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The effects of increasing the risk perception of high-risk behaviors on decision making among college daily smokers and never-smokers

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THE EFFECTS OF INCREASING THE RISK PERCEPTION OF HIGH-RISK BEHAVIORS ON DECISION MAKING AMONG COLLEGE DAILY SMOKERS AND NEVER-SMOKERS

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Abstract

Participation in high-risk behaviors, such as substance use or dangerous driving practices, is widely reported by young adults and college students. Psychosocial theories explain participation in high-risk behaviors by the effects of risk perception on the outcome of behavior. Physiological researchers assert that biological factors (such as the role of the prefrontal cortex) better account for participation in high-risk behaviors based on impulsive decision-making patterns in substance users. The current study explored the relationship between impulsive decision-making and risk perception by assessing the impact of changes in high-risk perceptions on a measure of impulsive decision-making (delay discounting task). A sample of college daily cigarette smokers (n=32) and never-smokers (n=32), participants at particular risk for problems with substance use and other high-risk behaviors, was used. This study demonstrated that an intervention presenting normative information using motivational interviewing techniques significantly changed multiple perceptions and predicted involvement in high-risk behaviors among the entire sample ($p < 0.05$), as well as the experimental group's performance on the delay discounting task ($t(31) = 1.75$, $p < 0.05$). While perceptions of high-risk behaviors and delay discounting task performance changed within this sample, scores on the delay discounting task and scores on a measure of high-risk perceptions did not significantly correlate prior to or following the intervention. Daily smokers and never-smokers did not differ in delay discounting task performance, but daily smokers reported significantly more positive risk perceptions and greater predicted involvement in drug and alcohol use than never smokers. Results suggest that changes in risk perception can influence delay discounting task performance, but smoking status doesn't appear to moderate this association.

Introduction

Participation in high-risk behaviors is defined as a decision-making process in which an individual chooses a dangerous, albeit potentially rewarding, behavior over other safer behaviors (Zuckerman & Kuhlman, 2000). These dangerous or high-risk behaviors pose a risk of social or physical harm to individuals. Participation in high-risk behaviors is common among many people, but not uniform across demographic variables (e.g., Hersch & Viscusi, 1998; Kelly, Donovan, et al., 2005). College students commonly report participation in a variety of high-risk behaviors, including the use of harmful substances (such as illicit drugs, alcohol, or nicotine), high-risk sexual behaviors, aggressive or illegal behaviors, negative work or school behaviors, full contact sports, and dangerous driving practices (Kelly, Rollings, & Harmon, 2005). College students are more likely than other same-age adults not enrolled in college to participate in high-risk activities, such as binge drinking and risky sexual behaviors (e.g., Boyd, McCabe, & d'Arcy, 2004; Bylund, Imes, & Baxter, 2005; Paschall, 2003). Additionally, individuals who engage in one type of high-risk behavior often engage in multiple high-risk behaviors (e.g., Bailey, Gao, & Clark, 2006; Beadnell et al., 2005; Crowley, Raymond, Mikulich-Gilbertson, Thompson, & Lejuez, 2006; Kelly, Donovan, et al., 2005).

Eaton et al. (2006) produced the latest assessment of the Youth Risk Behavior Surveillance study for the Centers for Disease Control and Prevention (CDC). These researchers compiled prevalence rates of the high-risk behaviors of high school students in the United States. The authors reported numerous high-risk behaviors among high school students. Eaton et al. (2006) reported that 28.5% of participants had accepted rides in a car with a driver who had used alcohol. Additionally, 35.9% had been involved in at least one physical fight in the last 12 months and 6.5% had carried a weapon to school in the 30 days prior to assessment. With regard to cigarette use, 54.3% had tried smoking cigarettes while 13.4% reported current daily smoking. As seen in other studies, greater likelihood to participate in high-risk behaviors is often reported in adolescents engaged in experimental smoking (e.g., Coogan et al., 1998; Wang, 2001; Zakarian, Hovell, Conway, Hofstetter, & Slymen, 2000).

Additional prevalence rates supplied by Eaton et al. (2006) demonstrated that 74.3% of high school students have had at least one alcoholic drink while 43.3% reported alcohol use in the 30 days prior to assessment. Illicit substance use prevalence rates were similarly high. Twenty percent of high school students reported using marijuana in the 30 days prior to assessment and 3.4% reported current cocaine use. High-risk sexual practices were also reported. Among high school students, 33.9% considered themselves sexually active (i.e., having intercourse within the three months prior to assessment) and 37.2% of these individuals reported not using a condom during intercourse (Eaton et al., 2006).

Prevalence rates of high-risk behavior in college students are often equivalent to or higher than high school rates (e.g., Arnett, 1996; George, Baechtold, Frost, & Campbell, 2006). Douglas et al. (1997) produced the National College Risk Behavior Survey for the CDC. Similar to the Youth Risk Behavior Surveillance study, the authors sought to establish prevalence rates of high-risk behaviors of college students across the United States. They found that 27.4% of college students had driven a motor vehicle after drinking alcohol in the 30 days prior to the survey. Recent studies of college alcohol use show that the majority of college students in the United States use alcohol (Wechsler, Lee, Kuo, & Lee, 2000). Other studies reveal that college alcohol use may be as high as 84%, with 60% of college students reporting at least one binge drinking occasion (Gaher & Simons, 2007). Between 34% and 44% of college students report regular heavy drinking (Douglas et al., 1997; Wechsler et al., 2002). Additionally, 29% reported current cigarette use, 14% reported current marijuana use, and 14.4% reported trying cocaine (Douglas et al., 1997).

Douglas et al. (1997) reported that 86.1% of college students have engaged in sexual intercourse by the age of 24. Of those individuals, 34.5% reported having more than six partners and only 29.6% reported using a condom during their last sexual intercourse. Only 10.2% of college students had been involved in a physical fight in the 12 months prior to the survey. While this number is lower than high school estimates, 8% of college students carried weapons in the 30 days prior to the survey. As many of these high-risk behaviors are not uncommon and place college students in social or physical danger, further study of this population is warranted.

Epidemiology and Impact of Cigarette Smoking in College Students

Cigarette use is one of the most common high-risk behaviors among college students. Approximately 29% of college students are current cigarette smokers (Douglas et al., 1997; Wechsler et al., 2002). While higher education has been historically shown to be a protective factor against both initiation and continued use of cigarettes (e.g., Escobedo & Peddicord, 1996), smoking rates in young adults, both non-students and those enrolled in college, increased by 28% during the 1990s to a total of over 14 million college smokers (Koontz et al., 2004; Rigotti, Lee, & Wechsler, 2000; Staten & Ridner, 2006). These statistics deviated from a 30-year trend showing a decline in smoking in this population (Koontz et al., 2004). A study by Lantz (2003) showed that this change is likely due to a larger than average amount of adolescent smoking, a cohort that reached adulthood in the late 1990s and early 2000s. The tobacco use of college students most often persists into adulthood, not remitting with age as is common with illicit drug and alcohol use (Koontz et al., 2004).

According to the Centers for Disease Control and Prevention (2004), cigarette smoking is the leading cause of preventable deaths and diseases in the United States. Nearly 500,000 deaths occurring each year are a result of cigarette smoking, both active cigarette use and passive secondhand smoke inhalation (Buchhalter & Eissenberg, 2000), and between one quarter and one third of all deaths in the U.S. are related to cigarette use (Helvig, Sobell, Sobell, & Simco, 2006). Cigarette use accounts for more deaths than suicide, homicide, and fire combined (Moskal, Dziuban, & West, 1999). Cigarette related health problems come in a number of forms. Cigarette use and smoke exposure is linked to diseases of the breasts, heart, kidneys, lungs, pancreas, and prostate (e.g., Conrad, Flay, & Hill, 1992; Helvig et al., 2006; Van Volkom, 2008). Among college students, cigarette use is also correlated with low satisfaction with life, high levels of reported stress, and high levels of alcohol use (e.g., Emmons, Wechsler, Dowdall, & Abraham, 1998; Schorling, Gutgesell, Klas, Smith, & Keller, 1994). As the impact of college cigarette use is great, further study into the patterns of use among this population is warranted.

Mechanisms of High-Risk Behavior

The potentially harmful impact of cigarette smoking and other high-risk behaviors has been well established and numerous theoretical mechanisms have been proposed to explain why some individuals are willing to participate in harmful activities and others are not. Prominent psychosocial models of high-risk behaviors include expectancy and learning-based theories. Physiological theories have also been proposed, specifically when examining engagement in high-risk substance use. These physiological theories focus on the role of dopamine as reinforcement of high-risk behaviors and the role of the ventromedial prefrontal cortex in decision-making. While the present study does not directly address these mechanisms, it is important to understand the theoretical precursors to participation in high-risk behaviors.

