and their relationships with personality and other psychosocial variables. Models of health behaviors, such as the Health Belief Model (Becker, 1974; Rosenstock, 1974), have been a framework to investigate the predictors and precursors to health behaviors, and various psychological factors have been included and related in the models. Attempts to expand the models of health behaviors to comprehensive and systematic ones have included more stable psychological factors such as personality traits than situational ones. For example, neuroticism has been linked to greater perceptions of susceptibility to health problems in the Health Belief Model (Gerend, Aiken, & West, 2004; Trobst, Wiggins, Costa, Herbst, McCrae, & Masters, 2000; Vollrath, Knoch, & Cassano, 1999). The adaptation of the BAS/BIS, on which personality traits are based on and to which other psychosocial factors are closely related, will make models of health behaviors more comprehensive and systematic, providing neurological foundations for the relationships among

personality, psychosocial factors, and health behaviors. This adapted Health Belief Model may be a more solid framework for studies of health behaviors and promote the application of research findings in real settings.

Actually, some studies have already applied the concept of the BAS and BIS in relation to the Health Belief Model. For example, the relationship between the BAS/BIS and message framing is one of the subjects that some researchers are focusing on in terms of health behaviors. Attitude and behavioral intention have been reported to be differentially related to BAS and BIS sensitivity, according to types of message framing (Shen & Dillard, 2007). Several studies suggested that message frames stressing advantages of health behaviors (thus, conceptually related to perceived benefits in the Health Belief Model) induce behavioral change through the BAS; while message frames focusing on disadvantages of risky health behaviors (and thus conceptually associated with perceived susceptibility in the Health Belief Model induce behavioral change through the BIS (Dillard & Anderson, 2004; Lauriola, Russo, Lucidi, Violani, & Levin, 2005; Shen & Dillard, 2007; Sherman, Mann, & Updegraff, 2006). From a practical viewpoint, this relationship between the BAS/BIS and message framing might be applied to modify risky health behaviors: perceived benefits and susceptibility can be differentially emphasized in interventions, depending on the targeted individuals' relative salience of the BAS and BIS. Thus, understanding the relationship between the BAS/BIS and health behaviors in models of health behaviors may be a critical step toward designing and tailoring health campaigns and educational programs that would appeal to a target audience.

Even though the BAS and BIS have seldom been measured directly, studies about the relationship between personality, other psychosocial factors, and health behaviors suggested that the BAS and BIS may interact with different drinking motives (Cooper, Frone, Russell, &

Mudar, 1995; O'Connor & Colder, 2005; Skeel, Pilarski, Pytlak, & Neudecker, 2008). In other words, considering that personality or other psychosocial variables known to be associated with the BAS and BIS are related to different drinking motives, it is expected that both BAS and BIS sensitivity should be strong predictors of alcohol use (e.g., heavy drinking, drinking problem) mediated by or interacting with personality and other psychosocial variables, especially different drinking motives, in the motivational model of alcohol use. BAS sensitivity is involved in approach behavior and more related to extraversion than neuroticism. Thus, linked to positive affect, impulsivity, and sensation seeking, BAS sensitivity has been hypothesized to be related to high levels of alcohol use (Lauriola, Russo, Lucidi, Violani, & Levin, 2005; Mardaga & Hansenne, 2007). Meanwhile, BIS sensitivity is involved in inhibition behavior and more related to neuroticism than extraversion. It is also linked to negative affect, anxiety, and harm avoidance, variables that have been inconsistently related to engagement in risk-seeking behaviors such as alcohol use (Staiger, Kambouropoulos, & Dawe, 2007). Thus, just like the relationship between neuroticism and alcohol use, the direct relationship between BIS sensitivity and alcohol use has been not clearly hypothesized: some have expected a positive relationship based on the susceptibility of the BIS to negative affect such as anxiety and the likelihood of involvement in self-medication or tension reduction, while others anticipated a negative relationship, based on BIS sensitivity to the possible negative consequences of heavy alcohol use.

There have been some studies, though not many, investigating the relationship between BAS/BIS sensitivity and alcohol use. Recent studies about alcohol use partially supported the previously discussed relationship between the BAS/BIS and alcohol use. BAS sensitivity is positively related to addictive behaviors such as alcohol use and response to alcohol cues (Franken, Muris, & Georgieva, 2006; Hundt, Kimbrel, Mitchell, & Nelson-Gray, 2008;

Kambouropoulos & Staiger, 2007, 2009; Kimbrel, Nelson-Gray, & Mitchell, 2007; Pardo, Aguilar, Molinuevo, & Torrubia, 2007; Zisseron & Palfai, 2007). However, as expected, the relationships between the BIS and alcohol use have been contradictory. Some studies reported positive relationships between BIS sensitivity and alcohol use (Kimbrel, Nelson-Gray, & Mitchell, 2007; Lauriola, Russo, Lucidi, Violani, & Levin, 2005), while other studies suggested a negative or non-significant relationship between BIS sensitivity and alcohol use (Franken, Muris, & Georgieva, 2006; Hundt, Kimbrel, Mitchell, & Nelson-Gray, 2008; Johnson, Turner, & Iwata, 2003; Pardo, Aguilar, Molinuevo, & Torrubia, 2007). There are studies that consider BAS/BIS sensitivity and positive/negative affect simultaneously in the relationship with alcohol use and concluded that BAS and negative affect are distinctive characteristics of heavy drinkers (Kambouropoulos & Staiger, 2007; 2009). However, in these studies, authors did not perform further analyses about the relationship between BIS sensitivity and negative affect or the mediation effect of negative affect in the relationship between BIS sensitivity and alcohol use. This may be a potential explanation for the partial support of the relationship between the BAS/BIS and alcohol use. In other words, considering that the BIS should be more associated with neuroticism than extraversion, BIS sensitivity is expected to be positively related to alcohol use, with the association mediated by negative affect. A study considering this relationship between the BAS/BIS and alcohol use, and including mediators such as coping and affect might resolve the contradictory results from studies about the relationship between the BAS/BIS and alcohol use. However, the studies on alcohol use directly linked to the BAS and BIS are still limited in both number and comprehensiveness.

Previously, it was mentioned that mood alteration or expectancy of mood alteration is not enough to explain alcohol use, contrary to the explanations posed by the motivational model of

alcohol use. In other words, alcohol use is rather characterized by positive events and negative affect, with some drinking to try to seek positive events and others drinking to cope with emotional reactions to negative events. One study investigating the relationship between the BAS/BIS, life events, and affect implied the necessity assessing BAS and BIS sensitivity in research about alcohol use. In the study, the BAS was directly related to positive events but indirectly associated with positive affect, through the mediation of positive events. Meanwhile, the BIS moderated reactions to negative events, magnifying the experience of negative affect (Gable, Reis, & Elliot, 2000). In short, this study reported the direct relations of BAS and BIS sensitivity with positive events and negative affect, respectively, that are now considered as critical factors in the explanation of alcohol use. Thus, this finding suggested that the BAS and BIS may be a framework to explain the relationship between life events, affect, and alcohol use, but this study did not extend the relationship to explain any risky health behaviors, including alcohol use.

1.4.2 MEASUREMENT OF BAS AND BIS

The second issue is the measurement of the BAS and BIS. The BAS and BIS were initially assessed by self-report measures that were not directly derived from the model (Quilty & Oakman, 2004; Torrubia, Ávila, Moltó, & Caseras, 2001). Thus, some studies used measures of Eysenck's dimensions of extraversion and neuroticism, and others administered measures of impulsivity and trait anxiety. However, studies of the BAS and BIS have been invigorated after the development of specific measures of Gray's dimensions, the most frequently used being the BIS/BAS Scales developed by Carver and White (1994). This questionnaire is composed of one BIS scale and three BAS scales. The BIS Scale includes items referencing reactions to potentially punishing events. The BAS scale is divided into three subscales: the Drive scale is

composed of items pertaining to the strong pursuit of desired goals; the Fun Seeking scale has items reflecting a desire for new rewards and a willingness to respond to potentially rewarding events; and the Reward Responsiveness scale has items focusing on positive responses to the occurrence or anticipation of reward. Scores on the BIS scale are significantly correlated with measures of anxiety, socialization, negative affectivity, susceptibility to punishment, and temperaments such as harm avoidance and reward dependence. Scores on three scales of the BAS scale are significantly correlated with extraversion, positive affectivity, positive temperament, and happiness (Carver & White, 1994). The BIS/BAS Scales have proven to have good reliability and validity across ages and cultures (Cogswell, Alloy, van Dulmen, & Fresco, 2006; Cooper, Gomez, & Aucote, 2007; Franken, Muris, & Rassin, 2005; Jorm et al., 1999; Leone, Perugini, Bagozzi, Pierro, & Mannetti, 2001; Müller & Wytkowska, 2005; Sava & Sperneac, 2006), and have been used in many studies (e.g., Amodio, Master, Yee, & Taylor, 2008; Mardaga & Hansenne, 2007; Putman, Hermans, & van Honk, 2004; Smits & Boeck, 2006; Sutton & Davidson, 1997).

However, some shortcomings of the BIS/BAS Scales have been raised. Basically, because the BIS/BAS Scales are administered in a paper-and-pencil format, they cannot be free from respondents' attitudinal effects, response biases, and correlations with other measures using the same assessment method. Further, as mentioned before, the BIS/BAS Scales were designed to assess reactions to anticipation of reward or punishment. Therefore, it should reflect dispositional sensitivities of the BAS and BIS at a cognitive level. However, the BIS/BAS Scales focus mainly on the consequences of BAS and BIS activity and not on BAS and BIS activity itself (Leone, Perugini, Bagozzi, Pierro, & Mannetti, 2001; Smits & Boeck, 2006). Thus, the variables that are measured by the BIS/BAS scales may be more affective aspects rather than

cognitive ones of BAS and BIS activity, and thus the high correlations between the BIS/BAS Scales and measures of other variables may be partly artifactual. This argument may be partially supported by a study that reported that scores on the BIS/BAS Scales were more strongly correlated with measures of affectivity than with any physiological marker (e.g., pre-ejection period (PEP), respiratory sinus arrhythmia (RSA); Brenner, Beauchaine, & Sylvers, 2005).

The BIS/BAS Scales have some problems that are related to confusing and troublesome aspects of Gray's model, itself (Torrubia, Ávila, Moltó, & Caseras, 2001). RST did not originally assume the simple relationship between the BAS/BIS and extraversion/neuroticism: Gray located his dimensions of the BAS and BIS at 45° from Eysenck's axes of extraversion and neuroticism (Gray, 1970). Thus, the BAS should be related positively with both extraversion and neuroticism, while the BIS should be associated positively with neuroticism and negatively with extraversion. Even though it was revealed that a smaller rotation, 30°, is more appropriate and, therefore, the BAS should be more related to extraversion than neuroticism and the BIS should be more associated with neuroticism than extraversion (Matthews & Gilliland, 1999b; Pickering, Corr, & Gray, 1999), it would be inappropriate to suggest that the BAS or BIS is exclusively related to extraversion or neuroticism. Rather, the BAS and BIS should be understood as a function of extraversion and neuroticism. A number of studies that administered BAS and BIS measures (e.g., Gray-Wilson Personality Questionnaire: GWPQ) or related measures (e.g., the impulsivity subscale from the Eysenck Personality Inventory (EPI), the trait scale of the State-Trait Anxiety Inventory (STAI)) have shown these patterns of relationships (Caseras, Avila, & Torrubia, 2003; Gomez & Gomez, 2005; Gomez, Gomez, & Cooper, 2002; Jackson, 2003). However, studies examining the psychometrics of the BIS/BAS Scales have generally reported exclusively positive relationships between the BAS and extraversion and between the BIS and

neuroticism, without considering this aspect of Gray's model (Carver & White, 1994; Franken, Muris, & Rassin, 2005; Müller & Wytykowska, 2005). Also, the relationship between the BAS and BIS should be orthogonal, as the relationship between extraversion and neuroticism has been postulated as orthogonal. When they developed the BIS/BAS Scales, Carver and White (1994) noticed that the BAS and BIS should be independent. Even though the behavioral effects of the BAS and BIS are regarded as reciprocally inhibitory, items of BAS and BIS measures should describe exclusive situations including either reward or punishment in order to avoid measuring BAS and BIS sensitivity simultaneously (Pickering, 1997; Torrubia, Ávila, Moltó, & Caseras, 2001). However, the Reward Responsiveness scale of the BIS/BAS Scales has been repeatedly reported to be positively related to the BIS scale or has loaded on the same factor in the same direction with the BIS scale (Franken, Muris, & Rassin, 2005; Heubeck, Wilkinson, & Cologon, 1998; Jorm et al., 1999; Leone, Perugini, Bagozzi, Pierro, & Mannetti, 2001; Müller & Wytykowska, 2005). Related to the issue of BAS and BIS independence, factor analyses of the BIS/BAS Scales have been contradictory, even though it is now pervasively believed that a 4-factor solution is more appropriate for the BIS/BAS Scales than a 2-factor solution. However, although the 4-factor solution has shown a better fit than the 2-factor solution, the fit indices have not been within acceptable ranges (Cogswell, Alloy, van Dulmen, & Fresco, 2006; Heubeck, Wilkinson, & Cologon, 1998; Jorm et al., 1999; Sava & Sperneac, 2006). Moreover, 4 factors for the BAS and BIS are not consistent with Gray's model that assumes 2 factors (Heubeck, Wilkinson, & Cologon, 1998).

The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) was developed to address the problems of the BIS/BAS Scales, and it has proven to satisfy requirements for measuring the BAS and BIS according to Gray's model or concepts (Torrubia,

Ávila, Moltó, & Caseras, 2001). It consists of two scales, the Sensitivity to Punishment and Sensitivity to Reward scales, matching Gray's two systems. However, compared to the BIS/BAS Scales, it was published more recently and the number of researchers who have used it in their studies is thus smaller. Also, factor analytic studies revealed a critical problem of the SPSRQ, demonstrating that two factors explain about 20% of the total variance and the fit indices are not within acceptable ranges (Cogswell, Alloy, van Dulmen, & Fresco, 2006; Save & Sperneac, 2006; Torrubia, Ávila, Moltó, & Caseras, 2001). Moreover, the SPSRQ was originally written in Catalan and thus data on the English version have only initially been examined in English-speaking samples (Cogswell, Alloy, van Dulmen, & Fresco, 2006). Respondents' attitudinal effects and response biases in a paper-and-pencil format may also impact scores on the SPSRQ.

Compensating for these shortcomings of self-report measures such as the BIS/BAS Scales or SPSRQ, frontal EEG asymmetry in the resting condition has been also widely used to measure individual differences in the BAS and BIS. However, it has been suggested that frontal asymmetry should not be consistent as a trait-like measure, but rather varied as an interaction between emotional demands of specific situations and emotion-regulatory abilities (Cacioppo, Priester, & Berntson, 1993; Coan, Allen, & McKnight, 2006; Crost, Pauls, & Wacker, 2008). Therefore, resting EEG asymmetry may not be a good indicator of the BAS and BIS because it does not consider the interaction of individuals and conditions. Also, as mentioned before, frontal EEG asymmetry is not specific to the distinction between the BAS and BIS: this asymmetry also distinguishes extraversion and neuroticism, as well as positive and negative affect (Cacioppo & Gardner, 1999; Coan, Allen, & McKnight, 2006; Hass, Omura, Amin, Constable, & Canli, 2006; Santesso et al., 2008; Sutton & Davidson, 1997). Thus, the relations

between frontal EEG asymmetry and the BAS and BIS distinction may be due to high correlations between the BAS/BIS and other variables such as extraversion/neuroticism.

Recently, several laboratory tasks and naturalistic procedures have been considered to provide empirical measures of RST based on the careful consideration of the theory (Corr & McNaughton, 2008). For example, the Card Arranging Reward Responsivity Objective Task (CARROT) was designed to assess BAS sensitivity by measuring behavioral responses to reward (Powell, Al-Adawi, Morgan, & Greenwood, 1996). It measures psychomotor output, the speed of card-sorting, when a small financial incentive is offered. The Q-task was developed to assess BIS sensitivity by measuring behavioral inhibition induced by punishment (Newman, Wallace, Schmitt, & Arnett, 1997). The development of these tasks was based on studies investigating the activity of the BAS and BIS in relation to response tendencies of response perseveration and passive avoidance learning (Gorenstein & Newman, 1980; Newman & Wallace, 1993; Patterson & Newman, 1993). Perseveration refers to the case that a person tends to present dominant responses repeatedly despite punishment (McCleary, 1966), while passive avoidance learning refers to the case that a person inhibit or withhold responses to avoid possible punishment (Patterson & Newman, 1993). On passive avoidance learning tasks (e.g., Go/No-Go task), participants are generally asked to respond to positive stimuli (e.g., touch a card) and not to respond to negative stimuli (e.g., not touch a card) when positive and negative stimuli are randomly and arbitrarily assigned. Studies have consistently reported that extraverts or neurotic extraverts (individuals with high BAS sensitivity) exhibit more commission errors and less omission errors compared to introverts when both rewards and punishments are presented on passive avoidance learning tasks (Avila, Moltó, Segarra, & Torrubia, 1995; Gomez & McLaren, 1997; Nichols & Newman, 1986; Patterson, Kosson, & Newman, 1987). Further, extraverts

exhibit faster responses when they are exposed to the availability to immediate rewards (Nichols & Newman, 1986; Patterson, Kosson, & Newman, 1987). Authors have concluded that the BAS is more active than the BIS when rewards are present and thus disinhibition is based on the overactivity of the BAS (Avila, Moltó, Segarra, & Torrubia, 1995; Gomez & McLaren, 1997). On the contrary, studies examining the BIS in relation to response disinhibition have reported fewer commission errors on passive avoidance tasks in individuals with high anxiety (Geen, 1987; Hagopian & Ollendick, 1994), and less total responses and commission errors in the group exposed to the punishment condition (Gomez & McLaren, 1997). Overall, based on Gray's theory, it can be argued that reward cues activate the BAS and more disinhibitory responses; while punishment cues activate the BIS and more inhibitory responses (Gomez & McLaren, 1997).

However, there are problems using these experimental assays to assess BAS and BIS sensitivity. For example, there are few studies that have investigated the psychometric properties of these tasks. Especially, studies using the paradigm of passive avoidance learning have focused on the activity of the BAS, and thus the characteristics and nature of the BIS in relation to passive avoidance tasks are not revealed as much as the BAS. Also, because a single task does not assess BAS and BIS sensitivity simultaneously and does not share the indicators of BAS and BIS sensitivity with the other task (i.e., CARROT vs. Q-task), it is difficult to perform a direct comparison between BAS and BIS sensitivity with one task. Further, more recent studies administering laboratory tasks have reported inconsistent correlations between task performance and BAS/BIS sensitivity that is measured by self-report questionnaires (i.e., SPSRQ), and no significant differences in task performance between BAS- and BIS-dominant groups (Kambouropoulos & Staiger, 2004b; 2007).

At present, none of the scales or measures constitutes a sound method to assess BAS and BIS sensitivity in terms of both psychometrics (e.g., factor analysis) and theoretical structure of RST (e.g., independence of the BAS and BIS) (Torrubia, Ávila, & Caseras, 2008). Thus, it is difficult to demonstrate that scales developed specifically to evaluate the BAS and BIS have better predictive capability than other scales developed to assess the related variables such as impulsivity/anxiety and extraversion/neuroticism. Torrubia, Ávila, and Caseras (2008) recommended the simultaneous use of scales meant to evaluate the BAS and BIS together with anxiety, impulsivity, extraversion, and neuroticism scales in future studies. However, as they pointed out, it should be considered in the assessment that the BAS and BIS are not constructs matching impulsivity and anxiety, respectively, or extraversion and neuroticism, respectively, which are much broader concepts than the BAS and BIS. Some laboratory tasks based on response perseveration and passive avoidance task paradigms seem promising to assess the BAS/BIS, carefully considering the theory of RST. However, studies using these tasks are not yet sufficient, especially studies directly applying the BAS/BIS concept or considering individual differences in BAS and BIS sensitivity.

1.5 AIMS OF THE STUDY

The aim of this study was to test the relationships among the BAS/BIS, life-events, affect, and alcohol use in college students. For this, two studies were performed. Some researchers have identified methodological limitations in research about alcohol use. For example, the use of self-reported recall of past affective processing and drinking situations may involve memory bias or response bias (Armeli, Todd, & Mohr, 2005; Schiffman, 2000). Also, some authors have questioned the use of between-person or long-term longitudinal designs that are not sensitive to daily or short-term variation in alcohol use (Armeli, Todd, & Mohr, 2005;

Park, Armeli, & Tennen, 2003; Tennen, Affleck, Armeli, & Carney, 2000). Actually, the relationships among alcohol use and related psychological variables were different when between-person comparisons were used, compared to when within-person comparisons was examined (Armeli, Todd, & Mohr, 2005; Park, Armeli, & Tennen, 2003). However, considering that, in some cases, positive and negative affect may not have an immediate effect on alcohol use due to social and physical constraints, the long-term pattern of alcohol use and relationship with relatively stable affective pattern or emotionality that is predictable by personality factors should be meaningful. Thus, this study tested both the long-term and short-term relationships among the BAS/BIS, life events, affect, and alcohol use in college students, considering both between-group and within-group variations in alcohol use.

Also, in this study other health behaviors such as smoking, eating, and exercising were included. Those investigating the relationship between risky health behaviors and related variables such as personality and affect have hypothesized that individuals engage in risky health behaviors such as alcohol use to get involved in positive events or regulate negative affect. However, studies have overlooked the possibility that one engages in only one risky health behavior intensively (e.g., smoking, but not drinking) or a number of risky health behaviors alternatively (e.g., drinking sometimes, but smoking at other times). Also, the motivational model or alternative models have focused on risky health behaviors, but have not demonstrated specificity of effects; it remains unknown whether results would generalize to other health behaviors such as eating and exercising. Thus, in this study, the relationships among the BAS/BIS, life events, affect, and other health behaviors were tested in an exploratory manner to examine the applicability of the model to explain other health behaviors.

In Study 1, the BAS/BIS, life events, affect, and alcohol use (e.g., frequency of alcohol use, alcohol-related problems) were assessed by self-report measures in order to test a long-term relationship between RST and alcohol-related outcomes in everyday life situations. Thus, while Study 1 used a correlational design, it lent ecological validity by inquiring about actual drinking behaviors and consequence. In order to test whether the RST effects were specific to alcohol use or general to other health behaviors, smoking, healthy eating, and exercising were also assessed. Based on the previous studies, the results are hypothesized as following:

Hypothesis 1a. BAS factor scores assessed by the BIS/BAS Scales and the SPSRQ are positively related to scores from measures of positive events and positive affect.