Psychosocial Theories of High-Risk Behavior

Theories explaining participation in high-risk behaviors have often concentrated on psychosocial and learning factors, including outcome expectancies (i.e., anticipated reinforcing or punishing consequences of high-risk behavior). In addition to probability or likelihood of a particular outcome, the desirability of the outcome influences behavior. If positive or desirable outcomes are expected following a behavior, the probability that an individual will participate in that behavior increases. If negative or undesirable outcomes are expected, the probability that an individual will participate in the behavior decreases. Subjective expected utility (SEU; Edwards, 1954) is the likelihood of an outcome to occur weighted by its importance or desirability.

Eiser (1983) examined one subcategory of high-risk behavior, smoking initiation. Eiser (1983) viewed smoking initiation as the effect of SEU on an assessment of short-term gains and long-term consequences. Specifically, an individual's positive expectations of gains associated with smoking initiation (e.g., social appearance) must outweigh the negative opinions associated with the long-term consequences (e.g., health hazards). An individual's assessment of gains and consequences is hypothesized to determine whether an individual will decide to initiate smoking. In order to begin smoking, Eiser (1983) suggested that an individual must modify outcome expectancies and choose to concentrate on anticipated rewards associated with smoking and ignore possible negative outcomes associated with smoking. After initiation of use, positive outcome expectancies reinforce drug use behaviors and lead to continued substance use.

Applying SEU to high-risk behavior literature, participation in high-risk behavior may be explained by studying how individuals perceive risk. Perception of risk, or risk appraisal, and perception of rewards have been cited as a possible cause of participation in high-risk behaviors (Johnson, McCaul, & Klein, 2002). Despite evidence of possible harm, many individuals pursue dangerous activities. Expectations of pleasurable results may outweigh perception of risk and lead to greater involvement in various high-risk activities (Fromme, Katz, & Rivet, 1997). Perception of consequences, and its effects on behavior, has been substantiated in substance use expectancies literature (e.g., Goldman, Brown, & Christiansen, 1987). For example, Hahn and Renner (1998) found that regular smokers were less likely to report that health risks associated with smoking could occur, such as cardiac problems or lung cancer, than non-smokers.

Reyna and Farley (2006) report that for an individual to cease participation in high-risk behaviors, he or she must perceive the risks associated with participation in that behavior, consider the risks great, and understand that those risks apply to him or herself. In addition Reyna and Farley (2006) state that the individual must understand that rewards associated with cessation of this behavior are significant and that the barriers to quitting are surmountable. A personal appraisal of greater rewards and less risk involved with high-risk behaviors may lead to continued or greater participation in dangerous activities. Therefore, minimizing beliefs regarding anticipated rewards and increasing beliefs regarding risks may lead to lessened participation in high-risk behaviors.

Physiological Theories of High-Risk Behavior and the Role of Impulsive Decision-Making

A select number of biological theories have been proposed to explain general participation in high-risk behaviors. These physiological theories have concentrated on the relationship between impulsive decision-making and one specific set of high-risk behaviors, substance use. Impulsive decision-making is defined as the likelihood of choosing immediate, if not potentially lesser, short-term rewards over greater delayed rewards (Hinson, Jameson, & Whitney, 2003). Such rewards may include a variety of components (e.g., money, thrill, peer approval, pleasure). Theoretically, individuals who make impulsive decisions are more likely to participate in high-risk behaviors, such as substance use, due to the often-present short-term rewards. Individuals who make impulsive decisions have been shown to be more likely to take physical and social risks than individuals who are less likely to make impulsive decisions (e.g., Ball, Carroll, & Rounsaville, 1994; Bates, White, & Labouvie, 1994; Dom, D'haene, Hulstijn, & Sabbe, 2006; Donohew et al., 2000). Specifically, participant scores on measures examining the likelihood to choose immediate short-term rewards over potentially greater delayed rewards have been correlated with participant substance use (e.g., Hirschman et al., 1984; Petry, 2001; Petry, Bickel, & Arnett, 1998), high-risk sexual behavior (Donohew et al., 2000; Dudley et al., 2004; Noar, Zimmerman, Palmgreen, Lustria, & Horosewskit, 2006), tattooing and body modification (Greif et al., 1999), and dangerous driving practices (Caspi, Begg, Dickson, & Langley, 1995).

Many physiological theories of impulsive decision-making have been derived from individuals who use and abuse substances. Researchers have assessed genetic variability in decision-making and discovered an increased amount of impulsive decision-making in individuals with variations in genes that manage dopamine release and retention. The dopamine receptor theory states that impulsive decision-making behavior elicits pleasure through neurological release of dopamine, a process similar to the effects of drugs of abuse (Benjamin et al., 1996; Ebstein et al., 1996; van Gaalen, van Koten, Schoffelmeer, & Vandershuren, 2006). Two specific genes have been implicated: the D4 dopamine receptor gene (D4DR; Ebstein et al., 1996) and the D1 dopamine receptor gene (D1DR; Misener et al., 2004; van Gaalen, Brueggeman, & Bronius, 2006; van Gaalen, van Koten, et al., 2006). Specific variations in these genes may lead to overproduction of dopamine (Ebstein et al., 1996; Misener et al., 2004). These studies have found that individuals with these variations in the D4DR and D1DR genes are more likely to choose small, immediate rewards over greater long-term rewards and are more likely to participate in high-risk behaviors, independent of ethnicity, sex, and age.

In addition to the dopamine receptor theory, studies investigating variations in decision-making have focused on the role of the ventromedial prefrontal cortex (VMPFC) with the knowledge that it plays a significant role in decision-making. The VMPFC is a specific area of the prefrontal cortex associated with decision-making (Rolls, 2000). Individuals with lesions to the VMPFC have been shown on behavioral tasks of impulsive decision-making to choose small immediate rewards over larger delayed rewards, even risking potential loss of reward to do so (Bechara et al., 2001). The authors report that individuals who are substance dependent (i.e., individuals meeting Diagnostic and Statistical Manual of Mental Disorders-IV criteria for substance dependence) perform more similarly to individuals with lesions to the VMPFC than normal controls and suggest that these individuals may share similar deficits in the VMPFC.

While the dopamine receptor theory and implications about the effects of the VMPFC have been proposed to explain substance abuse, they have not been used to explain other high-risk behaviors, such as dangerous driving practices or high-risk sports. Further examination of the relationship between impulsive decision-making and other high-risk behaviors may help to better explain why some individuals are willing to participate in high-risk behaviors and to develop more effective intervention and prevention programs.

Assessment and Intervention: Reduction of High-Risk Behaviors

Assessment of High-Risk Behaviors and Decision-Making

Various assessments have been developed for the measurement of the prevalence, effects, and beliefs about participation in high-risk behaviors. Additional behavioral measures have been developed to assess patterns of impulsive decision-making (i.e., the likelihood to choose immediate short-term rewards over greater delayed rewards; Hinson, Jameson, & Whitney, 2003). Measures used in the assessment of high-risk behaviors commonly involve the self-report of an individual's personal history of participation in one or more sets of high-risk behaviors. While many measures only assess one potentially high-risk behavior (such as measures of frequency of alcohol use, risky sexual behaviors, or dangerous driving) others are inclusive of multiple high-risk behaviors. An example of a comprehensive high-risk assessment instrument is the Cognitive Appraisal of Risky Events Questionnaire (CARE; Fromme et al., 1997). The CARE includes six different categories of high-risk behaviors (i.e., illicit drug use, aggressive and illegal behaviors, risky sexual activities, heavy drinking, high-risk sports, and negative academic or work behaviors). The CARE measures participants' beliefs about the consequences of participation in high-risk behaviors, as well as their past involvement and predicted future involvement in these behaviors (Fromme et al., 1997). The authors state that the CARE was developed with a college population due to the increased likelihood of high-risk behaviors among young adults (e.g., Larimer & Marlatt, 1991; Rhoades & Maggs, 2006). The CARE does not include items related to cigarette smoking. Using the CARE, Copeland, Kulesza, Patterson, and Terlecki (2008) found that undergraduate participants who smoked at least one cigarette a day reported significantly greater expected benefit and involvement in high-risk behaviors than current non-smokers.

Assessment of impulsive decision-making generally involves either self-report or behavioral demonstration. Self-report questionnaires are the most widely used method of measuring impulsive decision-making and substance abuse. Self-report questionnaires have often been used as an efficient and inexpensive method for identifying individuals at high risk for experimenting with substances (Scourfield, Stevens, & Merikangas, 1996). As general criticisms of the viability of self-report have increased, behavioral measures have been developed (Lejuez et al., 2002). Two behavioral measures of impulsive decision-making are the delay discounting task and the Gambling Task (Bechara, Damasio, Damasio, & Anderson, 1994).

Delay discounting tasks involve the presentation of a hypothetical reward, generally money, that is available to the participant immediately or after various time delays. Initially, the immediate reward is a large dollar amount. This amount is gradually decreased until the participant begins to select the time-delayed rewards. Delay discounting tasks may involve non-monetary rewards, such as hypothetical rewards of cigarettes, alcohol, food, or other desired goods (e.g., Field, Santarcangelo, Sumnall, Goudie, & Cole, 2006; Odum & Rainaud, 2003). These tasks are often presented as a hand-administered or computerized card task, with each card representing different time delays and reward amounts (e.g., Epstein et al., 2003; Petry, 2001). Using a delay discounting task, Petry (2001) found that alcohol dependent individuals (i.e., individuals meeting criteria for substance dependence on the Structured Clinical Interview for DSM; Spitzer, Williams, Gibbon, & First, 1992) were more likely to accept lesser immediate rewards over greater delayed rewards. This was true regardless of what type of reward, money or alcohol, was present. Individuals who did not currently use alcohol were less likely to accept lesser immediate rewards than those individuals with alcohol dependence and were more likely to select larger rewards that required a time delay to acquire. Similar results have been found using delay discounting tasks with illicit substance use (e.g., Hoffman et al., 2006; Kollins, 2003) and cigarette smoking (e.g., Heyman & Gibb, 2006; Reynolds, Richards, Horn, & Karraker, 2004).

Originally developed to assess impulsive decision-making in individuals with lesions in the VMPFC (Bechara, Tranel & Damasio, 2000), the Gambling Task (Bechara et al., 1994) has also been used to assess impulsive decision-making deficits among substance users. Bechara et al. (2001) found that individuals dependent on alcohol, cocaine, or amphetamine performed similar to individuals with damage in the VMPFC and significantly differently from non-substance using controls. The authors purpose that this may be due to shared deficits within the VMPFC. Using the Gambling Task, Petry et al. (1998) and Businelle, Kendzor, Patterson, Rash, Coffey, & Copeland (in press) have shown showed that individuals who use other substances (heroin and cigarettes, respectively) select significantly more cards from decks in which there are chances of occasional large rewards, but overall loss of funds, than non-users. However, other studies (Businelle, Apperson, Kendzor, Terlecki & Copeland, 2008) have not replicated these findings in a population of heavy smokers (i.e., individuals who smoked at least 20 cigarettes daily for a minimum of eight years).

When comparing the Gambling Task and delay discounting task, Monterosso, Ehrman, Napier, O'Brien, and Childress (2001) found that cocaine users performed significantly poorer than non-substance using controls on both tasks. While the tasks shared a moderate correlation ($r = 0.37$), performance on the Gambling Task was more highly correlated with measures of intelligence quotient ($r = 0.45$; Monterosso et al., 2001). The authors suggest that this relationship may demonstrate a lack of specificity in measurements on the Gambling Task. The delay discounting task has been shown to be unrelated to intelligence quotient ($r = 0.05$; Kirby, Petry, & Bickel, 1999; Monterosso et al., 2001). As research using the Gambling Task with smokers has been mixed (e.g., Businelle et al., 2008; Businelle et al., in press; Monterosso et al., 2001), the Gambling Task may not be sensitive to the differences in decision-making between smokers and non-smokers (Lejuez, Aklin, & Jones, 2003).

Educational Interventions Targeting Participation in High-Risk Behaviors

Prevention and intervention programs intended to reduce participation in high-risk behaviors are often dominated by educational components (e.g., Agostinelli, Brown, & Miller, 1995; D'Amico & Fromme, 2002; Malow, West, Corrigan, & Pena, 1994). Education on the effects and prevalence of high-risk behaviors is used to help minimize participation in high-risk behaviors and change expectations regarding these practices. Researchers have shown that individuals participating in high-risk behaviors often under-report risks involved or do not possess accurate information about the risks involved (e.g., Agius, Dyson, Pitts, Mitchell, & Smith, 2006; Kershaw, Ethier, Niccolai, Lewis, & Ickovics, 2003). For example, in a study of adolescent sexual practices, McIntyre & West (1992) stated that adolescents often know that the term "safe sex" is important, but were not able to report what the term actually means and what actions are necessary to have "safe sex". Additionally, adolescents generally understand that unprotected sex may lead to pregnancy or disease, but often do not understand specific normative risks of pregnancy, birth control, or immunities (Downs, Bruine de Bruin, Murray, & Fischhoff, 2004). Increasing understanding of these risks may be crucial to reducing high-risk behaviors.

One of the most effective psychoeducational techniques used for reduction of high-risk behaviors is the presentation of normative information. Normative information is information targeting misperceptions individuals may have as to the commonality of high-risk behaviors and their effects (Steffian, 1999). Lewis, Neighbors, Oster-Aaland, Kirkeby, and Larimer (2007) assessed the use of normative education on college alcohol users. The authors found that participants' perceptions of drinking norms were often incorrect and that this misperception was correlated with increased alcohol use. Following an educational presentation of normative information about college drinking habits, individuals in the study reported more accurate perceptions of the commonality of alcohol use among college students than prior to the intervention. In addition, the participants also reported significantly less alcohol use after participation in the educational program.

Neighbors, Lee, Lewis, Fossos, and Larimer (2007) assessed 818 college students who reported engaging in at least one heavy-drinking episode in the past 30 days. They found that knowledge of alcohol norms for college students was one of the best predictors of college student alcohol use. Those individuals who over-reported the commonality of alcohol use patterns in college students were more likely to report heavy-drinking episodes than individuals whose perceptions of alcohol use norms were more accurate. In a study of rural adolescents, Epstein, Botvin, and Spoth (2003) found that perceptions of smoking norms, prosmoking beliefs as to the benefits of smoking, and general tendency to participate in high-risk behaviors were significant predictors of cigarette use. Due to the impact that normative perceptions have on high-risk behaviors, special attention to normative-based education interventions may be warranted (Lewis et al., 2007).

As there are necessary considerations for cost and time effectiveness in interventions, recent literature has explored the effectiveness of brief education-based interventions. Brief normative information-based interventions have been shown to be effective in reducing HIV related risks in substance users (e.g., Fisher & Fisher, 2000; Kotranski et al., 1998; Patterson & Semple, 2003) and reducing substance use and dangerous driving practices (e.g., D'Amico et al., 2000). Williams, Bowen, Timpson, Ross, and Atkinson (2006) provided a two-hour normative educational intervention intended to reduce risk of HIV by increasing condom use to 112 male prostitutes. The authors found that the brief educational intervention resulted in significant increases in condom use post-intervention. In addition, the authors used two groups, one that included psychoeducational alone and one that included psychoeducation plus discussions meant to make condom use seem more desirable. No difference in effectiveness was seen between groups and changes in expectancies associated with condom use were equally significant in each group.

In another example of effective brief interventions using normative information, Chernoff and Davison (2005) evaluated a 20-minute self-administered intervention with 155 college students aimed at reducing HIV risk among sexually active college students. Participants were presented with normative information and a goal setting exercise in regards to sexual risk behaviors among college students. After 30 days post-intervention, men reported significantly higher condom use and women reported significantly fewer sexual partners. Given these results, high rates of attrition in treatment studies, and the potential dangers of participation in high-risk activities, usage of brief interventions presenting normative information may benefit future intervention research (Williams et al., 2006).

Therapeutic Interventions Targeting Participation in High-Risk Behaviors

In addition to psychoeducational components, intervention programs targeting high-risk behaviors must consider the current motivation and readiness of individuals to make behavioral changes. Individuals who are not motivated to make changes in their behaviors often do not respond well to therapeutic intervention (Miller & Rollnick, 2002). Understanding, monitoring, and adjusting therapeutic techniques based on an individual's level of motivation can increase the efficacy of an intervention (Engle & Arkowitz, 2006). The Transtheoretical Model

Prochaska & DiClemente, 1983) has been proposed as a theoretical explanation of how individuals make the decision to change. In addition, motivational interviewing is a therapeutic style aimed at reducing ambivalence in therapy clients and better preparing them to make behavioral changes (Miller & Rollnick, 2002).

The Transtheoretical Model of behavior change has been proposed to define the degrees of readiness to change within an individual (e.g., Prochaska & DiClemente, 1983; Prochaska, DiClemente, & Norcross, 1992; Velicer, Prochaska, Fava, Norman, & Redding, 1998). As a model of individual change, the Transtheoretical Model considers the internal decision-making process of an individual, with other factors such as social influence and biological factors defined as external influences (Prochaska & Velicer, 1997). The Transtheoretical Model of behavior change uses a temporal construct, named "stages of change", as its core organizing feature. The stages of change involve four individual stages: precontemplation, contemplation, action, and maintenance stages. During the precontemplation stage, individuals are not intending to take any actions to change their behaviors, or are unaware that a change in their behaviors may be warranted. In the contemplation (or contemplation/preparation) stage, individuals are considering a behavioral change, but may still be weighing the pros and cons of the change. If the individuals do wish to change their behaviors, they may create a plan to succeed. The action stage occurs when individuals are making active attempts at changing their behaviors and have produced some observable behavior change (such as a numerical reduction in cigarettes smoked per day or an observable weight loss). The final maintenance stage occurs when individuals work to prevent relapse and maintain achieved gains, but are less likely to be actively working on future changes (Velicer et al., 1998).