Hypothesis 1b. BIS factor scores assessed by the BIS/BAS Scales and the SPSRQ are positively related to scores from measures of negative events and negative affect.

Hypothesis 2a. BAS factor scores are positively related to scores from measures of positive drinking motives (i.e., enhancement and social motives). BIS factor scores are positively related to scores from measures of negative drinking motives (i.e., coping and conformity motives).

Hypothesis 2b. Both BAS and BIS factor scores are related to scores from measures of alcohol outcomes (e.g., frequency of alcohol use, alcohol-related negative consequences).

Hypothesis 2c. Both BAS and BIS factor scores are related to scores from measures of smoking, healthy eating, and exercising.

Hypothesis 3a. In the path model for alcohol use, the paths from BAS factor scores to alcohol outcomes (e.g., frequency of alcohol use, alcohol-related negative consequences) are significant. The paths from BIS factor scores interacting with scores from the measure of negative events to alcohol outcomes via the measure of negative affect are significant.

Hypothesis 3b. In the path model for smoking, healthy eating, and exercising, the paths from BAS factor scores to health behaviors are significant. The paths from BIS factor scores interacting with scores from the measure of negative events to health behaviors via the measure of negative affect are significant.

Study 2 was designed to test whether the long-term relationship hypothesized in Study 1 is applicable and useful to predict a short-term alcohol outcome, focusing more on the function of reinforcement sensitivity in alcohol use in an experimental context. Urge to drink indicates craving for alcohol, known to be closely related to actual drinking behaviors (Kamouropoulos & Staiger, 2001; 2004a). Urge to drink, instead of past alcohol use, was included to catch the short-term changes in craving for alcohol in Study 2. Urge to drink has been frequently used in cue reactivity paradigms of alcohol studies, and it is considered a basic feature of heavy drinkers and problematic drinkers (Ooteman, Koeter, Vserheul, Schippers, & van den Brink, 2006; Robinson & Berridge, 1993). In Study 2, BAS- and BIS-dominant groups of alcohol users were selected, and half of each group was randomly assigned to a reward or punishment task (i.e., reward-only Go/No-Go task, punishment-only Go/No-Go task). Before and after the task, participants were asked to complete affect and urge to drink measures. Thus, Study 2 was an experimental study, permitting causal inferences regarding the relationships between behavioral contingencies and alcohol outcomes in BAS- and BIS-dominant groups. In order to test whether

this relationship is specific to alcohol use or general to other health behaviors, other health behaviors such as smoking, unhealthy eating, and exercising (e.g., health behavior urges) were assessed after the task. Based on the previous studies, the results are hypothesized as following:

Hypothesis 4a. The BAS-dominant subgroup assigned to the reward-only Go/No-Go task shows more responses and commission errors on the task than other subgroups (e.g., the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task).

Hypothesis 4b. The BIS-dominant subgroup assigned to the punishment-only Go/No-Go task shows less responses and more omission errors on the task than other subgroups (e.g., the BIS-dominant subgroup assigned to the punishment-only Go/No-Go task).

Hypothesis 5a. The BAS-dominant subgroup assigned to the reward-only Go/No-Go task shows a greater increase in scores from the measure of positive affect after the task than other subgroups (e.g., the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task).

Hypothesis 5b. The BIS-dominant subgroup assigned to the punishment-only Go/No-Go task shows a greater increase in scores from the measure of negative affect after the task than other subgroups (e.g., the BIS-dominant subgroup assigned to the reward-only Go/No-Go task).

Hypothesis 6a. The BAS-dominant subgroup assigned to the reward-only Go/No-Go task shows a greater increase in scores from the measure of alcohol outcomes (e.g., urge to drink) after the task than other subgroups (e.g., the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task). This increase is not specific to scores from the measure of alcohol outcomes to enhance positive affect.

Hypothesis 6b. The BIS-dominant subgroup assigned to the punishment-only Go/No-Go task shows a greater increase in scores from the measure of alcohol outcomes than other subgroups (e.g., the BIS-dominant subgroup assigned to the reward-only Go/No-Go task). This increase is specific to scores from the measure of alcohol outcomes to regulate negative affect.

Hypothesis 7a. The same pattern of differences in smoking, unhealthy eating, and exercising urges after the Go/No-Go task as in alcohol outcomes is present among the BAS- and BIS-dominant subgroups assigned to the reward- and punishment-only Go/No-Go task. In other words, the BAS-dominant subgroup assigned to the reward-only Go/No-Go task shows higher smoking and unhealthy eating urges, and lower exercising urges after the task than other subgroups (e.g., the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task). This is not explained by urges to smoke, eat, and exercise to enhance positive affect.

Hypothesis 7b. The BIS-dominant subgroup assigned to the punishment-only Go/No-Go task shows higher smoking and unhealthy eating urges, and lower exercising urges after the task than other subgroups (e.g., the BIS-dominant subgroup assigned to the reward-only Go/No-Go task). This is explained by urges to smoke, eat, and exercise to regulate negative affect.

Chapter 2: Reinforcement Sensitivity, Life Events, Affect, and Alcohol Use in Everyday Life

Method

2.1 PARTICIPANTS

Three hundred seventeen college students from the University of Texas at El Paso were recruited to test a global relationship between BAS/BIS, life-events, affect, and alcohol use (e.g., frequency of alcohol use, alcohol-related negative problems). Participants who were not proficient in English were excluded from the study. Respondents who did not report alcohol use in the previous 6 months were also excluded from the study. Participation in the study was rewarded with research credit for psychology class at the University of Texas at El Paso.

The mean age of the participants was 19.7 ($SD = 2.35$) years (ranged from 17 years to 30 years). Sixty-one percent of the participants were females and 88 percent of the participants were Hispanics. Approximately 53 percent of the participants were freshmen and 28 percent were sophomores.

The number of participants for Study 1 ($N = 317$) was sufficient to support the main statistical technique for Study 1, path analysis, which is usually conducted by Structural Equation Modeling (SEM). Because there is little consensus on the recommended sample size for SEM, various recommendations were considered. Based on the path models in this study that included 5 measured variables and 16 free parameters, a recommended sample size of 80 students was estimated using 5 cases per estimated parameter (Bentler & Chou, 1987). Also, a recommended sample size of 75 was estimated using 15 cases per measured variable (Stevens, 2002). Even considering the most conservative rule of thumb on critical sample size for SEM, a

sample size of 200 would suffice for the proposed analyses (Garver & Mentzer, 1999; Hoe, 2008; Hoelter, 1983; Loehlin, 1992).

2.2 MEASURES

Demographic Survey (see Appendix A): A brief demographic survey was used to assess each participant's gender, age, ethnicity, and academic level (freshman, sophomore, etc.).

BIS/BAS Scales (Carver & White, 1994; see Appendix B): The BIS/BAS scale is a 20-item inventory designed to assess the sensitivity of Gray's BAS and BIS. Respondents were asked to endorse items on a 4-point Likert-type scale ranging from 1 (strongly agree) to 4 (strongly disagree). The BIS/BAS Scales comprise 4 subscales: one for the BIS (BIS; 7 items) and three for the BAS (Reward Responsiveness (RR; 5 items), Drive (D; 4 items), and Fun Seeking (FS; 4 items)).

In the original study, alpha coefficients ranged from .66 to .74 across subscales, and test-retest reliability values with an 8-week interval ranged from $r = .59$ to .69 across subscales. In this study, alpha coefficients were .69 for BIS, .59 for RR, .69 for D, and .67 for FS. In the original study, the three subscales for the BAS were significantly related to the Extraversion scale ($r = .39$ to .59); they were significantly associated with Positive Affect from the Positive and Negative Affect Schedule (PANAS; $r = .19$ to .31), but not with Negative Affect from the PANAS; and FS was positively correlated with Novelty Seeking from the Tridimensional Personality Questionnaire (TPQ; $r = .51$) and negatively correlated with Harm Avoidance from the TPQ ($r = -.27$). The BIS subscale was significantly related to the Susceptibility to Punishment scale ($r = .59$); it was significantly associated with Negative Affect from the PANAS ($r = .42$), but not with Positive Affect from the PANAS; and it was significantly correlated with Harm Avoidance from the TPQ ($r = .59$), but not with Novelty Seeking from the TPQ.

Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ: Torrubia, Ávila, Moltó, & Caseras, 2001; see Appendix C): The SPSRQ is a 48-item inventory designed to assess the BAS and BIS functioning. Respondents were asked to respond to items in a yes-no format. The SPSRQ comprises 2 subscales: Sensitivity to Punishment (SP; 24 items) and Sensitivity to Reward (SR; 24 items).

In the original study, alpha coefficients were .83 for SP and .78 for SR, and test-retest reliability values with a 3-month interval were $r = .89$ for SP and $.87$ for SR. In this study, alpha coefficients were .82 for SP and .72 for SR. In the original study, SP was positively correlated to Neuroticism from the Eysenck Personality Questionnaire (EPQ; $r = .62$) and negatively related to Extraversion from the EPQ ($r = .62$). SR was positively correlated to Extraversion and Neuroticism from the EPQ ($r = .41$ and $.33$) and the Impulsiveness Scale ($r = .41$).

Daily Event Survey (DES; Butler, Hokanson, & Flynn, 1994; see Appendix D): The DES is a 57-item inventory designed to assess positive and negative life-events. The scores of the DES are typically derived from Frequency and Importance ratings. Only Frequency ratings were used in this study, which focuses on the experiences of positive and negative events for the last 6 months. Respondents were asked to endorse items on a 4-point Likert-type scale ranging from 1 (rarely/never) to 4 (extremely frequently). In this study, two subscales were used: Positive Events (PE; 27 items), including positive social events, positive achievement events, and other positive events, and Negative Events (NE; 26 items), including negative social events, negative achievement events, and other negative events.

In the original study, alpha coefficients for Frequency were .60 for PE and .56 for NE. In this study, alpha coefficients were .86 for PE and .84 for NE. In a related study (Nezlek & Gable,

2001), PE was positively correlated with PA from the PANAS ($r = .44$). NE was positively correlated with NA from the PANAS ($r = .47$).

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988; see Appendix E): The PANAS is a 20-item inventory designed to assess positive and negative affect. The PANAS with “in general” (rather than “state”) instructions was included in this study. Respondents were asked to endorse items on a 5-point Likert-type scale ranging 1 (very slightly or not at all) to 5 (extremely). The PANAS comprises 2 subscales: Positive Affect (PA; 10 items) and Negative Affect (NA; 10 items).

In the original study, alpha coefficients were .88 for PA and .87 for NA, and test-retest reliability values with an 8-week interval were $r = .68$ for PA and $r = .71$ for NA. In this study, alpha coefficients were .85 for PA and .83 for NA. In the original study, NA was positively correlated with the Hopkins Symptom Checklist (HSCL; $r = .65$ and $.74$), Beck Depression Inventory (BDI; $r = .56$ and $.58$), and State scale from the State-Trait Anxiety Inventory (STAI-S; $r = .51$). PA was negatively correlated with the HSCL ($r = -.19$ and $-.29$), BDI ($r = -.35$ and $-.36$), and STAI-S ($r = -.35$).

Drinking Motives Questionnaire (DMQ; Cooper, 1994; see Appendix F): The DMQ is a 20-item inventory designed to assess drinking motives. Respondents were asked to endorse items on a 5-point Likert-type scale ranging 1 (never/almost never) to 5 (almost always/always). The DMQ comprises 4 subscales: Enhancement Motives (5 items), Coping Motives (5 items), Social Motives (5 items), and Conformity Motives (5 items).

In the original study, alpha coefficients were ranged from .84 to .88 across subscales. In this study, alpha coefficients were .89 for Enhancement Motives, .82 for Coping Motives, .87 for Social Motives, and .81 for Conformity Motives. In the original study, Enhancement, Coping,

and Social Motives were positively correlated with the usual quantity and frequency of alcohol use in the previous 6 months ($r = .25$ and $.29$, $.15$ and $.17$, and $.08$ and $.10$, respectively).

Conformity Motives were negatively correlated with the usual quantity and frequency of alcohol use in the previous 6 months ($r = -.06$ and $-.08$).

Frequency of Heavy Drinking (Cooper, 1994; see Appendix G): The Frequency of Heavy Drinking is a 2-item inventory designed to assess heavy drinking: frequency of drinking five or more drinks and frequency of drinking to intoxication. Respondents were asked to respond to items on a 9-point Likert-type scale ranging from 1 (never) to 9 (5 times a week or more). In this study, a question that asks the number of drinks on a typical day in the previous 6 months was added, and respondents who did not drink were asked to skip this inventory.

In the original study, the alpha coefficient was $.87$. In this study, the alpha coefficient was $.80$.

Short Michigan Alcoholism Screening Test (SMAST; Selzer, Vinokur, & van Rooijen, 1975; see Appendix H): The SMAST is a 13-item inventory designed to assess drinking problems. Respondents were asked to respond to items in a yes-no format.

In the original study, the alpha coefficient was $.76$. In this study, the alpha coefficient was $.47$.

Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991; see Appendix I): The FTND is a 6-item inventory designed to assess the nicotine dependence for adult and adolescent smokers. Respondents were asked to endorse items which have different options, ranging from two to four options according to items. In this study, a question that asks the average number of cigarette a day in the previous 6 months was added, and respondents who did not smoke were asked to skip this inventory.

In a related study (Etter, Vu Duc, & Perneger, 1999), the alpha coefficient was .70, and the test-retest reliability value with a 7-month interval was $r = .85$. In this study, the alpha coefficient was .64.

Healthstyle (Bobroff, 2006; see Appendix J): The Healthstyle is a 23-item inventory designed to assess health behaviors. The Healthstyle covers 6 health behaviors including Cigarette Smoking, Alcohol and Drugs, Eating Habits, Exercise/Fitness, Stress Control, and Safety, but only the 4-item Eating Habits and 3-item Exercise/Fitness subscales were used in this study. Respondents were asked to endorse items on a 3-point Likert-type scale ranging from 1 (almost always) to 3 (almost never).

In this study, alpha coefficients were .67 for Eating Habits and .67 for Exercise/Fitness.

2.3 PROCEDURES

The participants for Study 1 were recruited through the Experimetrix online experiment scheduling system (www.experimetrix.com). The investigator described the purpose, time, place, and reward associated with this research on Experimetrix, and set up a schedule for students' participation. Students who needed research credits and were interested in this research signed up for a time slot in the schedule at their convenience. The students who were not proficient in English and did not have any alcohol use in the previous 6 months were discouraged from participating in this study by a clear statement of the exclusion criteria in the description of this research. Participation was available for a maximum of four students every hour from 10 a.m. to 3 p.m. from Monday to Friday. Study 1 was performed from late September, 2009, to early March, 2010.

When the students arrived at the time for which they signed up, they were guided to a large, quiet experimental room. They were advised to sit apart from other students so as not to

interrupt other students' performances. Before questionnaires for Study 1 were administered, all participants were asked to read and sign the written informed consent form. Then, the participants were requested to complete the Demographic Survey, BIS/BAS Scales, SPSRQ, DES, PANAS, DMQ, Frequency of Heavy Drinking, SMAST, FTND, and HealthStyle in that order. When they completed questionnaires, the investigator checked for any missing items and asked participants to complete them. At the end of the study, the investigator debriefed the participants. It took approximately 30 minutes to complete Study 1.

2.4 DATA ANALYSIS

Three hundred ninety-seven students participated in Study 1, but the data from 75 students were excluded in data analyses due to several reasons, mainly the exclusion criterion of no alcohol use in the previous 6 months. Thus, only data from 314 college students were used in data analyses.

To obtain the factor scores for the BAS and BIS, factor analysis was performed for subscales of the BIS/BAS Scales and the SPSRQ. Factor weights of each subscale on the BAS and BIS were used to calculate the factor scores for the BAS and BIS.

To test the relationships among the BAS/BIS, life events, and affect, correlations among the factor scores of the BAS/BIS, PE and NE from the DES, and PA and NE from the PANAS were calculated. It was expected that BAS factor scores would be positively related to PE from the DES and PA from the PANAS, while BIS factor scores would be positively related to NE from the DES and NA from the PANAS.

To test the relationships among the BAS/BIS, drinking motives, and alcohol use, correlations were computed among the factor scores of the BAS/BIS, Enhancement, Coping, Social, and Conformity Motives from the DMS, the Frequency of Heavy Drinking, and the

SMAST. It was expected that BAS factor scores would be positively related to Enhancement and Social Motives from the DMS, while BIS factor scores would be positively related to Coping and Conformity Motives from the DMS. Also, it was expected that both BAS and BIS factor scores would be positively related to the Frequency of Heavy Drinking and the SMAST. To test the relationships between the BAS/BIS and other health behaviors, correlations were computed among the factor scores of the BAS/BIS and the FTND, Eating Habits from the Healthstyle, and Exercise/Fitness from the Healthstyle. It was expected that BAS factor scores would be positively related to the FTND and Eating Habits from the Healthstyle, and negatively related to Exercise/Fitness from the Healthstyle.

Path analysis was performed to test the global relationships among the BAS/BIS, life events, affect, and alcohol outcomes (e.g., frequency of alcohol use, alcohol-related problems) by Structural Equation Modeling (SEM). In the path model, the BAS factor score predicted the Frequency of Heavy Drinking and SMAST, while the BIS factor score interacting with NE from the DES predicted the Frequency of Heavy Drinking and SMAST via NA from the PANAS (Figure 1). It was expected that paths from the BAS to the Frequency of Heavy Drinking and SMAST, the path from the interaction term of the BIS factor scores and NE from the DES to NA from the PANAS, and paths from NA from the PANAS to the Frequency of Heavy Drinking and SMAST would be significant. To test the applicability of the path model to other health behaviors, path models in which FTND, Eating Habits from the Healthstyle, or Exercise/Fitness from the Healthstyle, instead of the Frequency of Heavy Drinking and the SMAST, was included were explored.

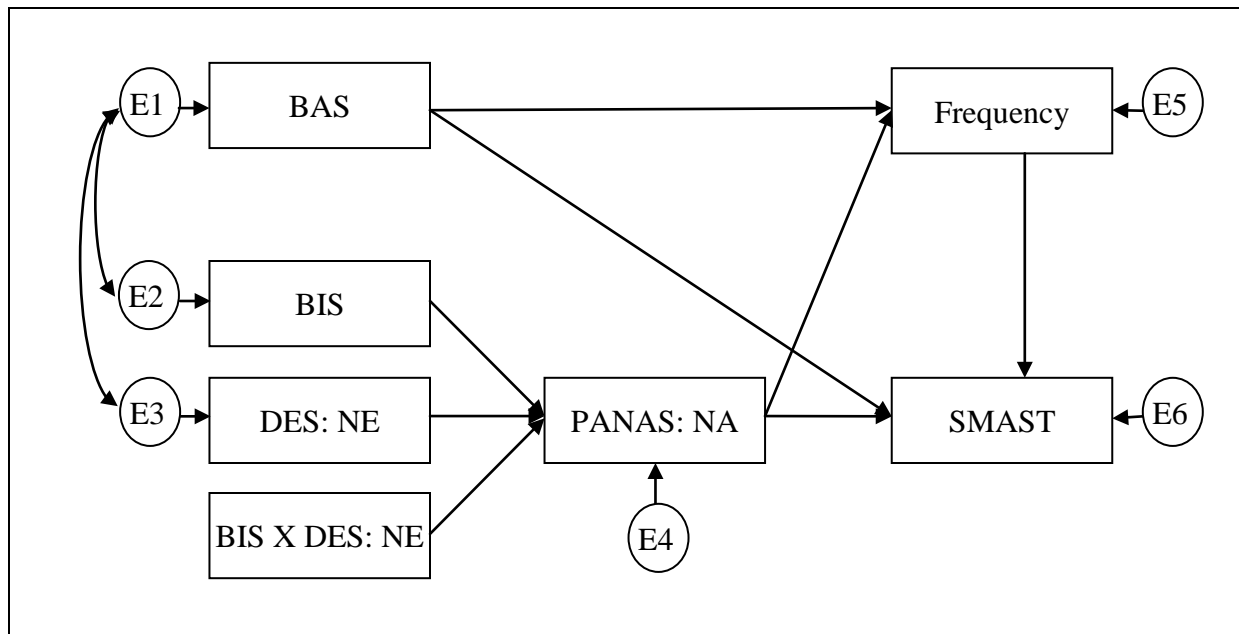


Figure 1: Path Model of BAS and BIS-Related Variables for Alcohol Outcomes

Chapter 3: Reinforcement Sensitivity, Life Events, Affect, and Alcohol Use in Everyday Life

Results

3.1 THE BAS AND BIS FACTOR SCORES

According to the recommendation of Torrubia, Ávila, and Caseras (2008) regarding the assessment of BAS and BIS sensitivity, BAS and BIS factor scores were used in the subsequent analyses. First, the propriety was tested of using BAS subscales from the BIS/BAS Scales (RR, D, and FS) and the SPSRQ (SR) for BAS factor scores and BIS subscales from the BIS/BAS Scales (BIS) and the SPSRQ (SP) for BIS factor scores, based on previous factor analysis studies (Elliot & Thrash, 2002; Smillie & Jackson, 2006; Zelenski & Larsen, 1999). A confirmatory factor analysis (CFA) was performed using AMOS 5.0 (Arbuckle, 2003). In the model, four BAS-related subscales from the BIS/BAS scales and the SPSRQ were loaded to one endogenous variable, BAS, while two BIS-related subscales from the BIS/BAS scales and the SPSRQ were loaded to the other endogenous variable, BIS. Based on Hu and Bentler's criteria (1999), goodness-of-fit indices for the model showed that the model was not acceptable ($\chi^2 = 50.62$, $df = 8$; $\chi^2/df = 6.327$; CFI = .882; NNFI = .778; RMSEA = .130 (.097 - .165); and SRMR = .072).

Considering the non-significant result of the confirmatory factor analysis and the problems in subscales of the BIS/BAS Scales and the SPSRQ (e.g., significant positive correlations between RR and BIS from the BIS/BAS Scales; Heubeck, Wilkinson, & Cologon, 1998; Jorm et al., 1999), the following formulas for BAS and BIS factor scores in which all subscales of the two scales were reflected were extracted.

BAS Factor Score = (.047*BIS/BAS Scales: Reward Responsiveness) + (.111*BIS/BAS Scales: Drive) + (.120*BIS/BAS Scales: Fun Seeking) + (.047*SPSRQ: Sensitivity to Reward) + (.003*BIS/BAS Scales: BIS) + (-.008*SPSRQ: Sensitivity to Punishment)

BIS Factor Score = (-.165*BIS/BAS Scales: BIS) + (.426*SPSRQ: Sensitivity to Punishment) + (.011*BIS/BAS Scales: Reward Responsiveness) + (.026*BIS/BAS Scales: Drive) + (.029*BIS/BAS Scales: Fun Seeking) + (.011*SPSRQ: Sensitivity to Reward)

The correlations among BAS/BIS factor scores and subscales of the BIS/BAS Scales (RR, D, FS, and BIS) and the SPSRQ (SR and SP) were assessed. The results are presented in Table 1. In sum, BAS factor scores were positively and significantly correlated with BAS-related subscales. Likewise, BIS factor scores were positively and significantly correlated with BIS-related subscales.