Velicer et al. (1998) comment that while behavioral change is often seen as a single event (e.g., quitting smoking) it should be seen as a progression of decision-making through various stages. Additionally, individuals can regress backwards through the stages. One example of this is relapse, in which an individual regresses from the maintenance stage to the action stage. While regression through stages is common, Velicer et al. (1998) found that in a population of individuals working on behavior problems related to smoking and exercise, only 15% of individuals who reach the maintenance stage regressed back to the precontemplation stage. A primary goal of therapeutic behavioral change, according to the authors of the Transtheoretical Model, is assisting an individual in advancing through the stages of change (Prochaska et al., 1992).

Motivational interviewing is a therapeutic style aimed at reducing ambivalence to change in individuals, such as those in the precontemplation or contemplation stages of the Transtheoretical Model. Specifically, motivational interviewing aims to assist individuals in exploring and resolving their own ambivalence to problems in a client-centered, directive way (Rollnick & Miller, 1995). Miller and Rollnick (2002) suggest that the key concepts to changing an individual's ambivalence are multi-faceted. The authors state that motivation to change must be elicited and articulated by the client, not created or imposed by the therapist. Individuals are more committed to changing problem behaviors when they decide themselves that these behaviors need to be changed (Walters & Baer, 2006). Therapists that use direct persuasion often find that clients become more resistant to the process of change (Miller, Benefield, & Tonigan, 1993). Miller and Rollnick (2002) also state that motivation is not a trait, but fluctuates constantly. Therapists must be aware of signs that motivation is increasing or decreasing in order to communicate effectively. Lastly, the authors state that intervention using motivational interviewing should be a partnership, as opposed to the therapist adopting an expert role. Communication should be non-aggressive, showing respect for the client's autonomy and choices (Rollnick & Miller, 1995).

Miller and Rollnick (2002) suggest that the key concepts of motivational interviewing give rise to the techniques used. The authors suggest that therapists use a quiet, affirming style of communication, expressing acceptance, empathy, and reward for motivational comments. Additionally, they suggest that use of reflective listening to help clients verbalize the meanings of their statements and make them explicit. Finally, using open-ended questioning to elicit discussion and develop discrepancies in beliefs about behavior problems are key skills within motivational interviewing (Engle & Arkowitz, 2006; Miller & Rollnick, 2002).

Originally used with problematic alcohol use, modern use of motivational interviewing has been applied to various behavioral problems, such as drug use, eating disorders, anxiety, negative health behaviors, and disease management (Arkowitz & Miller, 2008). Noonan and Moyers (1997) reviewed 11 clinical trials with interventions using motivational interviewing to address problematic alcohol and drug use. The authors found that nine of the studies supported the efficacy of motivational interviewing with populations of individuals with substance use problems. Expanding on this, Dunn, Deroo, and Rivara (2001) reviewed 29 intervention trials using a primary motivational interviewing component to address substance abuse, cigarette use, HIV risk reduction, diet, and exercise. These authors found that over 60% of the studies produced significant effect sizes, with interventions targeting addictions producing the most significant results. Burke, Arkowitz, and Dunn (2002) compiled results from 26 studies and found similar results to past analyses. These authors state that usage of motivational interviewing is an effective way to treat and maintain results from changes in behaviors related to substance and cigarette use, health-related behaviors, eating disorders, and other major psychiatric illnesses.

Statement of Problem and Hypotheses

While psychosocial theories of high-risk behavior have concentrated on the effect of high-risk expectancies on high-risk behavior (e.g., Johnson et al., 2002), biological theories of high-risk behavior have concentrated on the role of impulsive decision-making in high-risk behavior, specifically substance use (e.g., Bechara et al., 2001; Benjamin et al., 1996; Ebstein et al., 1996; Teichman, Barnea, & Ravav, 1989; van Gaalen, van Koten, Schoffelmeer, & Vandershuren, 2006). In addition, researchers have shown substantial correlations between performance on tasks of impulsive decision-making and participation in high-risk behaviors. The effect of changes in high-risk expectancies and involvement on impulsive decision-making task performance has yet to be investigated. Further defining the relationship between impulsive decision-making and high-risk behaviors may assist researchers in producing future treatment programs for minimizing participation in high-risk behaviors. The purpose of this project was two-fold. The first was to assess the impact that changes of perceptions (i.e., benefits and risks) and expected involvement in high-risk behaviors may have on impulsive decision-making task scores. The second was to assess whether changes in performance on impulsive decision-making tasks would differ significantly between daily cigarette smokers and individuals who have never smoked following interventions presenting normative information in a motivational interviewing framework that targets high-risk behaviors.

This project examined the effects of changes in perceptions and expected involvement in high-risk behaviors on impulsive decision-making scores. Participants received assessments of perceptions (i.e., benefits and risks) and expected involvement in high-risk behavior prior to and following a brief intervention. High-risk behavior was assessed using the Cognitive Appraisal of Risky Events Questionnaire (CARE; Fromme et al., 1997). Impulsive decision-making was assessed through the use of a delay discounting card task. A brief control and experimental intervention comprised of normative information targeting participant beliefs involving high-risk behavior was used to elicit change in beliefs and expected involvement in high-risk behavior. This information was presented within a motivational interviewing framework to better elicit change. The experimental intervention included normative information on high-risk topics included on the CARE. The control intervention included normative information on dangerous driving, a high-risk topic not used on the CARE. Additionally, as biological theories of high-risk behavior and impulsive decision-making have been largely conducted with substance users (e.g., Bechara et al., 2001; Benjamin et al., 1996; Ebstein et al., 1996; van Gaalen, van Koten, Schoffelmeer, & Vandershuren, 2006), the participant sample contained both daily cigarette smokers and individuals who had never smoked to examine the effects smoking status may have on any potential changes in high-risk perceptions and expected involvement or impulsive decision-making task scores.

The following hypotheses were proposed for this study:

1) Prior to the intervention, a positive correlation would exist between expected benefits associated with high-risk behaviors, as measured by the CARE, and scores on the delay discounting task. Similarly, prior to the intervention, a negative relationship would exist between reported risks related to high-risk behaviors on the CARE and scores on the delay discounting task.
2) Participants receiving high-risk behavior education related to CARE items would report fewer expected benefits and more risks associated with participation in

high-risk behaviors than those participants who received non-CARE related high-risk behavior education. Additionally, participants who received high-risk behavior education related to CARE items would report less expected involvement in those behaviors than individuals who received non-CARE related high-risk behavior education.

3) After intervention, the following correlations would exist. Post-intervention changes on all scales were derived by subtracting differences from pre- to post-intervention:
    a. A negative correlation between post-intervention changes in reported anticipated rewards and post-intervention changes in delay discounting task performance;
    b. A positive correlation between post-intervention changes in reported risks and post-intervention changes in delay discounting task performance;
    c. A negative correlation between post-intervention changes in expected involvement in high-risk activities and post-intervention changes in delay discounting task performance.
4) In an examination of the relationship between smoking status and performance on impulsive decision-making measures, it was hypothesized that daily smokers (i.e., individuals who smoke at least one cigarette per day) would select more immediate rewards on the delay discounting task than never-smokers (i.e., individuals who have never smoked a cigarette) prior to the intervention. Following the intervention, daily smokers would display significantly smaller changes in delay discounting task performance than never-smokers.

5) Based on past research with substance users (e.g., Copeland et al., 2008; Johnson et al., 2002; Kelly, Donovan, et al., 2005; Lejuez, Simmons, Aklin, Daughters, & Dvir, 2004) it was hypothesized that daily smokers would report less risk and more anticipated benefit from participating in all high-risk activities than never-smokers, as measured by the CARE (Fromme et al., 1997). In addition, daily smokers would report more expected involvement in high-risk behaviors than never-smokers.

Method

Power Analysis

The power analysis computer program GPOWER (Faul, Erdfelder, Lang, & Buchner, 2007) was used to compute the sample size for this study. Due to the fact that multiple statistical analyses were performed using the same set of participants, the analysis requiring the most participants was used in order to provide appropriate power to each hypothesis. In order to control for Type I Error, alpha was set at 0.05. In order to control for Type II Error power was set at 0.80. Review of the high-risk behavior and decision-making literature indicated that a medium effect size was appropriate, as medium effect sizes are most common among these research topics (e.g., Burke, Arkowitz, & Menchola, 2003; Moyer, Finney, Swearingen, & Vergun, 2002; Thompson, Molina, Pelham, & Gnagy, 2007; Walters, 2006). Using Cohen's f^2 (1988) estimate of a medium effect size of 0.25 for analysis of variance (ANOVA) procedures, it was estimated that a sample of 64 individuals (32 individuals in the Daily Smoker Group and 32 individuals in the Never-Smoker Group) was required in order to detect differences if they existed.

Participants

Participants were 64 undergraduate students recruited through the Louisiana State University Psychology Department's research participant pool. Undergraduate students were targeted as participants, as they constitute a large portion of young adult risk-takers (e.g., Larimer & Marlatt, 1991). Approval for this study was obtained from the Institutional Review Board for Louisiana State University and all participants provided signed informed consent prior to participation. Compensation for participation was extra credit for undergraduate psychology courses.

Copeland et al. (2008) found in a sample of 303 undergraduate participants that individuals who smoked at least one cigarette a day reported significantly more high-risk behaviors than non-smokers on the CARE (Fromme et al., 1997). Additionally, Johnson, Bickel, and Baker (2007) found that individuals who smoked less than ten cigarettes per day did not differ on measures of delay discounting from individuals that used ten or more cigarettes daily. The authors reported that the amount of daily smoking did not have an effect on monetary delay discounting, only whether an individual smoked at least one cigarette per day. Therefore, participants were divided into groups based on smoking status (Daily Smoker Group and Never-Smoker Group). Daily Smoker Group participants were defined as individuals who smoked at least one cigarette a day. Never-Smoker Group participants were defined as individuals who had never smoked a cigarette. Within each smoking status group, participants were randomized into either a control or active intervention condition based on the procedures section outlined below.

Materials

Smoking Status Questionnaire (SSQ)

The SSQ was used to assess participant demographic characteristics, including age, sex, and ethnicity. The SSQ also assesses current and past smoking patterns and includes the Fagerström Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991), which is a measure of severity of nicotine dependence.

Marlowe-Crowne Social Desirability Scale

The MCS (Crowne & Marlowe, 1960) is a forced-choice questionnaire containing items describing culturally acceptable behaviors that are unlikely to occur. The MCS is a measure of a participant's tendency to respond to test items in a socially or culturally desirable way or in a way that he or she believes is expected by the experimental situation. As this study includes measurement of multiple potentially undesirable behaviors (e.g., substance use, illegal behaviors, risky sexual activities), the MCS may provide valuable data as to the effects of response styles on self-reported high-risk behaviors. Within this project, the MCS was used as a statistical covariate, if significant differences exist between group response styles. In prior studies, Cronbach's alphas for the MCS have ranged from .74 to .88 indicating good internal consistency within the measure (Crowne & Marlowe, 1960; Paulhus, 1984; Tanaka-Matsumi & Kameoka, 1986).

Cognitive Appraisal of Risky Events Questionnaire

The CARE (Fromme et al., 1997) was used to assess participants' beliefs and participation in high-risk activities. The CARE was developed to explore the relationship between expectations and high-risk behaviors. Development of the CARE involved examining a large pool of items related to high-risk behavior for face validity. Remaining items were then subject to an exploratory factor analysis, which yielded four standard scales: Expected Risk of Activities, Expected Benefit of Activities, Expected Involvement in Activities, and Past Involvement in Activities (Fromme et al., 1997).

The Expected Risk of Activities and Expected Benefit of Activities scales are measured by a seven-point Likert rating scale in which the participants predict negative or positive consequences for participating in 30 activities. The Expected Involvement in Activities scale uses a similar Likert rating scale in which participants rate the likelihood that they will actually participate in each behavior during the next six-month period. The Past Involvement in Activities scale records the number of times individuals have engaged in the 30 high-risk activities over the past six months.

The CARE divides general high-risk behavior into six factor analyzed factors: illicit drug use, aggressive and illegal behaviors, risky sexual activities, heavy drinking, high-risk sports, and academic or work behaviors (Fromme et al., 1997). As cigarette smoking is considered a high-risk health behavior (e.g., Fisher, Schneider, Pegler, & Napolitano, 1991; Schneider & Morris, 1991), a measure that did not include items related to smoking was selected to better measure the effects of smoking on decision-making. No items within the CARE factors pertain specifically to cigarette smoking or nicotine use. Finally, the CARE has been shown to have a test-retest reliability of .79 and good content and criterion validity (Fromme et al., 1997; Katz, Fromme, & D'Amico, 2000).

University of Rhode Island Change Assessment

The URICA (McConnaughy, Prochaska, & Velicer, 1983) consists of 32 items rated with a five-point Likert scale. This measure was used to assess participants' readiness to change, according to the stages of change associated with the Transtheoretical Model (Prochaska et al., 1992). Reliability and factor analyses generated four scales on the URICA: precontemplation, contemplation, action, and maintenance, in which participants receive continuous scores on each scale. Individuals rate various statements in which different ideals regarding change are presented. Two versions of the URICA were presented. The experimental group received a version of the URICA adapted to the six high-risk behaviors presented in the experimental intervention: drug use, risky sexual practices, alcohol use, high-risk sports, negative academic behaviors, and aggressive or illegal behaviors. The control group received a version of the URICA adapted to dangerous driving practices presented in the control intervention.

Delay Discounting Task

The version of delay discounting task used in this study is a hand-administered card task used as a measure of impulsive decision-making. In this task, participants are asked to select between two hypothetical monetary rewards, one they can obtain immediately (i.e., "Now") and one they can obtain after a time delay (i.e., "Later").   In this study, two conditions were presented with a hypothetical time-delayed reward of $1000 for the first condition and $10000 for the second condition. Three index card stacks were presented: the immediately available money, the money available after a delay, and the length of the time delay. As each "Now" amount is chosen, the monetary amount available is decreased. When the participant selects the "Later" amount, which remained stable at $1000 or $10000 depending on the current condition, the "Now" amount not chosen will be recorded. After this point, the time delay was increased and the process is repeated.

The "Now" rewards available for the $1000 condition are $1000, $990, $980, $960, $940, $920, $900, $850, $800, $750, $700, $650, $600, $550, $500, $450, $400, $350, $300, $250, $200, $150, $100, $80, $60, $40, $20, $10, $5, and $1. The "Now" rewards available for the $10000 condition are ten times greater than each "Now" reward amount. During each condition, eight time delays were used. As such, sixteen data points are recorded for each participant (eight for the $1000 condition, eight for the $10000 condition). Time delay intervals are 1 week, 1 month, 6 months, 1 year, 3 years, 5 years, 10 years, and 25 years.

Scoring of the delay discounting task was conducted by deriving a median k-value, also known as an indifference score (Petry, 2001). Median k-values are indicators of the strength of the hyperbolic delay discounting function and are derived with the formula $V=A/(1+kD)$. Within this equation, V equals the final amount of the "Now" category that was not chosen, A

equals the amount of the "Later" category, and *D* equals the time delay in weeks. A median k-value was recorded for each participant. Established procedure states that median k-values are used to retain the hyperbolic shape of the delay discounting task (Bickel & Marsch, 2001; Hinson et al., 2003; Petry, 2001). One study examining $1000 and $10000 monetary conditions showed significant correlations between the conditions, $r = .90$ (Patterson & Copeland, 2005). Test-retest of monetary delay discounting tasks is generally good, ranging from .72 to .90 (Johnson et al., 2007).

Risk Information Handouts

A risk information handout was provided to participants, serving as the intervention component of this study. To control for experimenter effects, this study's author acted as the sole experimental facilitator for all study participants. The experimental facilitator read aloud the risk information provided. These handouts relayed basic information about negative consequences, normative prevalence, and harm reduction options related to participation in high-risk behaviors. During the presentation, the facilitator used a motivational interviewing framework and techniques to facilitate discussion of information with participants. Two versions of this handout were used, dependent on the participant's condition.

Those participants randomized into the experimental condition received a risk information handout with data on prevalence, negative consequences, and harm reduction options associated with participation in the six CARE factors: illicit drug use, aggressive and illegal behaviors, risky sexual activities, heavy drinking, high-risk sports, and academic or work behaviors (Fromme et al., 1997). Those participants randomized into the control condition received a risk information handout related to dangerous driving practices, an item set not included in the CARE factors. As normative information regarding high-risk behaviors has been shown to have a significant effect on risk perceptions (e.g., Lewis et al., 2007), both handouts included information specific to college student populations. Information included in the handouts was drawn from numerous sources: illicit drug use (Douglas et al., 1997; National Institute on Drug Abuse, 2007); aggressive and illegal behaviors (Centers for Disease Control and Prevention, n.d.; Douglas et al., 1997; Durant et al., 2007); risky sexual activities (Douglas et al., 1997; Labrie & Earleywine, 2000); heavy alcohol use (Hingson, Heeren, Zakocs, Kopstein, & Wechsler, 2002; International Harm Reduction Association, n.d.; Wechsler et al., 2000); high-risk sports (Covassin, Swanik, & Sachs, 2003; National Center for Health Statistics, n.d.; National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2005; Short, Reuter, Brandt, Short, & Kontos, 2005); negative academic or work behaviors (Beck, Koons, & Milgrim, 2000; Clump, Bauer, & Whiteleather, 2003; Gump, 2004; Konstantopoulos, 2006; Yuksel, 2006); dangerous driving practices (Beede & Kass, 2006; Clark et al., 1999; Clayton, Helms, & Simpson, 2006; DeVeauuse, Kim, Peek-Asa, Mcarthur, & Kraus, 1999; Pasto & Baker, 2001; Seo & Torabi, 2004).

Risk Information Quiz Sheet

In order to measure effective retention of information following the presentation of the risk information handouts, a brief assessment measure was used. A 15-item forced-choice assessment consisting of multiple choice and true-false items based on the risk information handouts was presented to all participants. As two experimental conditions are present, a 15-item assessment measure was developed independently for each condition. Each individual received a score based on the amount of correct answers they provided on the 15 items.