Table 1. Correlations among BIS/BAS Scales, SPSRQ, and BAS/BIS Factor Scores.

	2	3	4	5	6	7	8
1. BIS/BAS: RR	.33**	.26**	.28**	.21**	.11	.45**	.07
2. BIS/BAS: D		.47**	-.10	.41**	-.19**	.80**	-.13**
3. BIS/BAS: FS			-.10	.47**	-.14*	.83**	-.06
4. BIS/BAS: BIS				-.01	.53**	-.07	.30**
5. SPSRQ: SR					-.09	.73**	-.05
6. SPSRQ: SP						-.21**	.97**
7. BAS Factor							-.15**
8. BIS Factor							

Note. BIS/BAS: RR=BIS/BAS Scales: Reward Responsiveness; BIS/BAS: D=BIS/BAS: Drive; BIS/BAS: FS=BIS/BAS Scales: Fun Seeking; BIS/BAS: BIS=BIS/BAS Scales: BIS; SPSRQ: SR=Sensitivity to Punishment and Sensitivity to Reward Questionnaire: Sensitivity to Reward; SPSRQ: SP=Sensitivity to Punishment and Sensitivity to Reward Questionnaire: Sensitivity to Punishment

** $p < .01$; * $p < .05$

3.2 RELATIONSHIPS AMONG LIFE EVENTS, AFFECT, DRINKING MOTIVES, AND ALCOHOL USE

The average scores and interquartile ranges of scores on the measures that were used in Study 1 are presented in Table 2. Before the main data analyses were performed, the correlations among the DES, the PANAS, and the DMQ were assessed to examine the relationships of drinking motives with life events and affect and explore the predictive utility of motives in the motivational model of drinking. The results are presented in Table 3. In sum, Enhancement Motives from the DMQ were significantly correlated with PE from the DES ($r = .15, p < .01$), but not with PA from the PANAS ($r = .07, p = ns$). Coping Motives from the DMQ were significantly correlated with both NE from the DES and NA from the PANAS ($r = .15$ and $.30, ps < .01$).

The correlations among the DES, the PANAS, the DMQ, the Frequency of Heavy Drinking, and the SMAST were assessed to replicate findings from previous studies investigating the relationships of drinking motives with life events and affect. The results are presented in Table 4. In sum, the DES and the PANAS were not significantly correlated with any measure of alcohol use. The exception was the significant correlation between NE from the DES and the SMAST ($r = .15, p < .01$). Enhancement Motives from the DMQ were significantly correlated with measures of heavy drinking ($r = .39$ to $.47, ps < .01$), but not with the SMAST ($r = -.01, p = ns$). Coping Motives from the DMQ were significantly correlated with measures of both heavy drinking ($r = .20$ to $.34, ps < .01$) and the SMAST ($r = .11, p < .05$).

Table 2. Means and Interquartile Ranges of Scores on Measures

Measures		<i>M</i>	<i>SD</i>	Interquartile Range	
				25%	75%
BIS/BAS Scales	Reward Responsiveness	17.97	1.77	17.00	19.00
	Drive	11.64	2.09	10.00	13.00
	Fun Seeking	12.22	2.20	11.00	14.00
	BIS	20.79	3.45	18.00	23.00
Sensitivity to Punishment and Sensitivity to Reward Questionnaire	Sensitivity to Reward	13.30	3.97	11.00	16.00
	Sensitivity to Punishment	11.35	5.06	8.00	15.00
Daily Event Survey	Positive Events	72.50	10.74	65.00	80.00
	Negative Events	53.39	10.04	47.00	59.00
Positive and Negative Affect Schedule	Positive Affect	37.15	6.38	33.00	42.00
	Negative Affect	22.74	6.91	17.00	26.00
Drinking Motives Questionnaire	Enhancement Motives	12.70	5.50	8.00	17.00
	Coping Motives	9.50	4.35	6.00	12.00
	Social Motives	15.36	5.23	11.00	20.00
	Conformity Motives	7.28	3.16	5.00	8.00
Frequency of Heavy Drinking	Frequency	4.47	3.29	2.00	6.00
	5 or More	3.84	2.40	2.00	6.00
	Drunk	2.99	2.10	1.00	5.00
Short Michigan Alcoholism Screening Test		1.41	1.56	0.00	2.00
Fagerström Test for Nicotine Dependence		1.91	1.63	1.00	2.00
Healthstyle	Eating Habits	4.78	2.74	3.00	7.00
	Exercise/Fitness	4.36	2.50	2.00	6.00

Note. Frequency: The number of drinks imbibed on a typical day; 5 or More = The frequency of having 5 or more drinks on a single day (1=Never to 9=5 times a week or more); Drunk = The frequency of drinking enough to get drunk or very high (1=Never to 9=5 times a week or more)

Table 3. Correlations among DES, PANAS, and DMQ

	DMQ: ENH	DMQ: COP	DMQ: SOC	DMQ: CON
DES: PE	.15**	-.11*	.26**	.05
DES: NE	.04	.15**	.06	.14*
PANAS: PA	.07	-.19**	.10	-.06
PANAS: NA	-.02	.30**	-.02	.15**

Note. DES: PE=Daily Event Survey: Positive Events; DES: NE=Daily Event Survey: Negative Events; PANAS: PA=Positive and Negative Affect Schedule: Positive Affect; PANAS: NA=Positive and Negative Affect Schedule: Negative Affect; DMQ: ENH=Drinking Motives Questionnaire: Enhancement Motives; DMQ: COP= Drinking Motives Questionnaire: Coping Motives; DMQ: SOC= Drinking Motives Questionnaire: Social Motives; DMQ: CON= Drinking Motives Questionnaire: Conformity Motives

** $p < .01$; * $p < .05$

Table 4. Correlations among DES, PANAS, DMQ, and Alcohol Outcomes

	Frequency	5 or More	Drunk	SMAST
DES: PE	.06	-.03	-.01	-.03
DES: NE	.04	-.02	.01	.15**
PANAS: PA	.03	-.07	-.07	-.05
PANAS: NA	-.09	-.09	-.07	.10
DMQ: ENH	.39**	.47**	.42**	-.01
DMQ: COP	.20**	.34**	.33**	.11*
DMQ: SOC	.33**	.39**	.33**	.01
DMQ: CON	.01	.09	.10	.15**

Note. DES: PE=Daily Event Survey: Positive Events; DES: NE=Daily Event Survey: Negative Events; PANAS: PA=Positive and Negative Affect Schedule: Positive Affect; PANAS: NA=Positive and Negative Affect Schedule: Negative Affect; DMQ: ENH=Drinking Motives Questionnaire: Enhancement Motives; DMQ: COP= Drinking Motives Questionnaire: Coping Motives; DMQ: SOC= Drinking Motives Questionnaire: Social Motives; DMQ: CON= Drinking Motives Questionnaire: Conformity Motives; Frequency=Frequency of Heavy Drinking: The number of drinks imbibed on a typical day; 5 or More= Frequency of Heavy Drinking: The frequency of having 5 or more drinks on a single day; Drunk= Frequency of Heavy Drinking: The frequency of drinking enough to get drunk or very high; SMAST=Short Michigan Alcoholism Screening Test

** $p < .01$; * $p < .05$

3.3 RELATIONSHIPS AMONG THE BAS/BIS, LIFE EVENTS, AND AFFECT (HYPOTHESIS 1)

The correlations among the BAS/BIS factor scores, the DES, and the PANAS were assessed to replicate findings from previous studies investigating the relationships of BAS/BIS sensitivity with life events and affect. The results are presented in Table 5. In sum, BAS factor scores were significantly correlated with PE from the DES and PA from the PANAS ($r = .27$ and $.24, ps < .01$). Likewise, BIS factor scores were significantly correlated with NE from the DES and NA from the PANAS ($r = .36$ and $.40, ps < .01$).

Table 5. Correlations among BAS/BIS Factor, DES, and PANAS

	DES: PE	DES: NE	PANAS: PA	PANAS: NA
BAS Factor	.27**	.09	.24**	.05
BIS Factor	-.26**	.36**	-.35**	.40**

Note. DES: PE=Daily Event Survey: Positive Events; DES: NE=Daily Event Survey: Negative Events; PANAS: PA=Positive and Negative Affect Schedule: Positive Affect; PANAS: NA=Positive and Negative Affect Schedule: Negative Affect

** $p < .01$; * $p < .05$

3.4 RELATIONSHIPS AMONG THE BAS/BIS, DRINKING MOTIVES, AND ALCOHOL USE

(HYPOTHESIS 2)

The correlations among the BAS/BIS factor scores, the DMQ, the Frequency of Heavy Drinking, and the SMAST were assessed to examine the relationships of BAS/BIS sensitivity with drinking motives and alcohol use. The results are presented in Table 6. In sum, BAS factor scores were significantly correlated with both Enhancement Motives and Coping Motives from the DMQ ($r = .29$ and $.19$, $p < .01$), while BIS factor scores were significantly correlated with Coping Motives from the DMQ ($r = .22$, $p < .01$). BAS factor scores were significantly correlated with measures of heavy drinking ($r = .11$ to $.22$, $ps < .05$), but not with the SMAST ($r = .01$, $p = ns$). BIS factor scores was significantly and negatively correlated with only one of the measures of heavy drinking (the item tapping the frequency of having 5 or more drinks on a single day from the Frequency of Heavy Drinking; $r = -.14$, $p < .05$), but positively with the SMAST ($r = .16$, $p < .01$).

The correlations among the BAS/BIS factor scores, the FTND, Eating Habits from the Healthstyle, and Exercise/Fitness from the Healthstyle were assessed to examine the relationships of BAS/BIS sensitivity with other health behaviors such as smoking, healthy eating, and exercising. The results are presented in Table 7. In sum, BAS factor scores were

significantly correlated with Exercise/Fitness from the Healthstyle ($r = .19, p < .01$), while BIS factor scores were significantly correlated with the FTND ($r = .24, p < .05$).

Table 6. Correlations among BAS/BIS Factor, DMQ, and Alcohol Outcomes

	DMQ: ENH	DMQ: COP	DMQ: SOC	DMQ: CON	Frequ- ency	5 or More	Drunk	SMAST
BAS Factor	.29**	.19**	.25**	.13*	.11*	.22**	.19**	.01
BIS Factor	-.07	.22**	.01	.26**	-.10	-.14*	.03	.16**

Note. DMQ: ENH=Drinking Motives Questionnaire: Enhancement Motives; DMQ: COP= Drinking Motives Questionnaire: Coping Motives; DMQ: SOC= Drinking Motives Questionnaire: Social Motives; DMQ: CON= Drinking Motives Questionnaire: Conformity Motives; Frequency=Frequency of Heavy Drinking: The number of drinks imbibed on a typical day; 5 or More= Frequency of Heavy Drinking: The frequency of having 5 or more drinks on a single day; Drunk= Frequency of Heavy Drinking: The frequency of drinking enough to get drunk or very high; SMAST=Short Michigan Alcoholism Screening Test

** $p < .01$; * $p < .05$

Table 7. Correlations among BAS/BIS Factor and Other Health Behaviors

	FTND	HS: Eating	HS: Exercise
BAS Factor	.08	.04	.19**
BIS Factor	.24*	-.08	-.11

Note. FTND=Fagerström Test for Nicotine Dependence; HS: Eating=Healthstyle: Eating Habits; HS: Exercise=Healthstyle: Exercise/Fitness

** $p < .01$; * $p < .05$

3.5 PATH ANALYSIS (HYPOTHESIS 3)

Path analysis was performed to test the global relationships among the BAS/BIS, life events, affect, and alcohol outcomes (e.g., frequency of alcohol use, alcohol-related problems) using Structural Equation Modeling (SEM). In the path model, the BAS factor scores predicted the Frequency of Heavy Drinking and the SMAST, while the BIS factor scores interacting with NE from the DES predicted the Frequency of Heavy Drinking and the SMAST via NA from the PANAS. Based on previous studies including both moderation and mediation (Little, Card, Bovaird, Preacher, & Crandall, 2007; Morgan-Lopez, Castro, Chassin, & MacKinnon, 2003;

Morgan-Lopez & Mac Kinnon, 2006), a path model to test both moderating and mediating effects was constructed and standardized regression weights of paths were checked.

In Figure 2, the results of the path analysis are presented when the item tapping the number of drinks imbibed on a typical day from the Frequency of Heavy Drinking was used as an indicator of the Frequency of Heavy Drinking. The path from the BAS factor scores to the Frequency of Heavy Drinking was significant ($\beta = .12, p < .05$). The path from the BAS factor scores to the SMAST was not significant ($\beta = -.02, p = ns$), but indirectly and marginally significant via the path from the Frequency of Heavy Drinking to the SMAST ($\beta = .10, p = .06$). The path from the interaction term of the BIS factor scores and NE from the DES to NA from the PANAS was significant ($\beta = .62, p < .01$), and the paths from NA from the PANAS to the Frequency of Heavy Drinking and SMAST were significant ($\beta = -.11$ and $.13, ps < .05$). Likewise, in Figure 3, the results of the path analysis are presented when the item tapping the frequency of having 5 or more drinks on a single day from the Frequency of Heavy Drinking was entered as an indicator of the Frequency of Heavy Drinking. The path from the BAS factor scores to the Frequency of Heavy Drinking was significant ($\beta = .23, p < .01$). The path from the BAS factor scores to the SMAST was not significant ($\beta = -.04, p = ns$), but indirectly and marginally significant via the path from the Frequency of Heavy Drinking to the SMAST ($\beta = .11, p = .07$). The path from the interaction term of the BIS factor scores and NE from the DES to NA from the PANAS was significant ($\beta = .62, p < .01$), and the paths from NA from the PANAS to the Frequency of Heavy Drinking and SMAST were significant ($\beta = -.12$ and $.13, ps < .05$). In Figure 4, the results of the path analysis are presented when the item tapping the frequency of drinking enough to get drunk or very high from the Frequency of Heavy Drinking was entered as an indicator of the Frequency of Heavy Drinking. The path from the BAS factor

scores to the Frequency of Heavy Drinking was significant ($\beta = .20, p < .01$). The path from the BAS factor scores to the SMAST was not significant ($\beta = -.03, p = ns$), but indirectly significant via the path from the Frequency of Heavy Drinking to the SMAST ($\beta = .12, p < .05$). The path from the interaction term of the BIS factor scores and NE from the DES to NA from the PANAS was significant ($\beta = .62, p < .01$). The path from NA from the PANAS to the SMAST was significant ($\beta = .12, p < .05$), and the path from NA from the PANAS to the Frequency of Drinking was marginally significant ($\beta = -.10, p = .08$).

Path analysis was also performed to test the global relationships among the BAS/BIS, life events, affect, and other health behaviors such as smoking, healthy eating, and exercising. In the path model, the BAS factor scores predicted the FTND, Eating Habits from the Healthstyle, or Exercise/Fitness from the Healthstyle, while the BIS factor scores interacting with NE from the DES predicted the FTND, Eating Habits from the Healthstyle, or Exercise/Fitness from the Healthstyle via NA from the PANAS. For the FTND, the path from the interaction term of the BIS factor scores and NE from the DES to NA from the PANAS was significant ($\beta = .62, p < .01$). However, the path from the BAS factor scores to FTND and the path from NA from the PANAS to FTND were not significant ($\beta = .09$ and $.11, ps = ns$). For Eating Habits from the Healthstyle, the path from the interaction term of the BIS factor scores and NE from the DES to NA from the PANAS was significant ($\beta = .62, p < .01$). The path from NA from the PANAS to Eating Habits from the Healthstyle was marginally significant ($\beta = -.10, p = .09$), but the path from the BAS factor scores to Eating Habits from the Healthstyle was not significant ($\beta = .04, p = ns$). The results of the path analysis for Exercise/Fitness from the Healthstyle are presented in Figure 5. The path from the interaction term of the BIS factor scores and NE from the DES to NA from the PANAS was significant ($\beta = .62, p < .01$). The path from the BAS factor scores to

Exercise/Fitness from the Healthstyle and the path from NA from the PANAS to Exercise/Fitness from the Healthstyle were significant ($\beta = .20$ and $-.16$, $p < .01$).

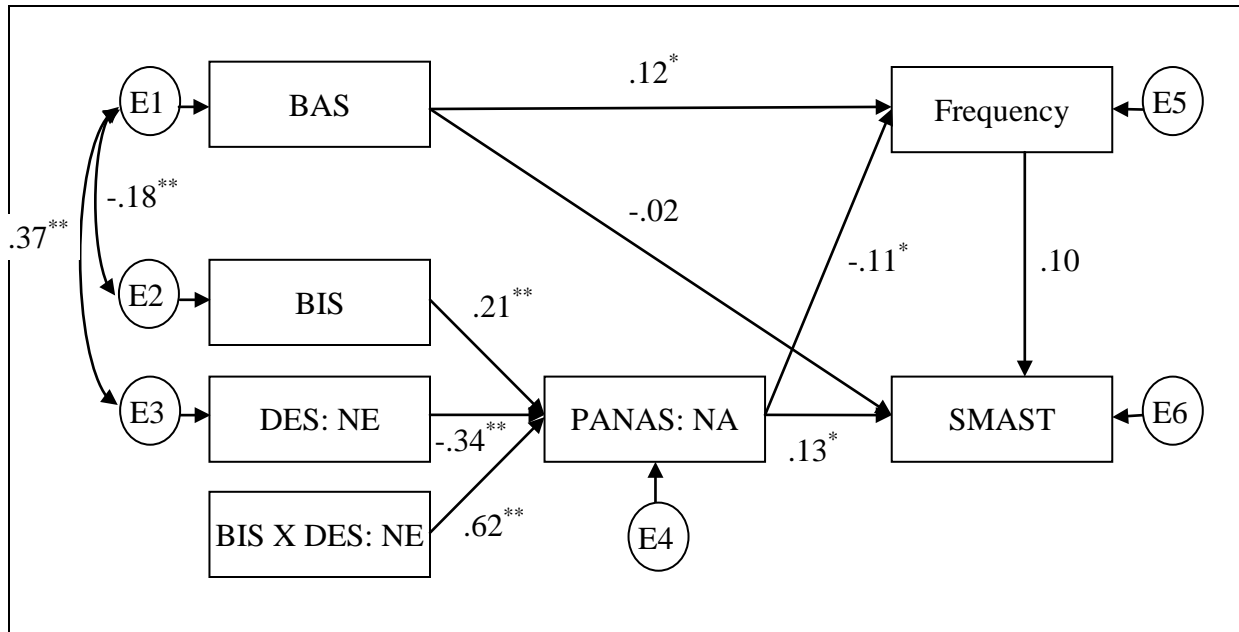


Figure 2. Path Model of BAS and BIS-Related Variables for Alcohol Outcomes:
Frequency and Drinking Problems

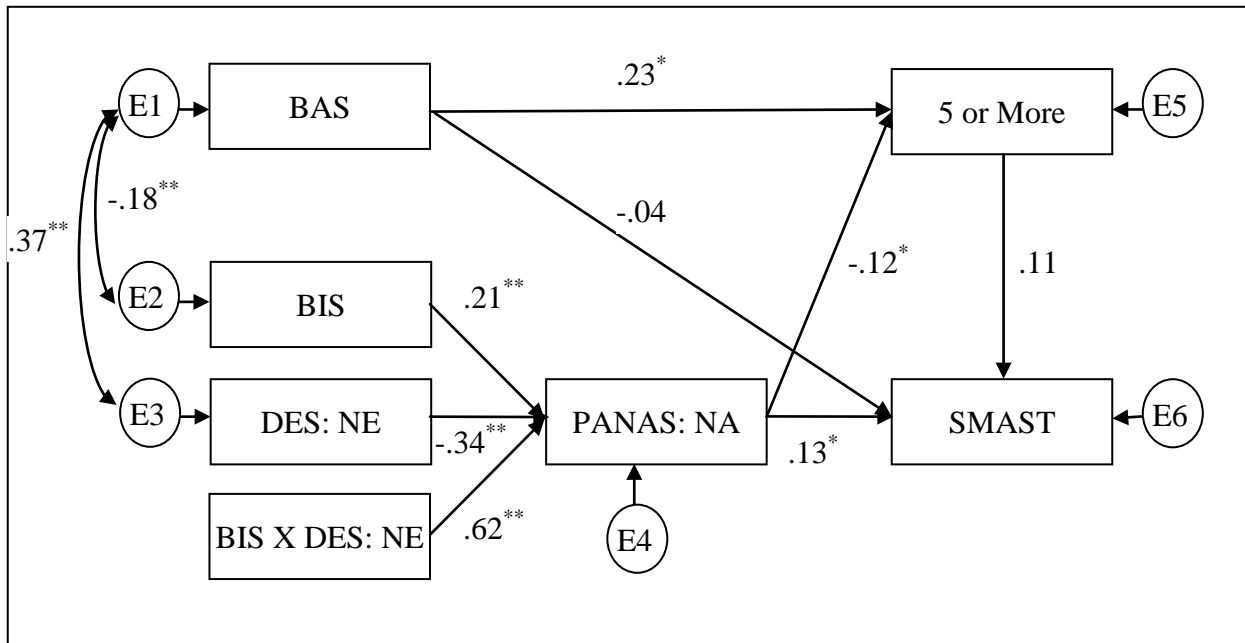


Figure 3. Path Model of BAS and BIS-Related Variables for Alcohol Outcomes:
5 or More and Drinking Problems