Procedure

Experiments were conducted in a classroom or conference room at Louisiana State University. When participants arrived, the study's components and criteria were explained and informed consent obtained. Participants then completed the SSQ and two groups were formed: the Daily Smoker Group, including those individuals who smoke at least one cigarette daily and the Never-Smoker Group, including individuals who have never smoked a cigarette. Within these two groups, participants were randomly assigned to one of two conditions: experimental and control. Randomization was conducted through a computer spreadsheet randomization function that placed each participant number in either the control or experimental group prior to the study. All participants then completed the CARE, MCS, the appropriate version of the URICA dependent on their experimental condition, and the $1000 condition of the delay discounting task. To control for order effects, the questionnaires and tasks were presented in a random order to each participant.

Following the completion of the SSQ, CARE, MCS, URICA, and $1000 condition of the delay discounting task, participants received a handout detailing basic information about high-risk behaviors. Those participants in the experimental condition received information about the prevalence, harm reduction options, and negative consequences of participation in high-risk behaviors related to items on the six CARE factors. Those participants in the control condition received information about the prevalence, harm reduction options, and negative consequences of dangerous driving practices, a high-risk behavior not included in the CARE. This information was provided both in writing and orally by the experimental facilitator using motivational interviewing techniques. Following the presentation of high-risk behavior information, participants received a five minute break. Participants that were smokers were allowed to leave the building to smoke if desired. After the break, participants were administered a brief assessment of their retention of the high-risk literature provided. Participants then repeated administration of the CARE, URICA, and be administered the $10000 condition of the delay discounting task. After completion of the study's components, extra credit was provided for each participant.

Results

Participant Characteristics

This study consisted of 64 undergraduate college students enrolled via electronic sign-up through Louisiana State University. Seventy-seven students signed up for this study electronically. Sixty-eight students presented to their scheduled experimental sessions. Out of the 68 students who presented for their scheduled experimental sessions, 64 participants met criteria for participation in this study and completed the study protocols. Four potential participants were excluded from the study due to failing to meet inclusion criteria. All participants were included in data analysis as there was no missing data.

The Daily Smoker Group consisted of 32 student participants who reported smoking at least one cigarette daily. The Never-Smoker Group consisted of an additional 32 student participants who reported never having smoked a cigarette. Each participant was randomized into one of two conditions, the experimental or control condition. Participants in this study were 70.3% Caucasian, 21.9% African American, 3.1% Hispanic, 1.6% Asian, and 3.1% other. Twenty-six percent of participants were male and 73.4% were female. The average age of participant was 21.47 years ($SD = 3.64$).

Descriptive and frequency statistics were compiled on the smoking habits of the individuals in the Daily Smoker Group. The average length of time individuals reported being a daily smoker was 4.02 years ($SD = 3.60$). The average number of cigarettes smoked per day was 7.72 ($SD = 5.78$), and they reported an average of 3.02 ($SD = 3.49$) quit attempts where they abstained from smoking for at least 24 hours. The average FTND score was 1.96 ($SD = 1.67$) indicating that the average participant within the Daily Smoker Group had low levels of nicotine dependence (Heatherton et al., 1991).

Group Differences

Two chi-square analyses with sex and smoking status as factors as well as sex and experimental vs. control conditions as factors were conducted showing no significant differences in sex between Daily Smoker and Never-Smoker groups, $X^2(1, N = 64) = 0.77$, *ns*, or between experimental and control conditions, $X^2(1, N = 64) = 0.77$, *ns*. Two additional Chi-square analyses were conducted with ethnicity and smoking status as factors in the first and ethnicity and experimental vs. control conditions as factors in the second. No significant differences were found between Daily Smoker and Never-Smoker groups, $X^2(4, N = 64) = 0.554$, *ns*, or between experimental and control conditions, $X^2(4, N = 64) = 0.324$, *ns*.

Two-way analyses of variance (ANOVAs) with smoking status (Daily Smoker/Never Smoker) and condition (experimental/control) as factors were conducted on continuous baseline variables to detect any pre-existing differences. There were no significant differences in MCS scores by smoking status ($F(1,60) = 3.10$, *ns*) or condition ($F(1,60) = 0.10$, *ns*). Additionally, there were no significant differences in age by smoking status ($F(1,60) = 0.05$, *ns*) or condition ($F(1,60) = 0.07$, *ns*).

Possible pre-existing differences between group CARE scores were examined. To measure this, three multivariate one-way analyses of variance (MANOVAs) were conducted with experimental/control condition as the factor and the six pre-intervention factor scores of three CARE scales (Expected Benefit; Risk; Involvement, respectively) as the dependent variables. Conditions did not differ significantly on pre-intervention scores for Expected Benefit [Pillai's Trace = 0.053, $F(1,62) = 0.52$, *ns*], Expected Risk [Pillai's Trace = 0.062, $F(1,62) = 0.624$, *ns*.], or Expected Involvement [Pillai's Trace = 0.093, $F(1,62) = 0.969$, *ns*].

Descriptive statistics were compiled on the study participants' past participation in various high-risk behaviors. Participants reported an average of 44.4 occasions of drug use over the past six months with a large standard deviation (SD = 125.66). Participants also reported an average of 16.2 (SD = 23.32) occasions of aggression or illegal behaviors, 8.0 (SD = 16.29) occasions of risky sexual practices, 27.78 (SD = 37.89) occasions of alcohol use, and 18.4 (SD = 52.42) occasions of participation in high-risk sports over the last six months. Past participation in high-risk behavior by individuals in the Daily Smoker Group and Never-Smoker Group was compared statistically using a MANOVA. In this analysis, smoking status was used as the independent variable and the six factors of the CARE Past Involvement in Activities scale served as the dependent variables. A significant effect of group was found for the combined dependent variables, Pillai's Trace = 0.176, $F(1,62) = 2.47$, $p < 0.05$. Follow up tests were conducted on between-subjects effects. Individuals in the Daily Smoker Group reported more past drug use ($F(1,62) = 5.56$, $p < 0.05$) and past alcohol use ($F(1,62) = 11.91$, $p < 0.001$) than individuals in the Never-Smoker Group. No other significant differences were found.

Hypothesis One

It was predicted in hypothesis one that a positive correlation would exist between anticipated rewards associated with high-risk behaviors and scores on the delay discounting task prior to the intervention. In order to assess this hypothesis, Pearson product-moment correlation coefficients were calculated. During this analysis, delay discounting task indifference scores and factor scores for the CARE Expected Benefit scale recorded prior to the intervention were used. No significant relationships were found between pre-intervention delay discounting task scores and any factor scores on the CARE Expected Benefit scale. Results are presented in Table 1.

Table 1. Correlation Coefficients for CARE Expected Benefit of Activities Factor Scores and Pre-Intervention Delay Discounting Task Scores

CARE Expected Benefit of Activities factors	Pearson Correlation	*p*
Drug Use	-0.053	*ns*
Aggression and Illegal Behaviors	-0.006	*ns*
Risky Sexual Practices	-0.135	*ns*
Alcohol Use	-0.048	*ns*
Risky Sports Practices	-0.006	*ns*
Negative Academic Behaviors	0.135	*ns*

Additionally, it was predicted that a negative relationship would exist between expected risks related to high-risk behaviors and performance on the delay discounting task prior to the intervention. Pearson product-moment correlations between delay discounting task indifference scores and factor scores for the CARE Expected Risk scale recorded prior to the intervention serving as variables. No significant relationships were found between pre-intervention delay discounting task scores and any factor scores on the CARE Expected Risk scale. Results are presented in Table 2.

Table 2. Correlation Coefficients for CARE Expected Risk of Activities Factor Scores and Pre-Intervention Delay Discounting Task Scores

CARE Expected Risk of Activities factors	Pearson Correlation	*p*
Drug Use	0.053	*ns*
Aggression and Illegal Behaviors	0.124	*ns*
Risky Sexual Practices	0.137	*ns*
Alcohol Use	0.066	*ns*

(table cont.)

Risky Sports Practices	0.068	*ns*
Negative Academic Behaviors	0.063	*ns*

Hypothesis Two

Hypothesis two stated that participants in the experimental group (i.e., individuals receiving high-risk behavior education related to high-risk behaviors assessed by the CARE) would report fewer anticipated rewards and more risk associated with participation in high-risk behaviors following the intervention than participants in the control group (i.e., those receiving non-CARE related dangerous driving education). To measure this hypothesis, two one-way MANOVAs were conducted using post-intervention change scores. To derive post-intervention change scores, pre-intervention CARE scale factor scores were subtracted from their post-intervention counterparts for each study participant on each CARE scale factor. This procedure allows for pre-intervention baseline scores to be held constant.

The first analysis used the six post-intervention change scores of the CARE Expected Benefit scale factors as the dependent variables and experimental or control group membership as the independent variable. A significant effect of group was found for the overall MANOVA model, Pillai's Trace = 0.530, $F(1,62) = 10.69$, $p < 0.001$. Follow up tests were conducted on between-subjects effects. The post-intervention change scores of the all six CARE Expected Benefit factor scores were found to be significantly lower in the experimental group than in the control group: Drug Use ($F(1,62) = 13.23$, $p < 0.001$), Aggressive and Illegal behaviors ($F(1,62) = 5.43$, $p < 0.05$), Risky Sexual Practices ($F(1,62) = 4.32$, $p < 0.05$), Alcohol Use ($F(1,62) =$

9.42, $p < 0.005$), High Risk Sports ($F(1,62) = 16.28$, $p < 0.001$), and Negative Academics ($F(1,62) = 3.13$, $p < 0.05$).

Similar to the first analysis, the second analysis used the six post-intervention change scores in the CARE Expected Risk scale factors as the dependent variables and experimental or control group membership as the independent variable. A significant effect of group was found for the overall MANOVA model, Pillai's Trace = 0.281, $F(1,62) = 3.70$, $p < 0.005$. Follow up tests were conducted on between-subjects effects. The post-intervention change scores of five of six CARE Expected Risk factor scores were found to be significantly greater in the experimental group than in the control group: Drug Use ($F(1,62) = 8.31$, $p < 0.005$), Aggressive and Illegal behaviors ($F(1,62) = 6.78$, $p < 0.01$), Risky Sexual Practices ($F(1,62) = 5.74$, $p < 0.01$), Alcohol Use ($F(1,62) = 2.93$, $p < 0.05$), High Risk Sports ($F(1,62) = 20.74$, $p < 0.001$). There was no significant difference between conditions on post-intervention change scores in the CARE Expected Risk factor score Negative Academics ($F(1,62) = 0.17$, *ns*).

In addition, hypothesis two stated that participants in the experimental group would report less predicted future involvement in high-risk behaviors than the control group following the intervention. To measure this, a MANOVA was conducted using post-intervention change scores in the factors of the CARE Expected Involvement scale as the dependent variables and experimental or control group membership as the independent variable. A significant effect of group was found for the overall MANOVA model, Pillai's Trace = 0.196, $F(1,62) = 2.31$, $p < 0.05$. Follow up tests were conducted on between-subjects effects. The post-intervention change scores of the all six CARE Expected Involvement factor scores were found to be significantly lower in the experimental group than in the control group: Drug Use ($F(1,62) = 11.16$, $p < 0.001$), Aggressive and Illegal behaviors ($F(1,62) = 6.61$, $p < 0.01$), Risky Sexual Practices

($F(1,62) = 4.83$, $p < 0.05$), Alcohol Use ($F(1,62) = 5.59$, $p < 0.05$), High Risk Sports ($F(1,62) = 4.51$, $p < 0.05$), and Negative Academics ($F(1,62) = 7.33$, $p < 0.005$).

Hypothesis Three

Hypothesis three addressed relationships between changes in CARE factor scores and delay discounting task scores following presentation of the intervention. It was predicted that a negative correlation would exist between post-intervention changes in factor scores on the CARE Expected Benefit scale and post-intervention changes in delay discounting task performance. Additionally, it was predicted that a positive correlation would exist between post-intervention changes in factor scores on the CARE Expected Risk scale and post-intervention changes in delay discounting task performance. Finally, it was predicted that a negative correlation would exist between post-intervention changes in factor scores on the CARE Expected Involvement scale and post-intervention changes in delay discounting task performance. The procedure for deriving post-intervention changes is described in Hypothesis Two. Pearson product-moment correlations were calculated to test this hypothesis with post-intervention changes on the delay discounting task and post-intervention changes on the factor scores for the CARE scales as variables. No significant relationships were found on changes in the factor scores for the CARE Expected Risk scale. Correlation coefficients are presented in Table 3.

Table 3. Correlation Coefficients for Changes in CARE Expected Risk of Activities Factor Scores and Delay Discounting Task Scores

CARE Expected Risk of Activities factors	Pearson Correlation	*p*
Drug Use	-0.158	*ns*
Aggression and Illegal Behaviors	0.016	*ns*
Risky Sexual Practices	-0.036	*ns*

(table cont.)

Alcohol Use	-0.078	*ns*
Risky Sports Practices	-0.088	*ns*
Negative Academic Behaviors	0.168	*ns*

Correlation coefficients were also derived to assess the relationship between changes in delay discounting scores and changes in the CARE Expected Benefit scale. Similar to the first analysis, no significant relationships were found on changes in the factor scores for the CARE Expected Benefit scale. Results are presented in Table 4.

Table 4. Correlation Coefficients for Changes in CARE Expected Benefit of Activities Factor Scores and Delay Discounting Task Scores

CARE Expected Risk of Activities factors	Pearson Correlation	*p*
Drug Use	0.113	*ns*
Aggression and Illegal Behaviors	-0.118	*ns*
Risky Sexual Practices	0.035	*ns*
Alcohol Use	0.053	*ns*
Risky Sports Practices	0.148	*ns*
Negative Academic Behaviors	0.007	*ns*

When examining relationships among changes on the CARE Expected Involvement scale and delay discounting task scores, changes in predicted involvement in high risk sports was shown to be positively correlated with changes in delay discounting task scores. Correlation coefficients for changes in the CARE Expected Involvement scale factor scores and changes in delay discounting task scores are presented in Table 5.

Table 5. Correlation Coefficients for Changes in CARE Expected Involvement in Activities Factor Scores and Delay Discounting Task Scores

CARE Expected Risk of Activities factors	Pearson Correlation	*p*
Drug Use	0.190	*ns*
Aggression and Illegal Behaviors	0.042	*ns*
Risky Sexual Practices	0.073	*ns*
Alcohol Use	0.114	*ns*
Risky Sports Practices	0.266	< 0.05
Negative Academic Behaviors	-0.014	*ns*

As few significant correlations were found between changes on the CARE scales and change on the delay discounting task, additional analyses were conducted to assess whether study participants reported improvements in CARE scores (i.e., reported fewer benefits, more risks, and/or less expected involvement in high-risk behaviors) or delay discounting task scores following intervention. A series of repeated measure t-tests were conducted to assess whether any of the six factor scores on the CARE scales or performance on the delay discounting task improved following intervention. Results are presented in Table 6. Among all 64 participants in this study, both delay discounting task performance as well as 17 of 18 CARE factors improved following intervention.

Table 6. Changes in CARE Scale Factors and Delay Discounting Task Scores Following Intervention

Measure	T-Score	*p*
CARE Expected Risk of Drug Use	-2.48	<0.01
CARE Expected Risk of Aggressive and Illegal Behaviors	-2.15	<0.05

(table cont.)

CARE Expected Risk of Risky Sex	-2.09	<0.05
CARE Expected Risk of Alcohol Use	-0.52	*ns*
CARE Expected Risk of High Risk Sports	-3.79	<0.001
CARE Expected Risk of Negative Academic Behaviors	-2.10	<0.05
CARE Expected Benefit of Drug Use	2.42	<0.01
CARE Expected Benefit of Aggressive and Illegal Behaviors	2.70	<0.005
CARE Expected Benefit of Risky Sex	3.77	<0.001
CARE Expected Benefit of Alcohol Use	5.59	<0.001
CARE Expected Benefit of High Risk Sports	6.55	<0.001
CARE Expected Benefit of Negative Academic Behaviors	1.95	<0.05
CARE Expected Involvement in Aggressive and Illegal Behaviors	3.14	<0.005
CARE Expected Involvement in Risky Sex	1.85	<0.05
CARE Expected Involvement in Alcohol Use	6.22	<0.001
CARE Expected Involvement in High Risk Sports	4.18	<0.001
CARE Expected Involvement in Negative Academic Behaviors	4.07	<0.001
Delay Discounting Task Indifference Scores	2.00	<0.05

To examine whether changes occurred in scores based on experimental or control group conditions, repeated measure t-tests were conducted on the six factor scores of each CARE scale and delay discounting task scores within each group, experimental and control. Within the control group, five of 18 CARE scale factors significantly improved from pre-intervention to post-intervention, expected benefits of risky sex ($t(31) = 2.12$, $p < 0.05$), expected benefits of alcohol use ($t(31) = 3.04$, $p < 0.005$), expected benefits of high risk sports ($t(31) = 3.04$, $p < 0.005$), expected involvement in alcohol use ($t(31) = 3.55$, $p < 0.001$), and expected involvement in high risk sports ($t(31) = 2.02$, $p < 0.05$). Delay discounting task performance did not improve within the control group, $t(31) = 0.973$, *ns*. Conversely, in the experimental group, 16 of 18 CARE scale factors and delay discounting task scores improved following intervention. Only expected risk of alcohol use ($t(31) = -1.36$, *ns*) and expected risk of negative academic behaviors ($t(31) = -1.52$, *ns*) did not significantly improve. Results are presented in Table 7.