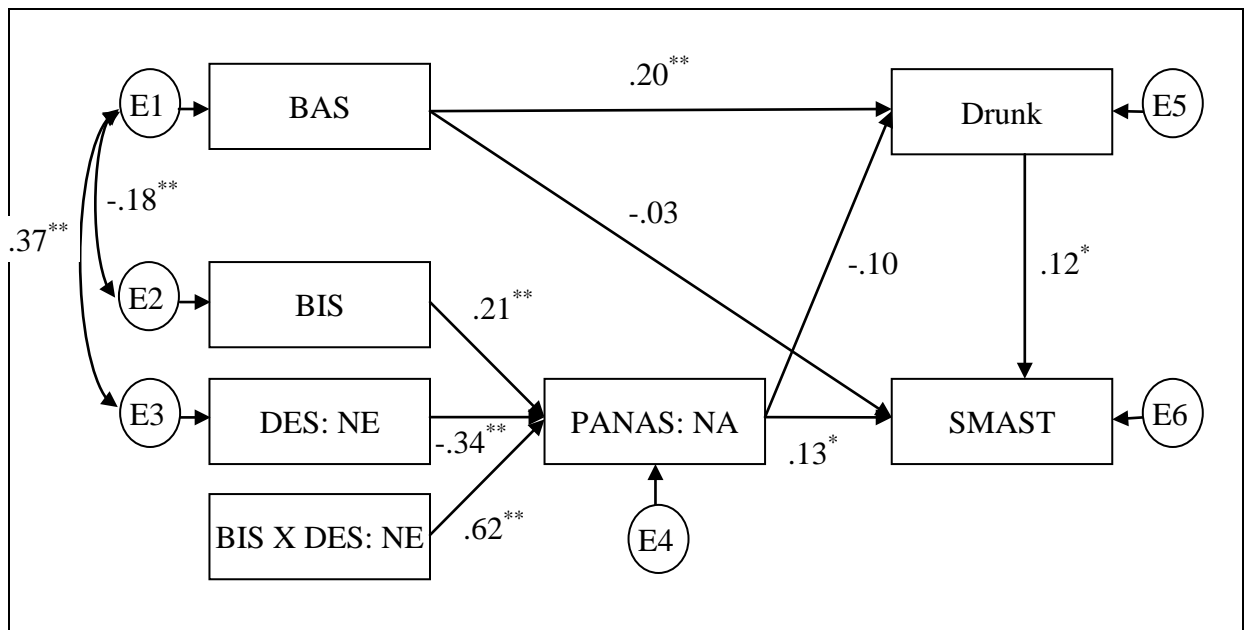


Figure 4. Path Model of BAS and BIS-Related Variables for Alcohol Outcomes:
Drunk and Drinking Problems

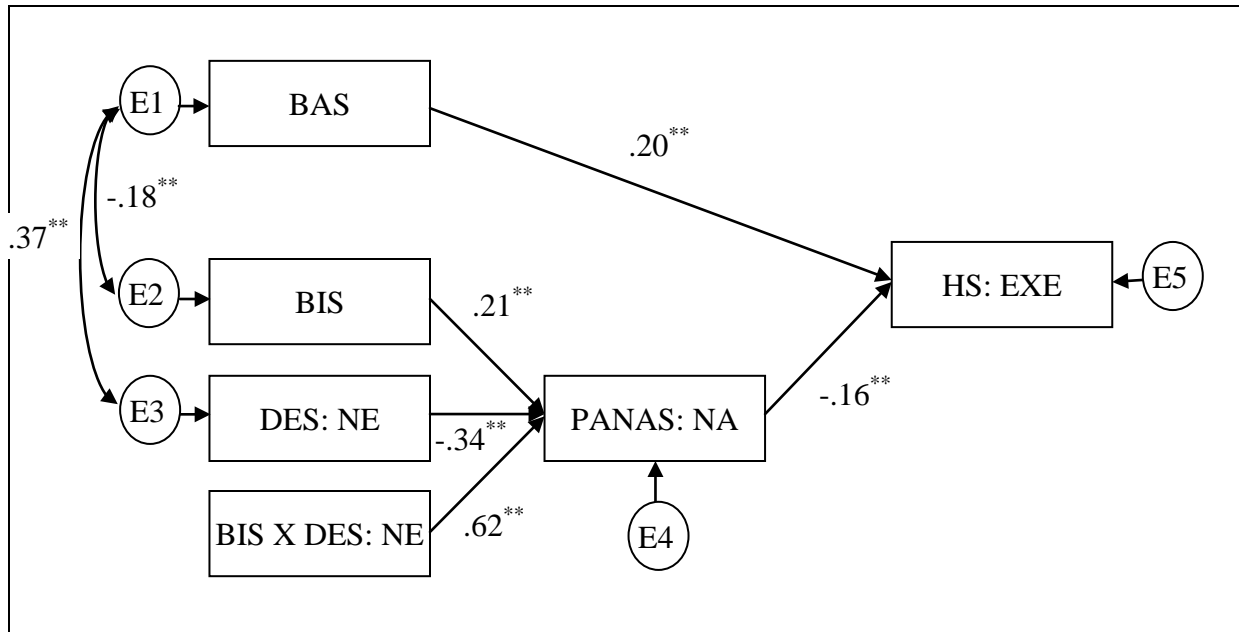


Figure 5. Path Model of BAS and BIS-Related Variables for Exercising

Chapter 4: Reinforcement Sensitivity, Life Events, Affect, and Alcohol Use in Everyday Life

Discussion

Study 1 tested whether and how reinforcement sensitivity predicts alcohol use in everyday life, related to life events and affect. The study was based on the critique that the motivational model in which alcohol use is determined by mood alteration lacks sufficient predictive power (Stewart, Hall, Wilkie, & Birch, 2002). In the motivational model, it has been hypothesized that enhancement motives are related to alcohol use in order to enhance positive affect, while coping motives are associated with alcohol use in order to reduce or regulate negative affect. However, studies have shown inconsistent relationships between positive and negative affect and alcohol use. This study also presented evidence that the motivational model is not enough to explain alcohol use. In this study, enhancement motives were not correlated with positive affect, while coping motive were associated with negative affect. Further, although enhancement and coping motives were correlated with alcohol use, positive and negative affect were not associated with alcohol use. This result rationalizes this study in which vulnerability factors such as personality were considered to explain alcohol use in college students.

Thus, RST was considered as explaining vulnerability to positive life events and negative affect and predicted alcohol use in college students in this study. As hypothesized on theoretical grounds, BAS sensitivity was significantly correlated with positive life events and positive affect, while BIS sensitivity was significantly associated with negative life events and negative affect. Thus, from this result, it can be hypothesized that BAS-dominant people are more susceptible to the perception of positive life events and the experience of positive affect than BIS-dominant people, while BIS-dominant people are more vulnerable to the perception of

negative life-events and the experience of negative affect. However, this study did not replicate the previous study that reported the exclusive relationship between the BAS and positive life events, rather than positive affect, and between the BIS and negative affect, rather than negative life events (Gable, Reis, & Elliot, 2000).

Next, the relationships among BAS/BIS sensitivity, drinking motives, and alcohol use were assessed. BAS sensitivity was unexpectedly correlated with negative drinking motives (i.e., coping and conformity motives) as well as positive drinking motives (i.e., enhancement and social motives). On the contrary, the relationships between BIS sensitivity and drinking motives supported the hypothesis: BIS sensitivity was associated with negative drinking motives, but not with positive drinking motives. This result may implicate the argument that the BIS is more exclusively related to affect than the BAS, especially in the context of alcohol use. Meanwhile, BAS and BIS sensitivity showed different patterns of association with alcohol use. In other words, BAS sensitivity was correlated with heavy drinking, but not with drinking problems. BIS sensitivity was negatively associated with one indicator of heavy drinking and positively with drinking problems. The relationship between BAS sensitivity and heavy drinking has been reported in previous studies. However, based on the results of this study, the relationship between BAS sensitivity and heavy drinking is not due to enhancement motives or positive motives. The relationship between BIS sensitivity and alcohol use in this study may shed some light on the inconsistent findings in previous studies investigating the relationship between the BIS and alcohol use. Those studies found negative relationships between BIS sensitivity and alcohol use if they focused on the frequency of alcohol use, while others reported positive relationships between BIS sensitivity and alcohol use if they focused on alcohol-related negative consequences.

Based on previous studies and the previous two tests of hypotheses in this study, the path analysis in which BAS and BIS sensitivity predict alcohol use differentially was performed. The BAS significantly and directly predicted heavy drinking. However, the BAS marginally and indirectly predicted drinking problems via heavy drinking. The moderation effect of negative life events and the mediation effect of negative affect in the path from the BIS to alcohol use were confirmed in this study. In other words, the BIS interacting with negative life events significantly and positively predicted drinking problems via negative affect, and marginally and negatively predicted heavy drinking via negative affect. Like the results previously mentioned, this result supports the previous studies reporting the direct relationship between BAS sensitivity and heavy drinking and indirect relationship between BAS sensitivity and drinking problems. Additionally, it showed that affective mediation may be not necessary for BAS sensitivity to explain alcohol use. Also, this result supports the relationship between negative affect and alcohol use characterized by “self-medication” or “tension reduction” theories. Such a relationship appeared to explain drinking problems, a qualitative aspect of alcohol use. However, the direction of the relationship was reversed to explain heavy drinking, a quantitative aspect of alcohol use. Again, this may explain the inconsistent findings in previous studies investigating the relationship between the BIS and alcohol use. Further, in the path model, the relationship between negative affect and alcohol use seemed to be better explained when vulnerability to the experience of negative affect was considered than when only negative affect was included.

The relationships among BAS/BIS sensitivity and other health behaviors were also assessed to examine the applicability of the path model of alcohol use to other health behaviors in this study. BAS sensitivity was significantly correlated with exercising, but not with smoking and healthy eating. BIS sensitivity was significantly associated with smoking, but not with heavy

eating and exercising. The path analysis for alcohol use was also applied to other health behaviors. The BAS significantly and directly predicted exercising, but not smoking and healthy eating. The BIS interacting with negative life events significantly and negatively predicted exercising via negative affect and marginally and positively predicted healthy eating, but not smoking. Based on this result, the path model may be not very effective in explaining other health behaviors than alcohol use since there were not definitely significant standardized regression weights in the models of smoking and healthy eating. Especially, considering the correlations among BAS/BIS sensitivity and other health behaviors together, the significant relationship between BIS sensitivity and smoking disappeared when the moderation and mediation effect in BIS sensitivity were considered. Even in the case of exercising, for which the path model included significant standardized regression weights, the direction of the relationships between BIS sensitivity and exercising was different from the relationships between BIS sensitivity and alcohol use. Thus, “self-medication” or “tension reduction” may be not a valid theory to explain exercising, and other variables and their relationships may have to be hypothesized to explain exercising.

There were some limitations in Study 1. First, this study tried to address the measurement issue associated with the BAS and BIS by administering multiple BAS/BIS measures, partly based on Torrubia, Ávila, and Caseras’s (2008) recommendation. However, CFA results in this study suggested that the proposed model of the factor structure was not acceptable. Further, one of the BAS-related subscales, Reward Responsiveness from the BIS/BAS Scales, and one of the BIS-related subscales, BIS from the BIS/BAS Scales, did not significantly load on the endogenous variables of the BAS and BIS, respectively. The problem of the two subscales from the BIS/BAS Scales has been raised in previous studies (Heubeck, Wilkinson, & Cologon, 1998;

Jorm et al., 1999). However, the use of only the SPSRQ to assess BAS and BIS sensitivity returns the measurement issue to the starting point because the SPSRQ also has some shortcomings. Further, as previously mentioned before, unacceptable model fit and non-significant loadings may be because the two measures focus on slightly different aspects of the BAS and BIS. The consequent BAS and BIS factor scores met the criterion of independence of the BAS and BIS and were significantly related to BAS- and BIS-related subscales. Because there is no golden standard for the assessment of the BAS and BIS, the factor scores in this study may be one step toward a measurement solution. However, there should be more psychometric studies about this issue in the future.

The second limitation concerns psychometric properties of some questionnaires used in this study. Psychometric properties, especially internal consistency reliability, were checked when the measures were selected. However, the alpha coefficients of some questionnaires in this study were lower than the acceptable range (e.g., .70). For example, past work reported the alpha coefficient of the SMAST as .76, but it was .47 in this study. From this single study, it is hard to conclude which factor contributes to this low internal consistency reliability. However, considering that drinking problems were one of the core variables to assess alcohol use in this study, this problem in internal consistency reliability cannot be ignored, and thus the results in this study should be carefully interpreted. Also, the alpha coefficients for measures of other health behaviors were slightly lower than the acceptable range. This study focused on alcohol use, not other health behaviors, and thus any inclusion or exclusion criteria based on other health behaviors were not considered. This might cause some limitations in the number of participants who engaged in other health behaviors and the variances in the scores on the measures of other health behaviors, and thus problems in the internal consistency. Thus, although it was suggested

that the path model of alcohol use may not be applicable to other health behaviors, this finding is not conclusive and further studies in which problems related to the measurement of other health behaviors are considered should be performed in the future.

Last, several self-report questionnaires were administered to test the global relationships among reinforcement sensitivity, life events, affect, and alcohol use. This was a good way to obtain long-term, ecologically valid data regarding alcohol use. However, as previously mentioned, it solely depends on the participants' responses and memory, which are susceptible to response and memory bias. Also, it cannot support causal inferences or explain more than simple relationships among variables, and it is not sensitive to the short-term changes in alcohol use. These two limitations of Study 1 emphasize the significance of Study 2, in which behavioral measurements of the BAS and BIS were undertaken, and an applied experimental design was used.

Chapter 5: Affect and Urge to Drink as a Function of Reinforcement

Sensitivity and Behavioral Contingencies

Method

5.1 PARTICIPANTS

One hundred thirty-four college students from the University of Texas at El Paso were recruited to test a short-term relationship between the BAS/BIS, life events, affect, and urge to drink. Considering the mean scores and standard deviations on the SR and SP from the SPSRQ (Cogswell, Alloy, van Dulmen, & Fresco, 2006), only those who scored .5 standard deviation higher than the mean score on the SR (14 or more) and .5 standard deviation lower than the mean score on the SP (8 or less), called the BAS-dominant group, and those who scored .5 standard deviation higher than the mean score on the SP (14 or more) and .5 standard deviation lower than the mean score on the SR (10 or less), called the BIS-dominant group, were included in Study 2. When they participated in Study 2, half of the 78 BAS-dominant and 56 BIS-dominant participants was randomly assigned to the reward-only Go/No-Go task and half to the punishment-only Go/No-Go task. Participants who were not proficient in English were excluded from the study. Respondents who did not have alcohol use in the previous 6 months were also excluded from the study. Participation in the study was rewarded with research credit for psychology class at the University of Texas at El Paso, and the participants kept the money that they earned from the Go/No-Go task.

The mean age of the participants was 19.7 ($SD = 2.19$) years (ranged from 18 years to 28 years). Sixty-two percent of the participants were females; and 87 percent of the participants were Hispanics. Approximately 52 percent of the participants were freshmen and 26 percent of

the participants were sophomores. Differences in demographic data among BAS- and BIS-dominant group assigned to the reward- and punishment-only Go/No-Go task are presented in Table 8.

A power analysis was conducted, considering the previous study that reported the correlation between the BAS/BIS and positive/negative urge to drink from .44 to .47 (average .46) (Kambouropoulos & Staiger, 2004a). The difference in commission errors between reward and punishment group ($F(1,85) = 9.22$, $d = .66$) was also considered (Gomez & McLaren, 1997). A power analysis indicates that the sample size of 134 college students yields 77% power to detect an average correlation of .46 (two-tailed test) or effect size, $d = .66$.

Table 8. Differences in Demographic Data by Group and Task

Demographic Variables		Group by Task				Difference
		BAS-R (<i>N</i> = 39)	BAS-P (<i>N</i> = 39)	BIS-R (<i>N</i> = 27)	BIS-P (<i>N</i> = 29)	
Age ^a		19.95 (<i>SD</i> =2.55)	19.51 (<i>SD</i> =2.22)	19.89 (<i>SD</i> =1.85)	19.55 (<i>SD</i> =1.98)	$F_{\text{Group}} = .00$ $F_{\text{Task}} = .99$ $F_{\text{Group} \times \text{Task}} = .02$
Gender ^b	Male	22	19	6	4	$\chi^2 = 17.57^{**}$
	Female	17	20	21	25	
Ethnicity ^b	Hispanic	36	30	24	27	$\chi^2 = 16.88$
	White	1	6	1	0	
	Black	1	3	1	2	
	Others	1	0	1	0	
Education ^b	Freshman	19	22	12	16	$\chi^2 = 7.05$
	Sophomore	10	9	6	10	
	Junior	4	4	2	1	
	Senior	6	4	7	2	

Note. a: numbers are the mean ages; b: numbers are frequencies; BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

5.2 MEASURES

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988; see Appendix K): The PANAS is a 20-item inventory designed to assess positive and negative affect. The PANAS with “state” (rather than “in general”) instructions was included in this study, and it was administered to the participants before and after the task. Respondents were asked to endorse items on a 5-point Likert-like scale ranging 1 (very slightly or not at all) to 5 (extremely). The PANAS comprises 2 subscales: Positive Affect (PA; 10 items) and Negative Affect (NA; 10 items).

In the original study, alpha coefficients values were .88 for PA and .87 for NA, and test-retest reliability values with an 8-week interval were $r = .54$ for PA and $r = .45$ for NA. In this study, alpha coefficients were .90 and .92 for PA, before and after the task, and .80 and .82 for NA, before and after the task. In the original study, NA was positively correlated with the Hopkins Symptom Checklist (HSCL; $r = .65$ and $.74$), Beck Depression Inventory (BDI; $r = .56$ and $.58$), and State scale of the State-Trait Anxiety Inventory (STAI-S; $r = .51$). PA was negatively correlated with the HSCL ($r = -.19$ and $-.29$), BDI ($r = -.35$ and $-.36$), and STAI-S ($r = -.35$).

Urge to Drink (Dawe & Gray, 1995; see Appendix L): The Urge to Drink is a 2-item inventory designed to assess levels of positive (e.g., “How much do you want to drink alcohol at this moment for its pleasant effect?”) and negative (e.g., “How much do you want to drink alcohol at this moment to take away an unpleasant feeling or mood?”) urge to drink. In this study, the item of general urge to drink (e.g., “How much do you want to drink alcohol at this moment?”) was added, modeled after items of positive and negative urge to drink. It was administered to the participants before and after the task. Respondents were asked to endorse

items on 10-cm visual analogue scales, and the percentages of the respondents' endorsement along a continuous line were recorded.

Modeled after Urge to Drink, the 9-item Health Behavior Urges were designed to assess levels of general (e.g., "How much do you want to smoke at this moment?"), positive (e.g., "How much do you want to eat something, especially fatty, salty, or sweet foods, at this moment for its pleasant effect?"), and negative (e.g., "How much do you want to exercising at this moment to take away an unpleasant feeling or mood?") urge to engage in other health behaviors including smoking, unhealthy eating, and exercising (see Appendix M).

5.2.1 Go/No-Go Task

A computerized Go/No-Go task used by Gomez and McLaren (1997) was administered to manipulate situations where only reward or punishment is presented and to test the feasibility of the Go/No-Go task as a measurement of the BAS and BIS. This task was designed using E-Prime v2.0 (Psychology Software Tools, Inc.) and presented on a 15-inch computer monitor. All instructions were presented in white-color letters (20-point font size, Arial, bold, left-aligned) on a black-color background. Numbers and feedback in test trials were presented by white-color letters (60-point font size, Arial, bold, centered) with black-color background.

There were 96 test trials, divided into eight sets of 12 trials each. Each trial consisted of one of 12 two-digit numbers, presented randomly. In each trial, each stimulus was presented until the participant responded or for a maximum of 3 seconds, if the participant did not respond. The inter-stimulus interval was 1.5 seconds. Of these 12 two-digit numbers, six were 'good' numbers, and six were 'bad' numbers. Whether specific numbers were labeled as 'good' or 'bad' was counterbalanced across conditions. Participants were instructed to learn which were 'good'

and ‘bad’ numbers by trial and error. Twelve practice trials were presented before the 96 test trials.

Participants in the reward-only Go/No-Go task were instructed that every time they responded to a ‘good’ number or refrained from responding to a ‘bad’ number they would gain 10 cents, and that there would be no loss of money for failing to respond to a ‘good’ number or for responding to a ‘bad’ number. Correct responses (responding to a ‘good’ number or not responding to a ‘bad’ number) resulted in a 1-second visual feedback indicating that the participant had earned 10 cents. Participants assigned to the reward-only Go/No-Go task earned an average of \$6.16. For the punishment-only Go/No-Go task, all participants started with a bonus of \$9.60. They were instructed that every time they failed to respond to a ‘good’ number or they responded to a ‘bad’ number, they would lose 10 cents, and that there was no gain of money for responding to a ‘good’ number or not responding to a ‘bad’ number. Incorrect response (Not responding to a ‘good’ number or responding to a ‘bad’ number) resulted in a 1-second visual feedback indicating that the participant had lost 10 cents. Participants assigned to the punishment-only Go/No-Go task lost an average of \$3.54 (had an average of \$6.06 at the end of the task). The instructions for each task were presented to the participant on the computer screen (see Appendix N).

5.3 PROCEDURES

The participants for Study 2 were recruited by two ways. First, at the end of Study 1, the criteria of alcohol use in the previous 6 months and BAS- or BIS-dominance were checked for each participant. Before they left the experimental room, those who participated in Study 1 and met the criteria for Study 2 were asked to participate in Study 2. When they agreed to participate in Study 2, the time and date were set up and a paper on which the participant’s schedule for

Study 2 was written was given for a reminder. Second, screening with the SPSRQ and the Frequency of Heavy Drinking was given to students in three Psychology classes to identify students who met the criteria for alcohol use in the previous 6 months and BAS- or BIS-dominance. An e-mail invitation to Study 2 was sent to the students who met the criteria. Schedule availability for participation in Study 2 was sent with the invitation, and the students who got the e-mail were advised to select any available schedule at their convenience if they were interested in participation. Eighty-seven participants were recruited in the former way, and 47 participants joined the study the latter way. The time slots were available for only one student every thirty minutes. Considering diurnal variation in craving for alcohol, the schedule was set up only from noon to 3 p.m. Study 2 was performed from mid October, 2009, to early March, 2010.

When the students arrived at the arranged time, they were guided to a small, quiet experimental room in which a computer for the Go/No-Go task was equipped on the desk, and all windows were blocked to prevent the influence of weather on craving for alcohol. Before questionnaires and tasks for Study 1 were administered, all participants were asked to read and sign the written informed consent form. Before completing questionnaires and tasks, the participants were randomly assigned to the reward-only Go/No-Go task or the punishment-only Go/No-Go task using a random number table. Thirty-nine BAS-dominant participants were assigned to the reward-only Go/No-Go task and another 39 BAS-dominant participants were assigned to the punishment-only Go/No-Go task. Twenty-seven BIS-dominant participants were assigned to the reward-only Go/No-Go task and another 29 BIS-dominant participants were assigned to the punishment-only Go/No-Go task.

All participants were asked to read and sign the written informed consent form. Before questionnaires and tasks for Study 2 were administered, those who participated in Study 2 through the screening procedure were asked to complete the Demographic Survey, BIS/BAS scales, SMAST, FTND, and HealthStyle in that order. This was because the scores on these scales informed the basic characteristics of participants' BAS/BIS sensitivity and health behaviors and were used in data analysis for Study 2; however, those who participated in Study 2 through the screening procedure had not already completed these measures, unlike those who had participated in the first study. All participants then completed the PANAS and the Urge to Drink. After performing either the reward- or the punishment-only Go/No-Go task according to the result of the random assignment, they were asked to complete the PANAS and the Urge to Drink again, including the Health Behavior Urges. At the end of the session, the investigator debriefed the participants. It took approximately 20 minutes to complete Study 2.

5.4 DATA ANALYSIS

For the Go/No-Go task, the number of total responses, hit responses, commission errors, and omission errors were obtained. For these measures, the scores were grouped into four blocks to allow for analysis and/or control of any cumulative learning effects over the course of the study: block 1 (set 1 and 2), block 2 (set 3 and 4), block 3 (set 5 and 6), and block 4 (set 7 and 8).

Several group comparisons were performed. First, in order to test for group differences in task performance (e.g., the number of total responses, hit responses, commission errors, and omission errors), 2 (BAS- and BIS-dominant group) X 2 (reward-and punishment-only Go/No-Go task) analyses of variances (ANOVA) were performed according to blocks. It was expected that the BAS-Reward group would show higher levels of total responses and commission errors than other groups, and that BIS-Punishment group would show lower levels of total responses

and higher levels of omission errors than other groups. It was anticipated that this difference would disappear by the end of the task (later blocks, such as Block 3 and Block 4), once sufficient learning had occurred that participants were able to identify ‘good’ and ‘bad’ numbers with relative ease.

Second, in order to test for differences in changes of affect before and after the Go/No-Go task, three-way mixed ANOVA with one within-subjects (time) variable and two between-subjects (group and task) variables were performed for Positive Affect and Negative Affect from the PANAS. It was expected that the interaction of group and task would be associated with changes of Positive Affect and Negative Affect from the PANAS before and after the Go/No-Go task. In other words, the increase in Positive Affect from the PANAS was expected to be more prominent in the BAS-dominant subgroup assigned to the reward-only Go/No-Go task than in the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task or the BIS-dominant subgroup assigned to the reward-only Go/No-Go task. Likewise, the increase in Negative Affect from the PANAS was expected to be more prominent in the BIS-dominant subgroup assigned to the punishment-only Go/No-Go task than in the BIS-dominant subgroup assigned to the reward-only Go/No-Go task or the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task.

Third, in order to test for differences in changes of urge to drink before and after the Go/No-Go task, three-way mixed ANOVAs with one within-subjects (time) variable and two between-subjects (group and task) variables were performed for the Urge to Drink. It was expected that the interaction of group and task would be associated with changes of General and Negative Urge to Drink, but not with changes of Positive Urge to Drink, before and after the Go/No-Go task. In other words, the increase in General Urge to Drink was expected to be more

prominent in both the BAS-dominant subgroup assigned to the reward-only Go/No-Go task and the BIS-dominant subgroup assigned to the punishment-only Go/No-Go task than in the BAS-dominant group assigned to the punishment-only Go/No-Go task or the BIS-dominant group assigned to the reward-only Go/No-Go task. The increase in Positive Urge to Drink was not expected to be higher in the BAS-dominant subgroup assigned to the reward-only Go/No-Go task compared to other groups. On the contrary, the increase in Negative Urge to Drink was expected to be more prominent in the BIS-dominant subgroup assigned to the punishment-only Go/No-Go task than in the BIS-dominant subgroup assigned to the reward-only Go/No-Go task or the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task.

Last, in order to test for differences in urges to engage in other health behaviors, 2 (BAS- and BIS-dominant group) X 2 (reward- and punishment-only Go/No-Go task) ANOVAs were performed for the Health Behavior Urges. The same pattern of differences in scores in the Health Behavior Urges as in the Urge to Drink was expected. In other words, the scores in General Health Behavior Urges were expected to be higher in both the BAS-dominant subgroup assigned to the reward-only Go/No-Go task and the BIS-dominant subgroup assigned to the punishment-only Go/No-Go task than in the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task or the BIS-dominant subgroup assigned to the reward-only Go/No-Go task. The higher scores in Positive Health Behavior Urges were not expected to be higher in the BAS-dominant subgroup assigned to the reward-only Go/No-Go task compared to other groups. On the contrary, the increase in Negative Health Behavior Urges was expected to be more prominent in the BIS-dominant subgroup assigned to the punishment-only Go/No-Go task than in the BIS-dominant subgroup assigned to the reward-only Go/No-Go task or the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task.

Chapter 6: Reinforcement Sensitivity, Life Events, Affect, and Alcohol Use in Everyday Life

Results

6.1 DIFFERENCES IN THE BAS/BIS, URGE TO DRINK, AND URGES TO ENGAGE IN OTHER HEALTH BEHAVIORS AMONG GROUPS AND TASKS

Before the main data analyses were performed, the differences in BAS/BIS factor scores, Frequency of Drinking, SMAST, FTND, Eating Habits from the Healthstyle, and Exercise/Fitness from the Healthstyle among groups and tasks were examined to confirm the random assignment of each group to tasks. For this, 2 (BAS- and BIS-dominant group) X 2 (reward- and punishment-only Go/No-Go task) ANOVAs were performed. In sum, there were significant differences in BAS factor scores and BIS factor scores among groups ($F_s[1,130] = 60.37$ and 115.51 , $ps < .01$) (Table 9). There were significant differences in scores on the measures of heavy drinking among groups ($F_s[1,130] = 6.92$ to 11.07 , $ps < .05$) with higher scores in the BAS-dominant group than the BIS-dominant group, but not on the SMAST ($F[1,130] = .01$, $p = ns$) (Table 10). There were no significant differences in the SMAST, the FTND, Eating Habits from the Healthstyle, and Exercise/Fitness from the Healthstyle among groups or tasks (Table 11).

Table 9. Differences in BAS and BIS sensitivity by Group and Task

BAS/BIS Sensitivity	Group by Task								Difference
	BAS-R (<i>N</i> = 39)		BAS-P (<i>N</i> = 39)		BIS-R (<i>N</i> = 27)		BIS-P (<i>N</i> = 29)		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
SPSRQ: SR	16.18	2.74	15.82	2.20	9.37	2.31	8.62	2.38	$F_{\text{Group}} = 41.40^{**}$ $F_{\text{Task}} = 2.20$ $F_{\text{Group} \times \text{Task}} = .11$
SPSRQ: SP	5.54	2.50	6.77	2.01	16.63	2.40	17.28	2.63	$F_{\text{Group}} = 171.45^{**}$ $F_{\text{Task}} = 3.10$ $F_{\text{Group} \times \text{Task}} = .08$
BAS Factor	4.57	.40	4.62	.41	3.66	.35	3.57	.46	$F_{\text{Group}} = 60.37^{**}$ $F_{\text{Task}} = 1.64$ $F_{\text{Group} \times \text{Task}} = .50$
BIS Factor	.40	.93	.85	.91	4.15	.90	4.42	1.10	$F_{\text{Group}} = 115.51^{**}$ $F_{\text{Task}} = 4.64^{*}$ $F_{\text{Group} \times \text{Task}} = .01$

Note. SPSRQ: SR=Sensitivity to Punishment and Sensitivity to Reward Questionnaire: Sensitivity to Reward; SPSRQ: SP=Sensitivity to Punishment and Sensitivity to Reward Questionnaire: Sensitivity to Punishment; BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

Table 10. Differences in Alcohol Outcomes by Group and Task

Alcohol Use	Group by Task								Difference
	BAS-R (<i>N</i> = 39)		BAS-P (<i>N</i> = 39)		BIS-R (<i>N</i> = 27)		BIS-P (<i>N</i> = 29)		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Frequency	5.22	3.44	5.03	3.42	4.19	4.09	3.19	1.97	$F_{\text{Group}} = 6.92^*$ $F_{\text{Task}} = .14$ $F_{\text{Group} \times \text{Task}} = .00$
5 or More	4.67	2.41	4.55	2.52	3.19	2.27	2.41	1.97	$F_{\text{Group}} = 11.07^{**}$ $F_{\text{Task}} = .33$ $F_{\text{Group} \times \text{Task}} = .92$
Drunk	3.64	2.28	3.39	2.21	2.30	1.88	2.14	2.07	$F_{\text{Group}} = 8.99^{**}$ $F_{\text{Task}} = .25$ $F_{\text{Group} \times \text{Task}} = .00$
SMAST	1.41	1.74	1.54	1.45	1.15	1.17	1.41	1.27	$F_{\text{Group}} = .01$ $F_{\text{Task}} = .07$ $F_{\text{Group} \times \text{Task}} = .15$

Note. Frequency= Frequency of Heavy Drinking: The number of drinks on a typical day; 5 or More= Frequency of Heavy Drinking: 5 or more drinks on a single day; Drunk= Frequency of Heavy Drinking: Get drunk on a single day; SMAST=Short Michigan Alcoholism Screening Test; BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

Table 11. Differences in Other Health Behaviors by Group and Task

Other Health Behavior	Group by Task								Difference
	BAS-R		BAS-P		BIS-R		BIS-P		
	(N = 39)		(N = 39)		(N = 27)		(N = 29)		
	M	SD	M	SD	M	SD	M	SD	
FTND	.67	1.32	.49	1.12	.78	1.67	.86	2.68	$F_{\text{Group}} = .24$ $F_{\text{Task}} = 1.35$ $F_{\text{Group} \times \text{Task}} = .48$
HS: Eating	4.90	3.06	4.77	3.00	4.41	2.62	4.62	3.12	$F_{\text{Group}} = 1.78$ $F_{\text{Task}} = .97$ $F_{\text{Group} \times \text{Task}} = .47$
HS: Exercise	5.44	2.26	5.13	2.42	4.26	2.23	4.72	2.39	$F_{\text{Group}} = .03$ $F_{\text{Task}} = 2.75$ $F_{\text{Group} \times \text{Task}} = .14$

Note. FTND=Fagerström Test for Nicotine Dependence; HS: Eating=Healthstyle: Eating Habits; HS: Exercise=Healthstyle: Exercise/Fitness; BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

6.2 DIFFERENCES IN THE CHANGES IN AFFECT AMONG TASKS

The differences in the changes in PA and NA from the PANAS before and after the Go/No-Go task among tasks were examined to confirm that the manipulation of positive and negative affect worked. For this, one-way ANOVAs were performed. Scores on PA from the PANAS before the Go/No-Go task were higher in the reward-only Go/No-Go task than in the punishment-only Go/No-Go task. However, this difference was not significant ($F[1, 132] = .90$, $p = ns$) (Table 12). There was an increase in PA after the reward-only Go/No-Go task, but there was no difference in PA after the punishment-only Go/No-Go task (Figure 6). This difference in the changes in PA after the Go/No-Go task was significant among tasks ($F[1, 132] = 12.15$, $p < .01$) (Table 13).

There was a significant difference in NA from the PANAS before the Go/No-Go task among tasks ($F[1, 132] = 12.22, p < .01$), with higher NA in the reward-only Go/No-Go task than in the punishment-only Go/No-Go task (Table 12). There was an increase in NA after the reward-only Go/No-Go task, while there was a decrease in NA after the punishment-only Go/No-Go Task (Figure 7). This difference in the changes in NA after the Go/No-Go task was significant among tasks ($F[1, 132] = 16.23, p < .01$) (Table 14).

Table 12. Differences in Affect between Tasks

Time	Affect	Task				Difference
		Reward-Only ($N = 66$)		Punishment-Only ($N = 68$)		F
		M	SD	M	SD	
Before Task	PANAS: PA	32.95	8.33	31.54	8.85	.90
After Task	PANAS: PA	36.71	7.74	31.54	9.28	.26
Before Task	PANAS: NA	15.05	5.18	14.63	4.21	12.22**
After Task	PANAS: NA	13.35	4.37	15.63	4.87	8.15**

Note. PANAS: PA=Positive and Negative Affect Schedule: Positive Affect; PANAS: NA=Positive and Negative Affect Schedule: Negative Affect

** $p < .01$; * $p < .05$

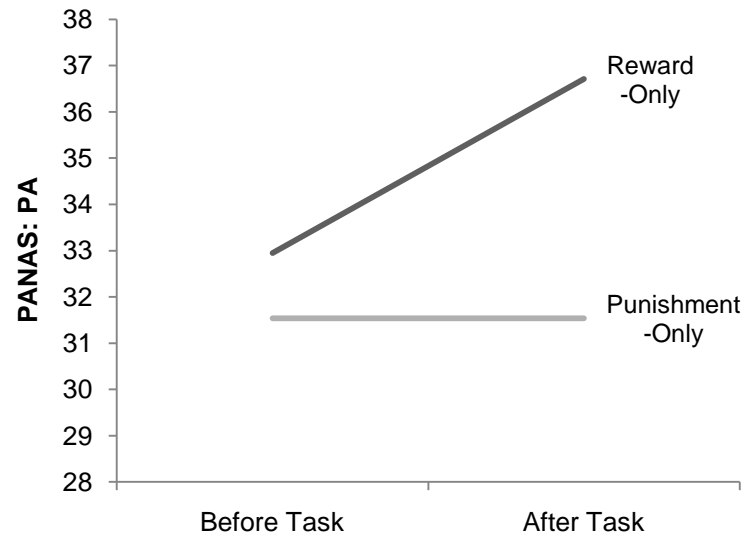


Figure 6. Changes in Positive Affect

Table 13. Summary of Two-Way Mixed ANOVA with One Within-Subject (Positive Affect) Variable and One Between-Subject (Task) Variables

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>
Between				
Task	724.71	1	724.71	5.67*
Error	16864.07	132	127.76	
Within				
Positive Affect	236.45	1	236.45	12.15**
Task X Positive Affect	236.45	1	236.45	12.15**
Error	2568.06	132	19.46	

** $p < .01$; * $p < .05$

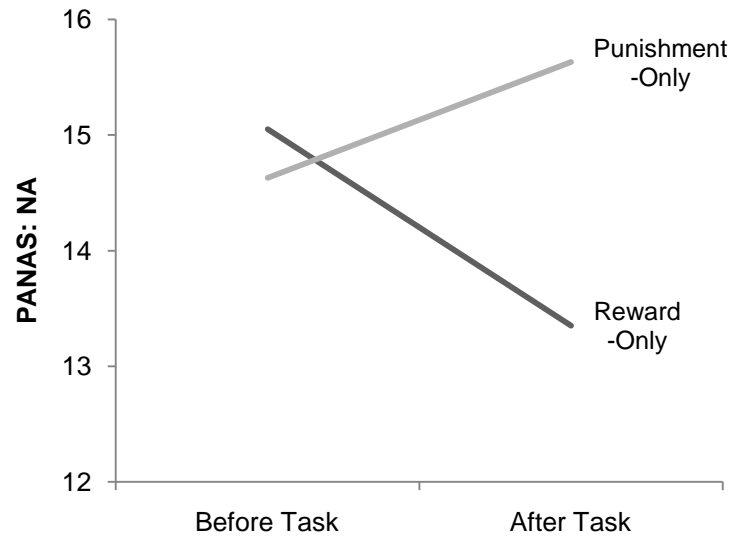


Figure 7. Changes in Negative Affect

Table 14. Summary of Two-Way Mixed ANOVA with One Within-Subject (Negative Affect) Variable and One Between-Subject (Task) Variables

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>
Between				
Task	58.61	1	58.61	1.62
Error	4768.50	132	36.13	
Within				
Negative Affect	8.14	1	8.14	1.08
Task X Negative Affect	121.81	1	121.81	16.23**
Error	990.97	132	7.51	

** $p < .01$; * $p < .05$

6.3 DIFFERENCES IN TASK PERFORMANCES AMONG GROUPS AND TASKS (HYPOTHESIS 4)

The differences in task performances on the Go/No-Go task were examined to test the feasibility of the Go/No-Go task as a measure of individual differences in BAS and BIS sensitivity. To this end, 2 (BAS- and BIS-dominant group) X 2 (reward-and punishment-only Go/No-Go task) ANOVAs were performed. Considering the problem of multiple comparisons, the Bonnferoni correction was used to interpret the significance level in order to maintain the familywise error rate. The BAS-dominant group showed a higher number of responses than the BIS-dominant group in Block 1, Block 2, and Overall. However, these differences were not significant ($F_s[1,130] = 1.78$ to 2.53 , $ps = ns$) (Table 15). In addition, the BAS-dominant group showed a higher number of commission errors than the BIS-dominant group in Block 1, Block 2, and Overall. However, these differences were not significant ($F_s[1,130] = .77$ to 1.38 , $ps = ns$) (Table 16). Also, the BIS-dominant group showed a higher number of omission errors than the BAS-dominant group in Block 1 and Overall. However, these differences were not significant ($F_s[1,130] = 1.84$ and 1.81 , $ps = ns$) (Table 17). Finally, the BAS-dominant subgroup assigned to the reward-only Go/No-Go task and the BIS-dominant subgroup assigned to the punishment-only Go/No-Go task showed faster responses than the other groups in block 1 and total. However, these differences were not significant ($F_s[1,130] = 3.11$ and 1.41 , $ps = ns$) (Table 18).

Table 15. Differences in the Number of Responses on Go/No-Go Task by Group and Task

Block	Group by Task								Difference
	BAS-R (<i>N</i> = 39)		BAS-P (<i>N</i> = 39)		BIS-R (<i>N</i> = 27)		BIS-P (<i>N</i> = 29)		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Block 1	15.28	2.97	14.08	3.12	14.00	4.05	13.55	2.90	$F_{\text{Group}} = 2.53$ $F_{\text{Task}} = 2.12$ $F_{\text{Group} \times \text{Task}} = .44$
Block 2	14.44	3.29	14.08	2.78	13.30	3.57	13.76	2.85	$F_{\text{Group}} = 1.78$ $F_{\text{Task}} = .01$ $F_{\text{Group} \times \text{Task}} = .57$
Block 3	13.54	2.82	13.62	2.91	13.44	3.39	13.21	2.69	$F_{\text{Group}} = .24$ $F_{\text{Task}} = .02$ $F_{\text{Group} \times \text{Task}} = .09$
Block 4	13.79	3.01	13.18	3.12	13.22	3.47	12.66	2.65	$F_{\text{Group}} = 1.04$ $F_{\text{Task}} = 1.21$ $F_{\text{Group} \times \text{Task}} = .00$
Overall	57.05	8.19	54.95	8.81	53.96	11.84	53.14	7.52	$F_{\text{Group}} = 2.37$ $F_{\text{Task}} = .85$ $F_{\text{Group} \times \text{Task}} = .16$

Note. BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

Table 16. Differences in the Number of Commission Errors on Go/No-Go Task by Group and Task

Block	Group by Task								Difference
	BAS-R		BAS-P		BIS-R		BIS-P		
	(N = 39)		(N = 39)		(N = 27)		(N = 29)		
	M	SD	M	SD	M	SD	M	SD	
Block 1	7.26	2.09	6.67	1.94	6.63	2.65	6.41	1.94	$F_{\text{Group}} = 1.38$ $F_{\text{Task}} = 1.15$ $F_{\text{Group} \times \text{Task}} = .25$
Block 2	6.21	2.36	6.21	2.45	5.70	2.28	5.76	2.39	$F_{\text{Group}} = 1.29$ $F_{\text{Task}} = .00$ $F_{\text{Group} \times \text{Task}} = .00$
Block 3	4.79	2.65	5.26	2.54	5.26	2.55	4.66	2.38	$F_{\text{Group}} = .02$ $F_{\text{Task}} = .03$ $F_{\text{Group} \times \text{Task}} = 1.43$
Block 4	4.26	2.61	4.69	2.77	4.52	2.75	4.14	2.30	$F_{\text{Group}} = .10$ $F_{\text{Task}} = .00$ $F_{\text{Group} \times \text{Task}} = .79$
Overall	22.51	7.17	22.82	7.62	22.11	8.21	20.93	6.85	$F_{\text{Group}} = .77$ $F_{\text{Task}} = .11$ $F_{\text{Group} \times \text{Task}} = .32$

Note. BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

Table 17. Differences in the Number of Omission Errors on Go/No-Go Task by Group and Task

Block	Group by Task								Difference
	BAS-R		BAS-P		BIS-R		BIS-P		
	(N = 39)		(N = 39)		(N = 27)		(N = 29)		
	M	SD	M	SD	M	SD	M	SD	
Block 1	3.97	1.72	4.59	2.01	4.63	2.44	4.86	1.64	$F_{\text{Group}} = 1.84$ $F_{\text{Task}} = 1.53$ $F_{\text{Group} \times \text{Task}} = .31$
Block 2	3.77	1.87	4.13	1.79	4.41	2.52	4.00	2.05	$F_{\text{Group}} = .51$ $F_{\text{Task}} = .01$ $F_{\text{Group} \times \text{Task}} = 1.16$
Block 3	3.26	1.63	3.64	1.76	3.81	1.94	3.45	1.96	$F_{\text{Group}} = .33$ $F_{\text{Task}} = .00$ $F_{\text{Group} \times \text{Task}} = 1.41$
Block 4	2.46	2.04	3.51	2.02	3.30	1.79	3.48	2.21	$F_{\text{Group}} = 1.28$ $F_{\text{Task}} = 3.04$ $F_{\text{Group} \times \text{Task}} = 1.48$
Overall	13.46	4.80	15.87	5.21	16.15	7.03	15.79	5.29	$F_{\text{Group}} = 1.81$ $F_{\text{Task}} = 1.13$ $F_{\text{Group} \times \text{Task}} = 2.04$

Note. BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

Table 18. Differences in Reaction Time on Go/No-Go Task by Group and Task

Block	Group by Task								Difference
	BAS-R (<i>N</i> = 39)		BAS-P (<i>N</i> = 39)		BIS-R (<i>N</i> = 27)		BIS-P (<i>N</i> = 29)		
	<i>M</i> (ms)	<i>SD</i>	<i>M</i> (ms)	<i>SD</i>	<i>M</i> (ms)	<i>SD</i>	<i>M</i> (ms)	<i>SD</i>	
Block 1	1409	304	1484	430	1437	393	1324	296	$F_{\text{Group}} = .62$ $F_{\text{Task}} = .16$ $F_{\text{Group} \times \text{Task}} = 3.11$
Block 2	1586	389	1575	391	1613	464	1530	324	$F_{\text{Group}} = .08$ $F_{\text{Task}} = .02$ $F_{\text{Group} \times \text{Task}} = 1.12$
Block 3	1561	399	1544	378	1695	445	1669	350	$F_{\text{Group}} = 1.67$ $F_{\text{Task}} = .04$ $F_{\text{Group} \times \text{Task}} = .19$
Block 4	1587	475	1643	399	1684	507	1737	312	$F_{\text{Group}} = .76$ $F_{\text{Task}} = 2.37$ $F_{\text{Group} \times \text{Task}} = .32$
Overall	1512	305	1552	312	1576	384	1529	224	$F_{\text{Group}} = .27$ $F_{\text{Task}} = .11$ $F_{\text{Group} \times \text{Task}} = 1.41$

Note. BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

6.4 DIFFERENCES IN THE CHANGES IN AFFECT AMONG GROUPS AND TASKS (HYPOTHESIS 5)

The differences in the changes in PA and NA from the PANAS before and after the Go/No-Go task were examined to test whether there are differences between groups in changes of positive and negative affect according to task. For this, three-way mixed ANOVAs with one within-subjects (time) variable and two between-subjects (group and task) variables were performed. There was a significant difference in PA from the PANAS before the Go/No-Go task among groups ($F[1, 130] = 27.90, p < .01$), with higher PA in the BAS-dominant group than in the BIS-dominant group (Table 19). In the BAS-dominant group, there were increases in PA after both the reward- and the punishment-only Go/No-Go task (Figure 8a). In the BIS-dominant group, there was an increase in PA after the reward-only Go/No-Go task, while there was a decrease in PA after the punishment-only Go/No-Go task (Figure 8b). The differences in patterns as a function of the group by task interaction were significant ($F[1,130] = 9.81, p < .01$) (Table 20).

In the analyses of negative affect, scores on NA from the PANAS before the Go/No-Go task were higher in the BIS-dominant group than in the BAS-dominant group. However, this difference was not significant ($F[1, 130] = .82, p = ns$) (Table 19). In both the BAS- and the BIS-dominant group, there was a decrease in NA after the reward-only Go/No-Go task, while there was an increase in NA after the punishment-only Go/No-Go task (Figure 9a and 9b). The differences in patterns were significant among tasks ($F[1,130] = 17.44, p < .01$), but not as a function of group or group by task interaction ($F_s[1,130] = .01$ and $1.62, ps = ns$) (Table 21).

Table 19. Differences in Affect by Group and Task

Time	Affect	Group by Task								Difference
		BAS-R		BAS-P		BIS-R		BIS-P		
		(<i>N</i> = 39)	(<i>N</i> = 39)	(<i>N</i> = 27)	(<i>N</i> = 29)					
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Before Task	PANAS : PA	36.51	6.55	34.03	8.40	27.81	8.03	28.21	8.47	$F_{\text{Group}} = 27.90^{**}$ $F_{\text{Task}} = .58$ $F_{\text{Group} \times \text{Task}} = 1.10$
After Task	PANAS : PA	39.54	5.63	36.08	7.18	32.63	8.62	25.45	8.30	$F_{\text{Group}} = 46.36^{**}$ $F_{\text{Task}} = 17.07^{**}$ $F_{\text{Group} \times \text{Task}} = 2.09$
Before Task	PANAS : NA	14.77	4.40	14.28	3.83	15.44	6.20	15.10	4.69	$F_{\text{Group}} = .82$ $F_{\text{Task}} = .25$ $F_{\text{Group} \times \text{Task}} = .01$
After Task	PANAS : NA	13.44	3.50	14.92	5.10	13.22	5.46	16.59	4.46	$F_{\text{Group}} = .80$ $F_{\text{Task}} = 8.95^{**}$ $F_{\text{Group} \times \text{Task}} = 1.34$

Note. PANAS: PA=Positive and Negative Affect Schedule: Positive Affect; PANAS: NA=Positive and Negative Affect Schedule: Negative Affect; BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

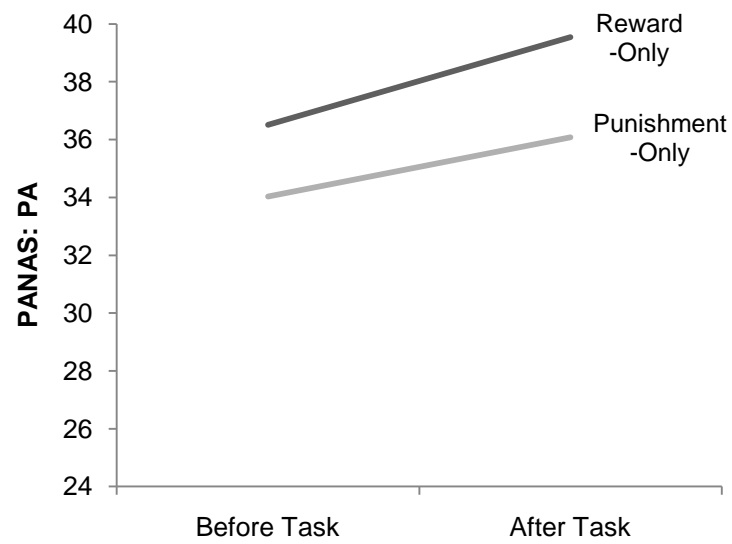


Figure 8a. Changes in Positive Affect for BAS-Dominant Group

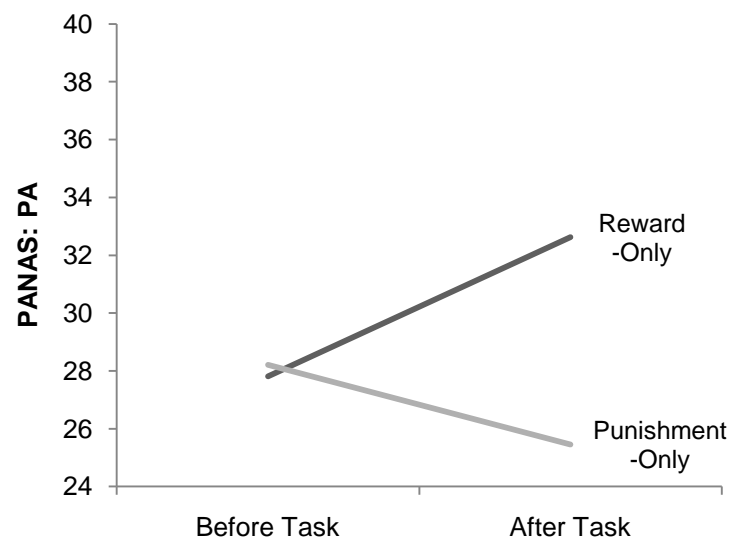


Figure 8b. Changes in Positive Affect for BIS-Dominant Group

Table 20. Summary of Three-Way Mixed ANOVA with One Within-Subjects (Positive Affect) Variable and Two Between-Subjects (Group and Task) Variables

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>
Between				
Group	4183.46	1	4183.46	42.92**
Task	660.64	1	660.64	6.78**
Group X Task	2.88	1	2.88	.03
Error	12671.35	130	97.47	
Within				
Positive Affect	207.17	1	207.17	11.46**
Group X Positive Affect	37.15	1	37.15	2.06
Task X Positive Affect	297.49	1	297.49	16.46**
Group X Task X Positive Affect	177.31	1	177.31	9.81**
Error	2350.13	130	18.08	

** $p < .01$; * $p < .05$

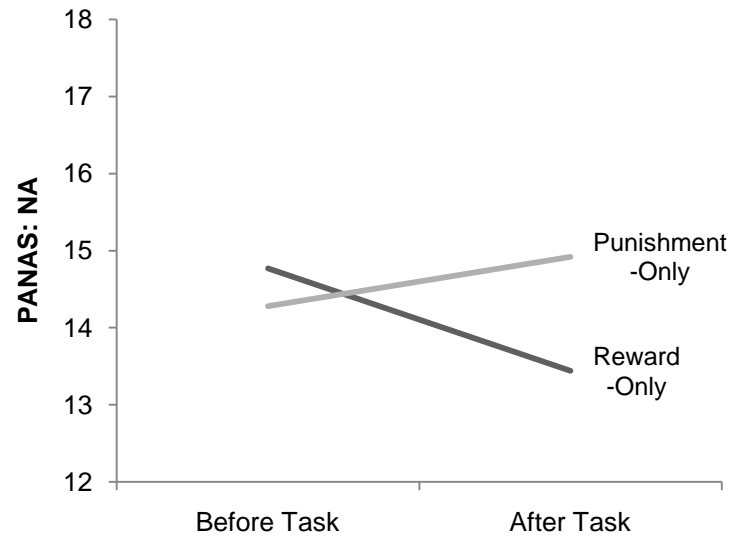


Figure 9a. Changes in Negative Affect for BAS-Dominant Group

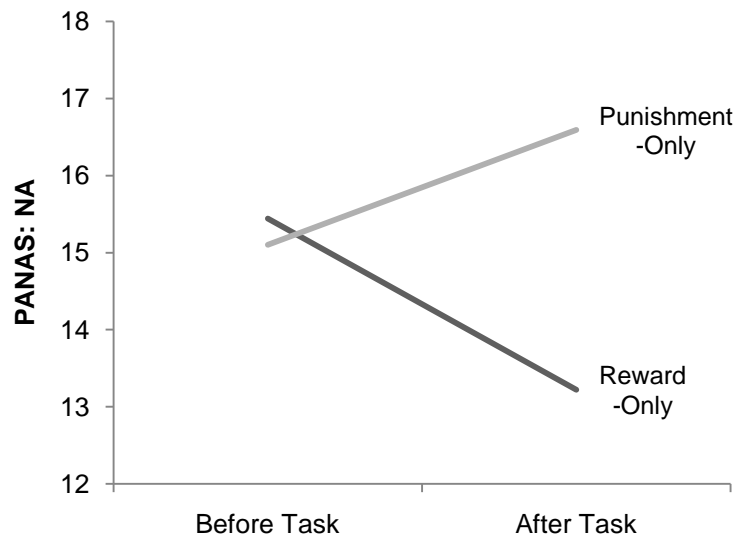


Figure 9b. Changes in Negative Affect for BIS-Dominant Group

Table 21. Summary of Three-Way Mixed ANOVA with One Within-Subjects (Negative Affect) Variable and Two Between-Subjects (Group and Task) Variables

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>
Between				
Group	35.34	1	35.34	.97
Task	65.90	1	65.90	1.82
Group X Task	16.66	1	16.66	.46
Error	4715.46	130	36.27	
Within				
Negative Affect	8.35	1	8.35	1.11
Group X Negative Affect	.01	1	.01	.01
Task X Negative Affect	131.33	1	131.33	17.44**
Group X Task X Negative Affect	12.20	1	12.20	1.62
Error	978.78	130	7.53	

** $p < .01$; * $p < .05$

6.5 DIFFERENCES IN THE CHANGES IN URGE TO DRINK AMONG GROUPS AND TASKS

(HYPOTHESIS 6)

The changes in the Urge to Drink before and after the Go/No-Go task were examined to test whether there are differences between groups in changes on urge to drink according to task. For this, three-way mixed ANOVAs with one within-subjects (time) variable and two between-subjects (group and task) variables were performed. There was a significant difference in General Urge to Drink before the Go/No-Go task as a function of the interaction ($F[1, 130] = 6.07, p < .05$), with higher General Urge to Drink in the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task and the BIS-dominant subgroup assigned to the reward-only Go/No-Go task than in the other groups (Table 22). In the BAS-dominant group, there was an increase in General Urge to Drink after the reward-only Go/No-Go task, while there was a decrease in General Urge to Drink after the punishment-only Go/No-Go task (Figure 10a). In the BIS-dominant group, there was a decrease in General Urge to Drink after the punishment-only Go/No-Go task, while there was an increase in General Urge to Drink after the reward-only Go/No-Go task (Figure 10b). The interaction effect was significant ($F[1,130] = 16.84, p < .01$) (Table 23).

Scores on Positive Urge to Drink before the Go/No-Go task were higher in the BAS-dominant group than in the BIS-dominant group. However, this difference was not significant ($F[1, 130] = 3.33, p = ns$) (Table 22). In the BAS-dominant group, there was an increase in Positive Urge to Drink after the reward-only Go/No-Go task, while there was a decrease in Positive Urge to Drink after the punishment-only Go/No-Go task (Figure 11a). In the BIS-dominant group, there were decreases in Positive Urge to Drink after both the reward- and the punishment-only Go/No-Go task (Figure 11b). The differences in patterns were significant

among groups ($F[1,130] = 5.10, p < .05$), but there was no significant group by task interaction effect ($F[1,130] = 3.66, p = ns$) (Table 24).

Scores on Negative Urge to Drink before the Go/No-Go task were lower in the BIS-dominant subgroup assigned to the punishment-only Go/No-Go task than in the other groups, especially the BIS-dominant subgroup assigned to the reward-only Go/No-Go task ($F[1,130] = 5.39, p < .05$) (Table 22). In the BAS-dominant group, there were decreases in Positive Urge to Drink after both the positive- and the reward-only Go/No-Go task (Figure 12a). In the BIS-dominant group, there was a decrease in Negative Urge to Drink after the reward-only Go/No-Go task, while there was an increase in Negative Urge to Drink after the punishment-only Go/No-Go task (Figure 12b). There was a significant group by task interaction effect ($F[1,130] = 5.38, p < .05$) (Table 25).

Table 22. Differences in Urge to Drink by Group and Task

Time	Urge to Drink	Group by Task								Difference
		BAS-R		BAS-P		BIS-R		BIS-P		
		<i>(N = 39)</i>		<i>(N = 39)</i>		<i>(N = 27)</i>		<i>(N = 29)</i>		
		<i>M (%)</i>	<i>SD</i>	<i>M (%)</i>	<i>SD</i>	<i>M (%)</i>	<i>SD</i>	<i>M (%)</i>	<i>SD</i>	
Before Task	General	15.50	15.35	25.74	24.53	18.63	21.70	11.51	17.44	$F_{\text{Group}} = 2.48$ $F_{\text{Task}} = .20$ $F_{\text{Group} \times \text{Task}} = 6.07^*$
After Task	General	20.76	18.46	24.35	24.71	10.97	15.87	15.22	19.95	$F_{\text{Group}} = 7.04^{**}$ $F_{\text{Task}} = 1.21$ $F_{\text{Group} \times \text{Task}} = .01$
Before Task	Positive	20.09	23.03	31.44	31.14	20.25	25.25	14.80	21.44	$F_{\text{Group}} = 3.33$ $F_{\text{Task}} = .43$ $F_{\text{Group} \times \text{Task}} = 3.45$
After Task	Positive	22.40	21.72	29.65	28.54	12.87	17.16	12.21	18.25	$F_{\text{Group}} = 11.70^{**}$ $F_{\text{Task}} = .70$ $F_{\text{Group} \times \text{Task}} = 1.00$
Before Task	Negative	14.13	15.54	13.86	19.57	21.14	23.28	6.48	9.99	$F_{\text{Group}} = .00$ $F_{\text{Task}} = 5.81^*$ $F_{\text{Group} \times \text{Task}} = 5.39^*$
After Task	Negative	11.28	12.04	12.07	15.50	11.86	19.50	9.80	11.86	$F_{\text{Group}} = .11$ $F_{\text{Task}} = .06$ $F_{\text{Group} \times \text{Task}} = .30$

Note. BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

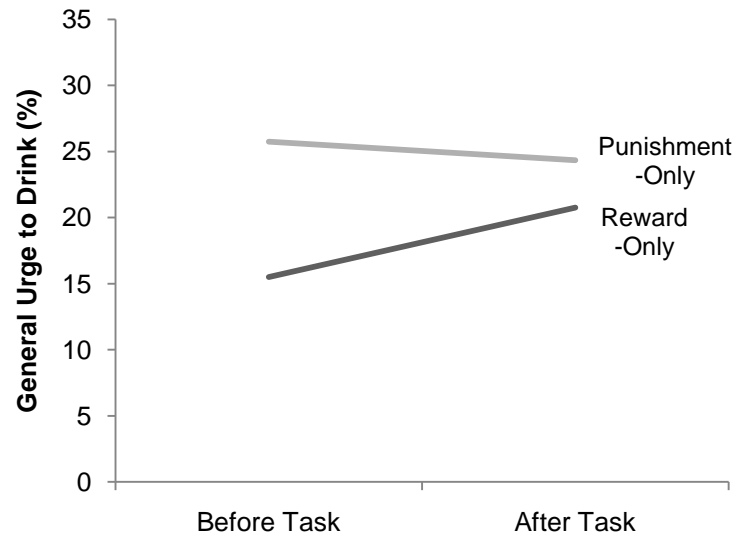


Figure 10a. Changes in General Urge to Drink for BAS-Dominant Group

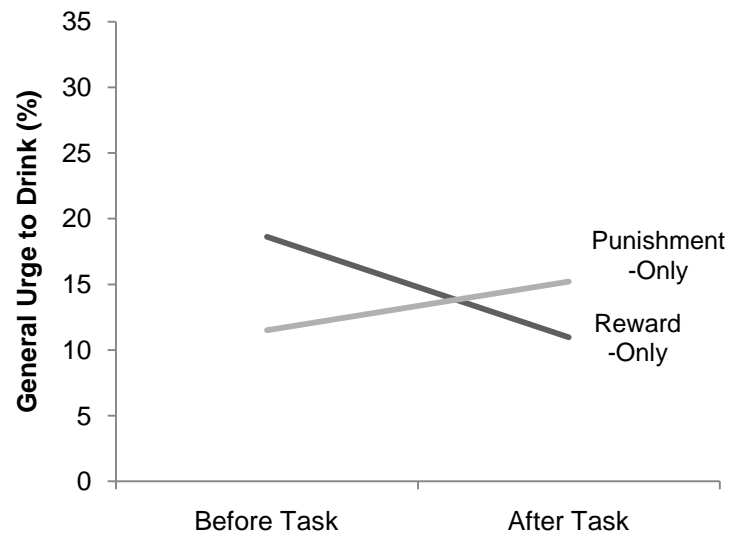


Figure 10b. Changes in General Urge to Drink for BIS-Dominant Group

Table 23. Summary of Three-Way Mixed ANOVA with One Within-Subjects (General Urge to Drink) Variable and Two Between-Subjects (Group and Task) Variables

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>
Between				
Group	3668.86	1	3668.86	4.96*
Task	488.36	1	488.36	.66
Group X Task	1134.74	1	1134.74	1.53
Error	96214.49	130	740.11	
Within				
General	.02	1	.02	.00
Group X General	249.34	1	249.34	3.18
Task X General	90.49	1	90.49	1.15
Group X Task X General	1321.67	1	1321.67	16.84**
Error	10204.93	130	78.50	

** $p < .01$; * $p < .05$

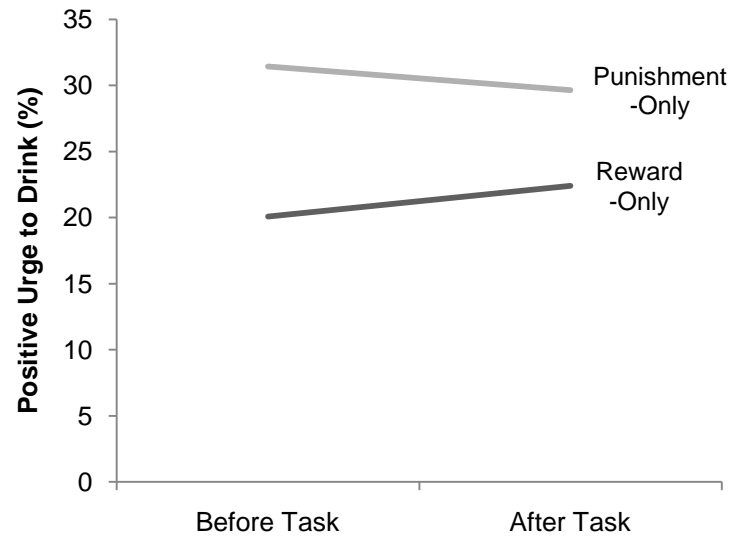


Figure 11a. Changes in Positive Urge to Drink for BAS-Dominant Group

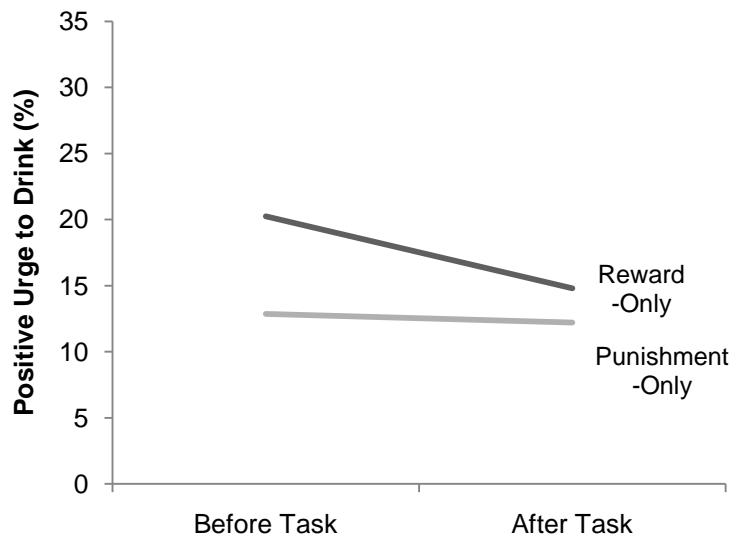


Figure 11b. Changes in Positive Urge to Drink for BIS-Dominant Group

Table 24. Summary of Three-Way Mixed ANOVA with One Within-Subjects (Positive Urge to Drink) Variable and Two Between-Subjects (Group and Task) Variables

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>
Between				
Group	7690.15	1	7690.15	7.10 ^{**}
Task	637.15	1	637.15	.59
Group X Task	2483.83	1	2483.83	2.29
Error	140890.39	130	1083.77	
Within				
Positive	363.74	1	363.74	4.14 [*]
Group X Positive	448.28	1	448.28	5.10 [*]
Task X Positive	1.89	1	1.89	.02
Group X Task X Positive	322.03	1	322.03	3.66
Error	11428.92	130	87.92	

^{**} $p < .01$; ^{*} $p < .05$

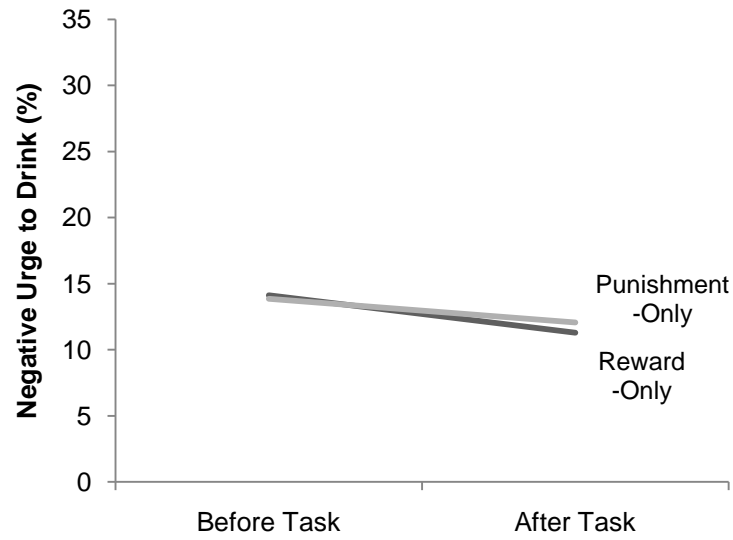


Figure 12a. Changes in Negative Urge to Drink for BAS-Dominant Group

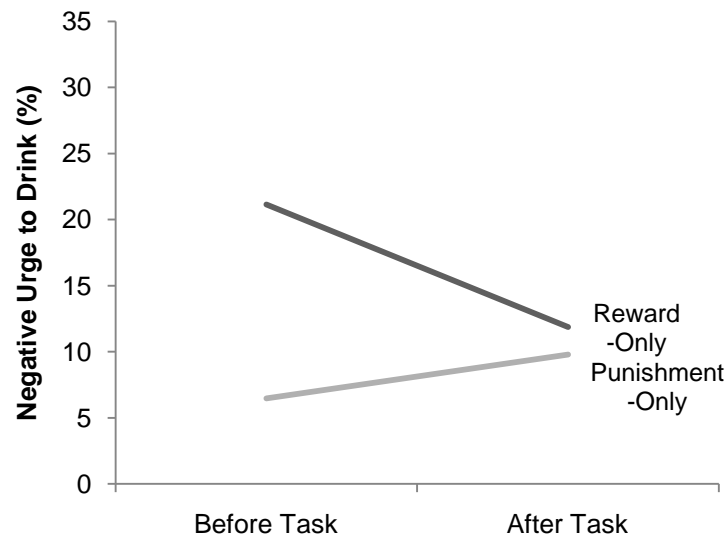


Figure 12b. Changes in Negative Urge to Drink for BIS-Dominant Group

Table 25. Summary of Three-Way Mixed ANOVA with One Within-Subject (Negative Urge to Drink) Variable and Two Between-Subject (Group and Task) Variables

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>
Between				
Group	17.26	1	17.26	.04
Task	1068.10	1	1068.10	2.48
Group X Task	1209.82	1	1209.82	2.81
Error	56005.80	130	430.81	
Within				
Negative	457.55	1	457.55	4.55*
Group X Negative	6.97	1	6.97	.07
Task X Negative	758.87	1	758.87	7.54**
Group X Task X Negative	41.42	1	541.42	5.38*
Error	13080.62	130	100.62	

** $p < .01$; * $p < .05$

6.6 DIFFERENCES IN OTHER HEALTH BEHAVIORS AMONG GROUPS AND TASKS

(HYPOTHESIS 7)

The differences in the Health Behavior Urges after the Go/No-Go were examined to test whether there are differences between groups in other health behaviors such as smoking, healthy eating, and exercising according to task. For this, 2 (BAS- and BIS-dominant group) X 2 (reward- and punishment-only Go/No-Go task) ANOVAs were performed. The results are presented in Table 26. Scores on Negative Health Behavior Urges: Smoking after the Go/No-Go task were higher in the BIS-dominant group than in the BAS-dominant group. However, these differences were not significant ($F[1,130] = 2.01, p = ns$). Also, there were no significant group by task interaction effects on General, Positive, and Negative Health Behavior Urges: Smoking after the Go/No-Go task ($F_s[1,130] = .05$ to $.48, ps = ns$).

There was a significant difference in General Health Behavior Urges: Unhealthy Eating after the Go/No-Go task among groups ($F[1,130] = 4.06, p < .05$), with greater General Health Behavior Urges: Unhealthy Eating in the BAS-dominant group than the BIS-dominant group. However, there were no significant differences in General, Positive, and Negative Health Behavior Urges: Eating after the Go/No-Go task among groups by tasks ($F_s[1,130] = .01$ to $1.15, ps = ns$).

There were significant group effects on General and Positive Health Behavior Urges: Exercising after the Go/No-Go task ($F_s[1,130] = 12.18$ and $7.32, p < .01$), with greater General and Positive Health Behavior Urges: Exercising in the BAS-dominant group than the BIS-dominant group. However, there were no significant interaction effect on General, Positive, and Negative Health Behavior Urges: Exercising after the Go/No-Go task among groups by tasks ($F_s[1,130] = .06$ to $1.28, ps = ns$).

Table 26. Differences in Health Behavior Urges among Group and Task

Health Behavior Urges		Group by Task								Difference
		BAS-R		BAS-P		BIS-R		BIS-P		
		(N = 39)		(N = 39)		(N = 27)		(N = 29)		
		M(%)	SD	M(%)	SD	M(%)	SD	M(%)	SD	
Smoking	General	31.30	29.16	29.16	30.84	38.32	28.24	37.10	25.19	$F_{\text{Group}} = .05$ $F_{\text{Task}} = .45$ $F_{\text{Group} \times \text{Task}} = .05$
	Positive	30.23	30.38	32.37	33.28	36.03	24.43	36.03	29.16	$F_{\text{Group}} = .07$ $F_{\text{Task}} = .00$ $F_{\text{Group} \times \text{Task}} = .14$
	Negative	13.28	14.35	11.30	23.05	26.56	18.32	25.04	26.87	$F_{\text{Group}} = 2.01$ $F_{\text{Task}} = .06$ $F_{\text{Group} \times \text{Task}} = .48$
Eating	General	43.51	30.08	38.32	28.85	27.79	26.87	33.44	29.47	$F_{\text{Group}} = 4.06^*$ $F_{\text{Task}} = .00$ $F_{\text{Group} \times \text{Task}} = 1.15$
	Positive	30.84	12.52	32.52	26.41	25.34	23.34	23.21	25.80	$F_{\text{Group}} = 2.64$ $F_{\text{Task}} = .00$ $F_{\text{Group} \times \text{Task}} = .20$
	Negative	12.37	17.71	16.95	22.14	10.84	14.50	16.03	20.15	$F_{\text{Group}} = .16$ $F_{\text{Task}} = 2.10$ $F_{\text{Group} \times \text{Task}} = .01$
Exercising	General	58.02	27.48	47.48	30.38	35.17	24.43	35.88	28.70	$F_{\text{Group}} = 12.18^{**}$ $F_{\text{Task}} = 1.04$ $F_{\text{Group} \times \text{Task}} = 1.28$
	Positive	52.37	28.85	45.80	32.82	33.28	24.58	36.34	31.76	$F_{\text{Group}} = 7.32^{**}$ $F_{\text{Task}} = .12$ $F_{\text{Group} \times \text{Task}} = .84$
	Negative	26.56	25.04	29.31	27.79	20.92	19.69	25.95	28.24	$F_{\text{Group}} = 1.00$ $F_{\text{Task}} = .77$ $F_{\text{Group} \times \text{Task}} = .06$

Note. BAS-R=BAS-dominant group who assigned to reward-only Go/No-Go task; BAS-P=BAS-dominant group who assigned to punishment-only Go/No-Go task; BIS-R=BIS-dominant group who assigned to reward-only Go/No-Go task; BIS-P=BIS-dominant group who assigned to punishment-only Go/No-Go task

** $p < .01$; * $p < .05$

Chapter 7: Reinforcement Sensitivity, Life Events, Affect, and Alcohol Use in Everyday Life

Discussion

Study 2 tested whether and how reinforcement sensitivity and reinforcement contingencies predict affect and urge to drink in an experimental context. Manipulation checks confirmed that the BAS-dominant group had higher BAS factor scores than the BIS-dominant group, while the BIS-dominant group had higher BIS factor scores than the BAS-dominant group. The BAS-dominant group also showed heavy drinking more frequently than the BIS-dominant group, reflecting the positive and direct relationship between BAS sensitivity and heavy drinking. However, there was no difference in drinking problems among groups. Also, there were no group differences on other health behaviors at baseline.

In this study, the Go/No-Go task was administered to expose the participants to reward- or punishment-only situation meant to provoke positive or negative affect. Thus, the differences in positive and negative affect after the reward- or the punishment-only Go/No-Go task were assessed to confirm that the Go/No-Go task worked as intended. The results showed that there was a significant increase in positive affect after the reward-only Go/No-Go task, but no change in negative affect. Also, negative affect significantly increased and positive affect significantly decreased after the punishment-only Go/No-Go task. Thus, the reward- and the punishment-only Go/No-Go task provoked positive and negative affect as intended.

Another reason that the Go/No-Go task was included in this study was to explore whether performance on the Go/No-Go task would reflect the characteristics of BAS and BIS sensitivity. For this, group effects on Go/No-Go task performance were assessed. There was a pattern that the BAS-dominant group showed higher numbers of total responses and commission errors than

the BIS-dominant group, while the BIS-dominant group showed lower numbers of total responses and higher numbers of omission errors than the BAS-dominant group. Also, the BAS-dominant group assigned to the reward-only Go/No-Go task and the BIS-dominant group assigned to the punishment-only Go/No-Go task showed faster responses than the other groups. This pattern was relatively clear in the first and second blocks, but disappeared at the third and fourth blocks, when the participants began to learn which numbers were "good" and "bad." However, this pattern did not reach the level of statistical significance. Thus, this study did not replicate the results of the earlier study in which the same reward- and punishment-only Go/No-Go task was used and the relationships between BAS/BIS sensitivity and task performances were revealed (Gomez & McLaren, 1997). Also, this result did not support the line of research findings on which the latter study was based, such as studies considering performances on passive avoidance learning tasks according to personality factors. However, it should be considered that this study directly applied the BAS/BIS concept, different from the most of the previous studies applying BAS/BIS-related concepts (e.g., extraversion and neuroticism). Also, in this study, individual differences in relative BAS or BIS dominance were considered, compared to the previous studies focusing on global correlations between BAS and BIS sensitivity and performances on tasks.

The differences in the changes in positive and negative affect were assessed to test for group by task interaction effects. The BAS-dominant group showed higher positive affect at baseline than the BIS-dominant group. Regardless of the type of the Go/No-Go task, there was an increase in positive affect after the task in the BAS-dominant group. However, in the BIS-dominant group, positive affect increased after the reward-only Go/No-Go task, while it decreased after the punishment-only Go/No-Go task. The high positive affect at baseline and

increases in positive affect regardless of the type of task suggested that the BAS is more susceptible to experience positive affect than the BIS. Especially in a novel situation such as the experiment, BAS-dominant students seemed to perceive the situation as positive and thus experience positive affect. Meanwhile, the BAS-dominant subgroup assigned to the reward-only Go/No-Go task showed a decrease in negative affect, while the BAS-dominant subgroup assigned to the punishment-only Go/No-Go task showed an increase in negative affect. The BIS-dominant group showed the same patterns of increase and decrease in negative affect according to the type of the task as the BAS-dominant group. However, the degree of increase and decrease was larger in the BIS-dominant group than in the BAS-dominant group. This suggests that the BIS is more susceptible to the experience of negative affect. Also, the greater change in affect even in those assigned to the reward-only Go/No-Go task suggests that BIS-dominant students are more reactive to even positive events in terms of the relief from negative affect.

Next, urge to drink was assessed to test for group by task interaction effects. There were significant increases in general urge to drink in the BAS-dominant subgroup assigned to the reward-only Go/No-Go task and the BIS-dominant subgroup assigned to the punishment-only Go/No-Go task, compared to the other two groups. There was also a slight increase in positive urge to drink in the BAS-dominant subgroup assigned to the reward-only Go/No-Go task, which did not reach the significant level. Rather, regardless of the type of the task, the BAS-dominant group showed only a slight change in positive urge to drink, while the BIS-dominant group showed slight decreases in positive urge to drink. This means that, even when the BAS-dominant subgroup assigned to the reward-only Go/No-Go task, their increased urge to drink may not be directed toward enhancing or maintaining positive affect. On the contrary, there was an increase in negative urge to drink in the BIS-dominant group assigned to the punishment-only Go/No-Go

task, which reached the significant level. Negative urge to drink slightly decreased in the BAS-dominant group, regardless of the type of the task, and it dramatically decreased in the BIS-dominant subgroup assigned to the reward-only Go/No-Go task. This means that the BIS-dominant group's increased urge to drink may be directed toward regulating negative affect, and they are more reactive even to positive events in terms of the decrease in negative urge to drink. The differential functions of urge to drink in the BAS- and BIS-dominant groups are clear if the changes in affect are considered. The BAS-dominant group showed increases in positive affect after the task, regardless of the type of the task, but the increases in positive affect were not reflected in positive urge to drink. The BIS-dominant subgroup assigned to the punishment-only Go/No-Go task showed an increase in negative affect, which was reflected in the increased negative urge to drink. Also, the BIS-dominant subgroup assigned to the reward-only Go/No-Go task showed a dramatic decrease in negative affect, compared to the BAS-dominant group, which was reflected in the dramatic decrease in negative urge to drink. Overall, as in Study 1, this result supports the main hypothesis that both BAS and BIS sensitivity is related to alcohol use, but the role of affect is more specific to the BIS rather than the BAS, in the context of alcohol use. In this causal interpretation, the probability of response bias such as demand characteristics (Orne, 1962) or the influence of any extraneous variables cannot be totally excluded. However, it is believed that the use of the experimental design, the compliance to the procedure of random assignment and the use of visual analogue scales reduced the probability that response bias or extraneous variables systematically influence the causal relationship between affect and urge to drink. In addition, the complex interactions observed are unlikely to result from a simple demand effect.

Last, the differences in urge to engage in other health behaviors were assessed to examine the applicability of the findings for alcohol use to other health behaviors. The urge to smoke was not significantly different as a function of group or task. There was a significant difference in general urge to eat after the task between BAS- and BIS-dominant groups, but there were no group differences in positive or negative urge to eat after the task. Also, the two groups were not differentially reactive to reward- or punishment-only Go/No-Go tasks in terms of general, positive, and negative urge to eat after the task. Finally, there was a significant group difference in general and positive urge to exercise after the task. However, there was no group by task interaction effect on general, positive, or negative urge to exercise. Thus, some other health behaviors such as eating and exercising had significant relationships with reinforcement sensitivity, but the effects of events and affect seemed not to be involved in the relationships. Overall, as in Study 1, it appeared that the hypothesized relationships among reinforcement sensitivity, events, and affect and their impact on health behaviors were specific to alcohol use.

Although hypotheses about changes in affect and alcohol-related urges were supported in this study, there are some limitations to be considered in the interpretation of the results. First, the process of random assignment was strictly followed in respect to task assignment, but there were some baseline differences between the BIS and the BAS-dominant group, as might be expected. An example is the baseline difference in the gender ratio between the BAS- and BIS-dominant groups. Some studies have suggested that BIS sensitivity is higher in females than males (Torrubia, Ávila, & Caseras, 2008; Torrubia, Ávila, Moltó, & Caseras, 2001), which may be reflected by the definitely larger number of females in the BIS-dominant group in this study. Meanwhile, since alcohol use is more frequent in males or male college students (Byrnes, Miller, & Schafer, 1999; Ham & Hope, 2003), the impact of the differential gender ratio cannot be

ignored. Thus, in order to eliminate this potentially confounding factor, the gender differences in the BAS and BIS should be considered in future research, perhaps by the application of differential selection criterion for males and females. Other baseline differences may be more problematic. For example, there were interaction effects on general and negative urge to drink at baseline. This problem was not so critical in the interpretation of the results in this study because this study focused on the differences in the patterns of the changes in urge to drink before and after the task. However, in order to confirm that there are no baseline differences related to dependent variables among groups and thus make interpretation straightforward, a larger sample might be employed using random assignment, or other kinds of assignment methods such as matching should be applied in the future research.

Another limitation is the size of the changes in affect and urge to drink. Although affect and urge to drink were generally changed in the expected direction, the degrees of the changes were relatively small. In this study, affect was changed by 1 to 5 points out of 50 points, and urge to drink was changed by 1 to 10 percent. In order to provoke the changes in affect and urge to drink, this study administered a manipulation that was used in a previous study (Gomez & McLaren, 1997), in which it also produced relatively small changes in affect and urge to drink. However, these small changes in affect and urge to drink may be different from ones that individuals experience in everyday life. Thus, to improve the generalization of the study findings to real-life situations, stronger manipulations to change affect and urge to drink should be considered in future research.

Chapter 8: General Discussion and Implications

From the two studies in this project, it was consistently suggested that BAS sensitivity directly predicts alcohol use, especially heavy drinking, while BIS sensitivity predicts alcohol use, especially problem drinking, in interaction with negative events and through the mediation of negative affect. In other words, both BAS and BIS sensitivity are related to alcohol use. However, the ways in which BAS and BIS sensitivity are associated with alcohol use are different, and BAS and BIS sensitivity are related to different aspects of alcohol use, so-called quantity and quality aspects of alcohol use. This result has implications for previous studies investigating various predictions of alcohol use in college students. First, many studies have focused on the simple relationships between personality factors and alcohol use or between affective factors and alcohol use. However, this study suggests a broader picture with related variables is needed in alcohol use studies. Personality may be too distal to predict alcohol use because it cannot reflect situational variations related to actual alcohol use. Likewise, affective factors may be too unstable to predict consistent patterns of alcohol use. Although in this study the simultaneous considerations of personality and affective factors enhanced the ability to explain alcohol use, and their interrelationships revealed some different paths to predict alcohol use in college students, two factors may not be enough. For example, coping strategies have been frequently included in alcohol use studies and the relationships of coping strategies with personality and affect have been well established. Thus, the inclusion of this related variable might increase the predictability of alcohol use.

Second, the previous studies investigating the relationship between personality and alcohol use in college students have reported inconsistent findings. Although the BAS and BAS-related personality factors (e.g., extraversion, sensation seeking) have been consistently and

positively related to alcohol use, the BIS and BIS-related personality factors (e.g., neuroticism, harm avoidance) have been inconsistently associated with alcohol use. Both studies in this project suggested the probable reason of this inconsistency in the relationships between the BIS and alcohol use. In other words, the BIS or BIS-related personality factors function as vulnerability to negative life events and trigger negative affect, which predicts alcohol use. Thus, without consideration of negative life events and affect, the simple relationships between the BIS and alcohol use may be unstable. Further, if only the quantity of alcohol use is considered, the relationships between the BIS and alcohol use may be not positive because the BIS, negative life events, and negative affect are more related to the qualitative aspect of alcohol use (i.e., problem drinking) rather than the quantitative aspect of alcohol use.

Third, the motivational model of drinking based on the relationships between affect and alcohol use has frequently been studied in college students. Although there have been a lot of studies that support the motivational model of drinking, the concepts of the motivational model should be reconsidered, based on the results of this study. In other words, enhancement and coping motives explain drinking behavior as triggered by mood or mood alteration. However, enhancement motives are not related to the experience of positive affect. Further, the two studies in this project consistently suggested that positive affect or the change in positive affect is not reflected in alcohol use or the change in urge to drink. Thus, although coping motives involving the regulation of negative affect may be valid to explain alcohol use, enhancement motives involving the improvement or maintenance of positive affect may be less likely to predict alcohol use in college students.

Since alcohol use is frequently considered as a coping strategy, other health behaviors such as smoking, eating, and exercising were included to determine the specificity of effects to

drinking. However, in the two studies of this project, reinforcement sensitivity and affect did not explain other health behaviors well. It appears that the models studied have at least some specificity in the prediction of alcohol use. This might be expected to some extent, given that the literature review and design of the current project focused on alcohol use. However, important factors, including personality and affective factors, and their relationships, specific to other health behaviors should be considered in future research. Also, if there are different factors that contribute to the explanation of other health behaviors, it will be an interesting research question to explore which factors predict specific health behaviors among other health-related coping strategies.

Last, there are some practical implications in this study. It was previously mentioned that models of health behavior form a framework for research and intervention. Some important factors in traditional models of health behaviors, such as perceived susceptibility from the Health Beliefs Model, look closely related to reinforcement sensitivity. The factors in models of health behaviors have been frequently related to other personality factors, such as extraversion and neuroticism, but they have seldom been studied in relation to the BAS and BIS. This study provides evidence of an important role for reinforcement sensitivity in alcohol use research and programs. Thus, existing research and interventions based on models of health behaviors may be more productive and effective to predict and treat heavy drinking and drinking problems by applying work on reinforcement sensitivity, and related situational variation such as life events and affect. For this to occur, more studies that investigate the application of reinforcement sensitivity to real interventions or programs in alcohol use are needed in the future.

Also, as mentioned before, BAS and BIS sensitivity have been already applied in work on message framing. Because in this study, the types of reinforcement sensitivity and drinking

motives were differentially related to aspects of alcohol use and drinking situations, it is clearer which type of message framing can be used to prevent or treat which aspect of alcohol use and in which situation. However, the relationships between the BAS/BIS and message framing were not firmly established, and thus more studies are needed on this topic in the future. In other words, as mentioned before, many studies have suggested that message frames involving advantages of health behaviors work through the BAS, while message frames involving disadvantages of health behaviors function through the BIS (Dillard & Anderson, 2004; Lauriola, Rusoo, Lucidi, Violani, & Levin, 2005; Shen & Dillard, 2007; Sherman, Mann, & Updegraff, 2006). However, additional research points up the complexity of the issue. For example, it has been suggested that disadvantage-framing is more effective for individuals who are willing to take some risks to engage in disease detection behaviors, while advantage-framing is more effective for individuals who try to avoid risks by engaging in preventive health behaviors (Gerend & Cullen, 2008; Rothman, Bartels, Wlaschin, & Salovey, 2006; Rothman & Salovey, 1997). If it is considered that the BAS or BAS-related personality constructs (e.g., sensation seeking) is related to more risk-taking than the BIS or BIS-related personality constructs (e.g., harm avoidance), these lines of research appear to be inconsistent with one another. Also, if the types of message framing have differential effects according to personality and types of health behaviors, there is an implication that target groups and behaviors should be more specified in future research. Thus, it is hoped that this study will trigger further research investigating reinforcement sensitivity and alcohol use, especially, in applied areas such as message framing.

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Appendix A

Demographic Survey

Please respond to the following items:

1. Gender: Male ____ Female ____

2. Age: _____

3. Ethnicity (place a checkmark next to the appropriate description):

(a) ____ Hispanic or Latino

(b) ____ White, not of Hispanic origin

(c) ____ Black, not of Hispanic origin

(d) ____ Asian or Pacific Islander

(e) ____ Native American

(f) ____ Other (write in): _____

4. Academic level:

(a) ____ Freshman

(b) ____ Sophomore

(c) ____ Junior

(d) ____ Senior

(e) ____ Graduate Student

Appendix B

BIS/BAS Scales

Each item of this questionnaire is a statement that a person may either agree with or disagree with. For each item, indicate how much you agree or disagree with what the item says. Please respond to all the items; do not leave any blank. Choose only one response to each statement. Please be as accurate and honest as you can be. Respond to each item as if it were the only item. That is, don't worry about being "consistent" in your responses.

	Very true for me	Somewhat true for me	Somewhat false for me	Very false for me
1. A person's family is the most important thing in life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Even if something bad is about to happen to me, I rarely experience fear or nervousness.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I go out of my way to get things I want.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. When I'm doing well at something I love to keep at it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I'm always willing to try something new if I think it will be fun.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. How I dress is important to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. When I get something I want, I feel excited and energized.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Criticism or scolding hurts me quite a bit.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. When I want something I usually go all-out to get it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I will often do things for no other reason than that they might be fun.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. It's hard for me to find the time to do things such as get a haircut.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. If I see a chance to get something I want I move on it right away.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. I feel pretty worried or upset when I think or know somebody is angry at me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. When I see an opportunity for something I like I get excited right away.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. I often act on the spur of the moment.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Very true for me	Somewhat true for me	Somewhat false for me	Very false for me
16. If I think something unpleasant is going to happen I usually get pretty “worked up.”	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. I often wonder why people act the way they do.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. When good things happen to me, it affects me strongly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. I feel worried when I think I have done poorly at something important.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. I crave excitement and new sensations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. When I go after something I use a “no holds barred” approach.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. I have very few fears compared to my friends.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. It would excite me to win a contest.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. I worry about making mistakes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Appendix C

Sensitivity to Punishment and Sensitivity to Reward Questionnaire

Please answer to the following questions about characteristics. Please respond to all the items; do not leave any blank. Please be as accurate and honest as you can be.

	Yes	No
1. Do you often refrain from doing something because you are afraid of it being illegal?	<input type="checkbox"/>	<input type="checkbox"/>
2. Does the good prospect of obtaining money motivate you strongly to do some things?	<input type="checkbox"/>	<input type="checkbox"/>
3. Do you prefer not to ask for something when you are not sure you will obtain it?	<input type="checkbox"/>	<input type="checkbox"/>
4. Are you frequently encouraged to act by the possibility of being valued in your work, in your studies, with your friends or with your family?	<input type="checkbox"/>	<input type="checkbox"/>
5. Are you often afraid of new or unexpected situations?	<input type="checkbox"/>	<input type="checkbox"/>
6. Do you often meet people that you find physically attractive?	<input type="checkbox"/>	<input type="checkbox"/>
7. Is it difficult for you to telephone someone you do not know?	<input type="checkbox"/>	<input type="checkbox"/>
8. Do you like taking some drugs because of the pleasure you get from them?	<input type="checkbox"/>	<input type="checkbox"/>
9. Do you often renounce your rights when you know you can avoid a quarrel with a person or an organization?	<input type="checkbox"/>	<input type="checkbox"/>
10. Do you often do things to be praised?	<input type="checkbox"/>	<input type="checkbox"/>
11. As a child, were you troubled by punishments at home or in school?	<input type="checkbox"/>	<input type="checkbox"/>
12. Do you like being the center of attention at a party or a social meeting?	<input type="checkbox"/>	<input type="checkbox"/>
13. In tasks that you are not prepared for, do you attach great importance to the possibility of failure?	<input type="checkbox"/>	<input type="checkbox"/>
14. Do you spend a lot of your time on obtaining a good image?	<input type="checkbox"/>	<input type="checkbox"/>
15. Are you easily discouraged in difficult situations?	<input type="checkbox"/>	<input type="checkbox"/>
16. Do you need people to show their affection for you all the time?	<input type="checkbox"/>	<input type="checkbox"/>
17. Are you a shy person?	<input type="checkbox"/>	<input type="checkbox"/>
18. When you are with a group, do you try to make your opinions the most intelligent or the funniest?	<input type="checkbox"/>	<input type="checkbox"/>
19. Whenever possible, do you avoid demonstrating your skills for fear of being embarrassed?	<input type="checkbox"/>	<input type="checkbox"/>
20. Do you often take the opportunity to pick up people you find attractive?	<input type="checkbox"/>	<input type="checkbox"/>

	Yes	No
21. When you are with a group, do you have difficulties selecting a good topic to talk about?	<input type="checkbox"/>	<input type="checkbox"/>
22. As a child, did you do a lot of things to get people's approval?	<input type="checkbox"/>	<input type="checkbox"/>
23. Is it often difficult for you to fall asleep when you think about things you have done or must do?	<input type="checkbox"/>	<input type="checkbox"/>
24. Does the possibility of social advancement move you to action, even if this involves not playing fair?	<input type="checkbox"/>	<input type="checkbox"/>
25. Do you think a lot before complaining in a restaurant if your meal is not well prepared?	<input type="checkbox"/>	<input type="checkbox"/>
26. Do you generally give preference to those activities that imply an immediate gain?	<input type="checkbox"/>	<input type="checkbox"/>
27. Would you be bothered if you had to return to a store when you noticed you were given the wrong change?	<input type="checkbox"/>	<input type="checkbox"/>
28. Do you often have trouble resisting the temptation of doing forbidden things?	<input type="checkbox"/>	<input type="checkbox"/>
29. Whenever you can, do you avoid going to unknown places?	<input type="checkbox"/>	<input type="checkbox"/>
30. Do you like to compete and do everything you can do to win?	<input type="checkbox"/>	<input type="checkbox"/>
31. Are you often worried by things you said or did?	<input type="checkbox"/>	<input type="checkbox"/>
32. Is it easy for you to associate tastes and smells to very pleasant events?	<input type="checkbox"/>	<input type="checkbox"/>
33. Would it be difficult for you to ask your boss for a raise (salary increase)?	<input type="checkbox"/>	<input type="checkbox"/>
34. Are there a large number of objects or sensations that remind you of pleasant events?	<input type="checkbox"/>	<input type="checkbox"/>
35. Do you generally avoid speaking in public?	<input type="checkbox"/>	<input type="checkbox"/>
36. When you start to play with a slot machine, is it often difficult for you to stop?	<input type="checkbox"/>	<input type="checkbox"/>
37. Do you, on a regular basis, think that you could do more things if it was not for your insecurity or fear?	<input type="checkbox"/>	<input type="checkbox"/>
38. Do you sometimes do things for quick gains?	<input type="checkbox"/>	<input type="checkbox"/>
39. Comparing yourself to people you know, are you afraid of many things?	<input type="checkbox"/>	<input type="checkbox"/>
40. Does your attention easily stray from your work in the presence of an attractive stranger?	<input type="checkbox"/>	<input type="checkbox"/>

	Yes	No
41. Do you often find yourself worrying about things to the extent that performance in intellectual abilities is impaired?	<input type="checkbox"/>	<input type="checkbox"/>
42. Are you interested in money to the point of being able to do risky jobs?	<input type="checkbox"/>	<input type="checkbox"/>
43. Do you often refrain from doing something you like in order not to be rejected or disapproved of by others?	<input type="checkbox"/>	<input type="checkbox"/>
44. Do you like to put competitive ingredients in all of your activities?	<input type="checkbox"/>	<input type="checkbox"/>
45. Generally, do you pay more attention to threats than to pleasant events?	<input type="checkbox"/>	<input type="checkbox"/>
46. Would you like to be a socially powerful person?	<input type="checkbox"/>	<input type="checkbox"/>
47. Do you often refrain from doing something because of your fear of being embarrassed?	<input type="checkbox"/>	<input type="checkbox"/>
48. Do you like displaying your physical abilities even though this may involve danger?	<input type="checkbox"/>	<input type="checkbox"/>

Appendix D

Daily Event Survey

Using the key below, rate each event on how frequently it happened for the last 6 months and how important it was to you.

	Rarely /Never	Sometimes	Frequently	Extremely frequently
1. Had especially good interactions with friend(s) or acquaintance(s).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Completed work on an interesting project or assignment.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Showed an interest in someone and they ignored or rejected me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Did poorly on a school or work task (e.g., test, assignment, job duty).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Received or sent a card, gift, or positive letter.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Did some extra activity to enhance my schooling or career.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Did something awkward or embarrassing in a social situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Got added pressure to work harder in my classes or job.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Kissed, necked, petted, or had other sexual relations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Teacher, boss, or other authority figure complimented me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Was excluded or left out by my group of friends.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Felt behind in coursework or work duties.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Went out socializing with friends/date (e.g., party, dance, club).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Met a daily fitness goal.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Tried to share something important and other acted disinterested.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Had problems controlling negative feelings.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Had especially good interaction with my steady date.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Performed well (sports, music, speaking, drama, etc).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. A disagreement with a close friend or steady date was left unresolved.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. Teacher, boss, or other authority figure disapproved of me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Rarely /Never	Sometimes	Frequently	Extremely frequently
21. Did something special for a friend/steady date which was appreciated.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. Went to a stimulating class or lecture.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Got along poorly with a family member.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Did OK on a school or work task but worse than I expected.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. Flirted with someone or arranged a date.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. Talked about my career ambitions with someone.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. Friend or steady date let me down (didn't call, meet, or do as promised).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. Was either kept waiting or was directed in a bossy manner.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. Patched things up with a friend or steady date.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. Got caught up (or ahead) in coursework or work duties.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. Got along poorly with peers (e.g., classmates, co-workers, roommates).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. Failed to meet a daily fitness goal.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. Made a new friend or nice acquaintance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34. Classmate, co-worker, or friend complimented me on my abilities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. Steady date/friend and I discussed negative aspects of our relationship.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36. Felt overwhelmed by difficult class material.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37. Went out to eat with a friend/date.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38. Achieved a goal in an area related to work or school.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39. Talked to or was near unpleasant people.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40. Tried to do homework and couldn't understand it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41. Got along well with a family member.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42. Did well on a school or work task (e.g., test, assignment, job duty).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Rarely /Never	Sometimes	Frequently	Extremely frequently
43. Was separated from my steady date/friends for a day or more.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44. Did not have enough privacy.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45. Spent pleasant time with friends/date/family in a homelike setting.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46. Friend, steady, date, or family member was displeased with me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
47. Friend, steady date, or family member helped me out with a problem.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
48. Had plans fall through to spend time with someone special.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49. Had a minor illness, injury, or discomfort.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50. Had financial problems (unexpected expense, overspent, etc).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51. Took (or am still on) a pleasant trip out of town.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
52. Had other pleasant event involving friends/family/date.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
53. Had other unpleasant event involving friends/family/date.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
54. Had other pleasant event involving performance at school/work/other.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
55. Had other unpleasant event involving performance at school/work/other.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
56. Had other pleasant event.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
57. Had other unpleasant event.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Appendix E

Positive and Negative Affect Schedule (“In General” Instructions)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you generally feel this way, that is how you feel on the average. Use the following scale to record your answers.

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
_____	interested	_____	irritable	
_____	distressed	_____	alert	
_____	excited	_____	ashamed	
_____	upset	_____	inspired	
_____	strong	_____	nervous	
_____	guilty	_____	determined	
_____	scared	_____	attentive	
_____	hostile	_____	jittery	
_____	enthusiastic	_____	active	
_____	proud	_____	afraid	

Appendix F

Drinking Motives Questionnaire

Please read each item below and indicate, by using the following rating scale, how often you drink for it.

<i>How often do you drink . . .</i>	Never/ Almost never	Some of the time	Half of the time	Most of the time	Almost always/ Always
1. To forget your worries?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Because your friends pressure you to drink?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Because it helps you enjoy a party?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Because it helps you when you feel depressed or nervous?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. To be sociable?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. To cheer up when you're in a bad mood?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Because you like the feeling?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. So that others won't kid you about not drinking?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Because it's exciting?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. To get high?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Because it makes social gatherings more fun?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. To fit in with a group you like?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Because it gives you a pleasant feeling?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Because it improves parties and celebrations?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Because you feel more self-confident or sure of yourself?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. To celebrate a special occasion with friends?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. To forget about your problems?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Because it's fun?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. To be liked?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. So you won't feel left out?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Appendix G

Frequency of Heavy Drinking

1. A drink is a 4 oz. glass of wine, a 12 oz. wine cooler, a 12 oz. beer, or a shot or drink containing 1 oz. of liquor. Using these guidelines, about how many drinks on the average would you have on a typical day when you drank during the past 6 months? _____

■ If your answer to question 1 is 0, skip the following questions (question 2 and 3).

Use following scale (2-3):

- A. 5 times a week or more
- B. 3 to 4 times a week
- C. 2 times a week
- D. 1 time a week
- E. 2 to 3 times a month
- F. 1 time a month
- G. 3 to 5 times in past 6 months
- H. 1 to 2 times in past 6 months
- I. Never

2. How often during the past six months did you have 5 or more drinks of any kind of alcoholic beverage in a single day? _____

3. How often during the past 6 months did you drink enough to get drunk or very, very high?

Appendix H

Short Michigan Alcoholism Screening Test

Please check the appropriate answer.

	Yes	No
1. Do you feel you are a normal drinker?	<input type="checkbox"/>	<input type="checkbox"/>
2. Do your spouse or parents worry or complain about your drinking?	<input type="checkbox"/>	<input type="checkbox"/>
3. Do you ever feel bad about your drinking?	<input type="checkbox"/>	<input type="checkbox"/>
4. Do friends or relatives think you are a normal drinker?	<input type="checkbox"/>	<input type="checkbox"/>
5. Are you always able to stop drinking when you want to?	<input type="checkbox"/>	<input type="checkbox"/>
6. Have you ever attended a meeting of Alcoholics Anonymous?	<input type="checkbox"/>	<input type="checkbox"/>
7. Has drinking ever created problems between you and your spouse?	<input type="checkbox"/>	<input type="checkbox"/>
8. Have you ever gotten into trouble at work because of drinking?	<input type="checkbox"/>	<input type="checkbox"/>
9. Have you ever neglected your obligations, your family, or your work for 2 or more days in a row because you were drinking?	<input type="checkbox"/>	<input type="checkbox"/>
10. Have you ever gone to anyone for help about your drinking?	<input type="checkbox"/>	<input type="checkbox"/>
11. Have you ever been in the hospital because of drinking?	<input type="checkbox"/>	<input type="checkbox"/>
12. Have you ever been arrested even for a few hours because of drinking?	<input type="checkbox"/>	<input type="checkbox"/>
13. Have you ever been arrested for drunk driving or driving after drinking?	<input type="checkbox"/>	<input type="checkbox"/>

Appendix I

Fagerström Test for Nicotine Dependence

1. About how many cigarettes on the average would you have on a typical day during the past 6 months? _____

■ If your answer to question 1 is 0, skip the following questions (questions 2 to 7).

2. How soon after you wake up do you smoke your first cigarette?

- A. Within 5 minutes
- B. 6 to 30 minutes
- C. 31 to 60 minutes
- D. After 60 minutes

3. Do you find it difficult to refrain from smoking in places where it is forbidden such as church, the library, or movie theatres?

- A. Yes
- B. No

4. Which cigarette would you hate most to give up?

- A. The first one in the morning
- B. All others

5. How many cigarettes do you smoke? (20 cigarettes are in a pack)?

- A. 10 or less
- B. 11 – 20
- C. 21 – 30
- D. 31 or more

6. Do you smoke more frequently during the first hours after waking than the rest of the day?

- A. Yes
- B. No

7. Do you smoke if you are so ill that you are in bed most of the day?

- A. Yes
- B. No

Appendix J

Healthstyle

Check the response that best fits your behaviors for the last 6 months.

	Almost always	Sometimes	Almost never
1. I eat a variety of foods each day, such as fruits and vegetables, whole grain breads and cereals, lean meats, dairy products, dry peas and beans, and nuts and seeds.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I limit the amount of fat saturated fat, and cholesterol I eat (including fat on meats, eggs, butter, cream, shortenings, and organ meats such as liver).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I limit the amount of salt I eat by cooking with only small amounts, not adding salt at the table, and avoiding salty snacks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I avoid eating too much sugar (especially, frequent snacks of sticky candy or soft drinks).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Almost always	Sometimes	Almost never
1. I maintain a desired weight, avoiding overweight and underweight.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I do vigorous exercises for 15-30 minutes at least 3 times a week (examples include running, swimming, brisk walking).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I use part of my leisure time participating in individual, family, or team activities that increase my level of fitness (such as gardening, bowling, golf, and baseball).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Appendix K

Positive and Negative Affect Schedule (“State” Instructions)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following scale to record your answers.

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
_____	interested	_____	irritable	
_____	distressed	_____	alert	
_____	excited	_____	ashamed	
_____	upset	_____	inspired	
_____	strong	_____	nervous	
_____	guilty	_____	determined	
_____	scared	_____	attentive	
_____	hostile	_____	jittery	
_____	enthusiastic	_____	active	
_____	proud	_____	afraid	

Appendix L

Urge to Drink

Please indicate or mark your answer to the question on the following line.

Example: How much do you like school?

Not at all

Extremely

1. How much do you want to drink alcohol at this moment?

Not at all

Extremely

2. How much do you want to drink at this moment for its pleasant effect?

Not at all

Extremely

3. How much do you want to drink at this moment to take away an unpleasant feeling or mood?

Not at all

Extremely

Appendix M

Urge to Engage in Other Health Behaviors

Please indicate or mark your answer to the question on the following line.

Example: How much do you like school?

Not at all

Extremely

1. How much do you want to smoke at this moment?

Not at all

Extremely

2. How much do you want to smoke at this moment for its pleasant effect?

Not at all

Extremely

3. How much do you want to smoke at this moment to take away an unpleasant feeling or mood?

Not at all

Extremely

4. How much do you want to eat something, especially fatty, salty, or sweet foods, at this moment?

Not at all

Extremely

5. How much do you want to eat something, especially fatty, salty, or sweet foods, at this moment for its pleasant effect?

Not at all

Extremely

6. How much do you want to eat something, especially fatty, salty, or sweet foods, at this moment to take away an unpleasant feeling or mood?

Not at all

Extremely

7. How much do you want to exercise at this moment?

Not at all

Extremely

8. How much do you want to exercise at this moment for its pleasant effect?

Not at all

Extremely

9. How much do you want to exercise at this moment to take away an unpleasant feeling or mood?

Not at all

Extremely

Appendix N

Instructions of Go/No-Go Task

This task is to discriminate different numbers that will be presented to you on the computer screen.

Twelve two-digit numbers will be presented on the screen. Of the 12 numbers, 6 are "good" numbers and 6 are "bad" numbers. You have to identify which are "good" numbers and which are "bad" numbers by trial and error.

(Press enter to go to the next page)

If you think that a number presented on the screen is a "good" number, you should press the space bar on the keyboard. If it is actually a "good" number and you press the space bar, you will see "CORRECT" on the screen. If it is a "bad" number and you press the space bar, you will see "INCORRECT" on the screen.

(Press enter to go to the next page)

In contrast, if you think that a number presented on the screen is a "bad" number, you should not press the space bar on the keyboard. If it is actually a "bad" number and you do not press the space bar, you will see "CORRECT" on the screen. If it is a "good" number and you do not press the space bar, you will see "INCORRECT" on the screen.

(Press enter to go to the next page)

The experimenter will give you 10 cents for every "CORRECT" response. In other words, you can get 10 cents if you press the space bar when a "good" number is presented or if you do not press the space bar when a "bad" number is presented. There is no penalty for "INCORRECT" responses.

(Press enter to go to the next page)

You can get a maximum of \$9.60 from this task. The experimenter will put a dime in the box on the table for every "CORRECT" response. Also, you can see "+ \$.10" on the lower right side of the screen every time when you give a correct response, and thus earn money.

(Press enter to go to the next page)

Twelve two-digit numbers will be presented, one at a time. If you think that a number presented on the screen is a “good” number, you should press the space bar on the keyboard as soon as possible. If you think that a number presented on the screen is a “bad” number, you should not press the space bar and you should just wait for the feedback of “CORRECT” or “INCORRECT.”

(Press enter to go to the next page)

In this practice, the twelve two-digit numbers that you need to learn will be presented. However, you will not start earning 10 cents for “CORRECT” responses until the next block of trials. You should use this practice to start figuring out which are the good and bad numbers.

Do you have any questions?

(Press enter when you are ready to do the practice)

The same twelve two-digit numbers as in the practice will be presented, and the same numbers are good and bad. The numbers will be presented several times each in a random sequence, and you will get better at distinguishing good and bad numbers as you go along.

(Press enter to go to the next page)

Again, if you think that a number presented on the screen is a "good" number, you should press the space bar on the keyboard as soon as possible. If you think that a number presented on the screen is a "bad" number, you should not press the space bar and you should just wait for the feedback of "CORRECT" or "INCORRECT."

(Press enter to go to the next page)

Starting now, you will earn 10 cents for every "CORRECT" response. You can see "+ \$.10" on the lower right side of the screen every time when you give a correct response, and thus earn money.

Do you have any questions?

(Press enter when you are ready to do the main task)

The experimenter will give you \$9.60 before you begin to perform this task. You will lose 10 cents for every "INCORRECT" response. In other words, you will lose 10 cents if you do not press the space bar when a "good" number is presented or if you press the space bar when a "bad" number is presented. There is no compensation for "CORRECT" responses.

(Press enter to go to the next page)

The experimenter will take a dime from the box on the table for every "INCORRECT" response. Also, you can see "- \$.10" on the lower right side of the screen every time when you give an incorrect response, and thus lose money.

(Press enter to go to the next page)

Twelve two-digit numbers will be presented, one at a time. If you think that a number presented on the screen is a “good” number, you should press the space bar on the keyboard as soon as possible. If you think that a number presented on the screen is a “bad” number, you should not press the space bar and you should just wait for the feedback of “CORRECT” or “INCORRECT.”

(Press enter to go to the next page)

In this practice, the twelve two-digit numbers that you need to learn will be presented. However, you will not start losing 10 cents for “INCORRECT” responses until the next block of trials. You should use this practice to start figuring out which are the good and bad numbers.

Do you have any questions?

(Press enter when you are ready to do the practice)

The same twelve two-digit numbers as in the practice will be presented, and the same numbers are good and bad. The numbers will be presented several times each in a random sequence, and you will get better at distinguishing good and bad numbers as you go along.

(Press enter to go to the next page)

Again, if you think that a number presented on the screen is a "good" number, you should press the space bar on the keyboard as soon as possible. If you think that a number presented on the screen is a "bad" number, you should not press the space bar and you should just wait for the feedback of "CORRECT" or "INCORRECT."

(Press enter to go to the next page)

Starting now, you will lose 10 cents for every "INCORRECT" response. You can see "- \$.10" on the lower right side of the screen every time when you give an incorrect response, and thus lose money.

Do you have any questions?

(Press enter when you are ready to do the main task)

Vita

Hyoung S. Lee was born on July 8, 1974 in Seoul, South Korea. He completed his formal education in Seoul, South Korea. He received his master's degree in Clinical Psychology at Korea University in the spring of 1999. He finished a three-year clinical internship at the Samsung Medical Center of South Korea in 2003, and achieved a specialist certification in clinical psychology from the Korean Clinical Psychology Association in 2004. He entered the doctoral program in Health Psychology at the University of Texas at El Paso in the fall of 2005. After receiving his Ph.D. degree, he will enter a post-doctoral program in Psychology at the University of Missouri-Kansas City in the fall of 2010.

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