Table 7. Changes in CARE and Delay Discounting Task Scores Following Intervention by Experimental and Control Group

	Control Group		Experimental Group	
Measure	T-Score	*p*	T-Score	*p*
CARE Expected Risk of Drug Use	0.27	*ns*	-3.12	<0.005
CARE Expected Risk of Aggressive and Illegal Behaviors	0.31	*ns*	-2.94	<0.005
CARE Expected Risk of Risky Sex	0.26	*ns*	-2.51	<0.01
CARE Expected Risk of Alcohol Use	1.04	*ns*	-1.36	*ns*
CARE Expected Risk of High Risk Sports	0.22	*ns*	-5.02	<0.001
CARE Expected Risk of Negative Academic Behaviors	-1.47	*ns*	-1.52	*ns*
CARE Expected Benefit of Drug Use	-0.91	*ns*	3.73	<0.001
CARE Expected Benefit of Aggressive and Illegal Behaviors	0.42	*ns*	3.07	<0.005
CARE Expected Benefit of Risky Sex	2.12	<0.05	3.28	<0.005

(table cont.)

CARE Expected Benefit of Alcohol Use	3.04	<0.005	5.13	<0.001
CARE Expected Benefit of High Risk Sports	3.04	<0.005	6.71	<0.001
CARE Expected Benefit of Negative Academic Behaviors	0.17	*ns*	2.48	<0.05
CARE Expected Involvement in Drug Use	-1.00	*ns*	3.23	<0.005
CARE Expected Involvement in Aggressive and Illegal Behaviors	0.82	*ns*	3.24	<0.005
CARE Expected Involvement in Risky Sex	-0.47	*ns*	2.15	<0.05
CARE Expected Involvement in Alcohol Use	3.55	<0.001	5.38	<0.001
CARE Expected Involvement in High Risk Sports	2.02	<0.05	3.80	<0.001
CARE Expected Involvement in Negative Academic Behaviors	1.36	*ns*	4.27	<0.001
Delay Discounting Task Indifference Scores	0.97	*ns*	1.75	<0.05

Hypothesis Four

Hypothesis four examined the relationship between smoking status and performance on the delay discounting task. It was hypothesized that individuals in the Daily Smoker Group (i.e., individuals who smoke at least one cigarette per day) would select more immediate rewards on the delay discounting task than individuals in the Never-Smoker Group (i.e., individuals who have never smoked a cigarette) prior to the intervention. A one-way ANOVA with smoking status as the independent variable and pre-intervention delay discounting task indifference score used as the dependent variable was conducted. No significant difference was found on pre-intervention delay discounting task scores based on smoking status, $F(1,62) = 2.209$, *ns*. It was further hypothesized that, following the intervention, individuals in the Daily Smoker Group would display significantly smaller changes in delay discounting task performance than those in the Never-Smoker Group. A two-way ANOVA using smoking status (Daily Smoker/Never Smoker) and condition (experimental/control) as factors and post-intervention change scores on the delay discounting task as the dependent variable was conducted. Information on how post-intervention change scores were derived is described in Hypothesis Two. No significant difference was found on the overall ANOVA model with regards to post-intervention change scores on the delay discounting task based on smoking status or condition, $F(3,60) = 1.42$, *ns*.

In a further examination of the effect of smoking status on delay discounting task performance, correlation coefficients were derived to assess whether there was a relationship between the number of cigarettes smoked per day and delay discounting task scores. There was no relationship found between number of cigarettes smoked per day and pre-intervention delay discounting task scores ($r = -0.13$, *ns*) or post-intervention delay discounting task scores ($r = -0.13$, *ns*).

Hypothesis Five

In hypothesis five, it was predicted that individuals in the Daily Smoker Group would report less risk, more benefit, and more predicted involvement in participating in high-risk activities than individuals in the Never-Smoker Group prior to the intervention. To assess this, three MANOVAs were conducted using smoking status (Daily Smoker Group vs. Never-Smoker Group) as the independent variable and the six factor scores of each pre-intervention CARE scale as dependent variables. The first MANOVA consisted of factor scores on the Expected Risk of

Activities scale. A significant effect of smoking status was found for the overall MANOVA model, Pillai's Trace = 0.307, $F(1,62) = 4.21$, $p < 0.001$. Follow up tests were conducted on between-subjects effects. The post-intervention CARE Expected Risk of Activities factor scores for Drug Use ($F(1,62) = 9.88$, $p < 0.005$), Alcohol Use ($F(1,62) = 8.92$, $p < 0.005$), and High Risk Sports ($F(1,62) = 7.86$, $p < 0.005$) were found to be significantly lower in the Daily Smoker Group than in the Never-Smoker Group. Individuals in the Daily Smoker Group reported less risk involved with these three categories than individuals in the Never Smoker Group.

The second MANOVA used factor scores from the CARE Expected Benefit of Activities scale as the dependent variables and smoking status as the independent variable. A significant effect of smoking status was found for the overall MANOVA model, Pillai's Trace = 0.388, $F(1,62) = 6.03$, $p < 0.001$. Follow up tests were conducted on between-subjects effects. Only the post-intervention CARE Expected Benefit of Activities factor scores for Drug Use ($F(1,62) = 11.64$, $p < 0.001$) and Alcohol Use ($F(1,62) = 15.69$, $p < 0.001$) were found to be significantly higher in the Daily Smoker Group than in the Never-Smoker Group. Individuals in the Daily Smoker Group reported more benefit with these two categories than individuals in the Never Smoker Group.

Finally, the third MANOVA used pre-intervention factor scores from the Expected Involvement in Activities scale as the dependent variables and smoking status as the independent variable. A significant effect of smoking status was found for the overall MANOVA model, Pillai's Trace = 0.453, $F(1,62) = 7.88$, $p < 0.001$. Follow up tests were conducted on between-subjects effects. Similar to the previous analysis, only the post-intervention CARE Expected Involvement in Activities factor scores for Drug Use ($F(1,62) = 18.68$, $p < 0.001$) and Alcohol Use ($F(1,62) = 22.51$, $p < 0.001$) were found to be significantly higher in the Daily Smoker

Group than in the Never-Smoker Group. Individuals in the Daily Smoker Group predicted more involvement in these two categories than individuals in the Never Smoker Group.

In a further examination of the effect of smoking status on CARE factor scores, correlation coefficients were derived to assess whether there was a relationship between the number of cigarettes smoked per day and factor scores on the three CARE scales. Number of cigarettes smoked per day was significantly negatively correlated with expected risk of drug use ($r = -0.27$, $p < 0.05$) and expected risk of high risk sports ($r = -0.25$, $p < 0.05$). The number of cigarettes smoked per day was significantly positively correlated with expected benefits of drug use ($r = 0.29$, $p < 0.05$), expected benefits of alcohol use($r = 0.27$, $p < 0.05$), expected involvement in drug use ($r = 0.315$, $p < 0.05$), and expected involvement in alcohol use ($r = 0.40$, $p < 0.001$).

Discussion

Previous studies have demonstrated relationships between substance use and participation in various other high-risk behaviors (e.g., Bailey et al., 2006; Beadnell et al., 2005; Crowley et al., 2006; Kelly, Donovan, et al., 2005). Specifically, individuals who use substances, such as cigarettes or alcohol, often participate in other high-risk behaviors, such as risky sexual practices or dangerous driving. Researchers have theorized that numerous factors, both psychosocial and physiological, may influence an individual's decision to participate in high-risk behaviors. Psychosocial theories explain high-risk behaviors through use of SEU (Edwards, 1954). SEU proposes that the likelihood that someone participates in high-risk behaviors is predicted by how desirable the individual considers the outcomes of the behavior. High-risk perceptions (i.e., expectations of the rewards and penalties associated with participation in a high-risk behavior) influence the desirability of a high-risk behavior. In contrast, physiological researchers assert that biological factors (such as the role of specific genes and the prefrontal cortex) better account for participation in high-risk behaviors by way of increased impulsive decision-making (e.g., Ball et al., 1994; Bates et al., 1994; Dom et al., 2006; Donohew et al., 2000). The current study addressed multiple questions about the relationship between measures of perceptions of high-risk behavior and proposed measures of impulsive decision-making, as well as the differences in these measurements that may be associated with cigarette use. Specifically, this study sought to explore the impact of changes in high-risk perceptions (as measured by the CARE) on a proposed measure of impulsive decision-making (i.e., delay discounting task) among college daily smokers and never-smokers.

Hypothesis One

Based on theoretical relationships established in past research between perception of high-risk behaviors and impulsive decision-making (e.g., Ball et al., 1994; Dom et al., 2006; Donohew et al., 2000), the relationship between the CARE and the delay discounting task (i.e., a theorized measure of impulsive decision-making) was examined. Perception of risks and rewards related to high-risk behaviors and measures of impulsive decision-making have both been correlated with participation in high-risk behaviors in previous studies (e.g., Donohew et al., 2000; Goldman et al., 1987; Johnson et al., 2002; Petry, 2001; Petry, Bickel, & Arnett, 1998). Based on these findings, it was predicted that there would be a positive correlation among factor scores on two CARE scales, Expected Risk of Activities and Expected Benefit of Activities, and performance on the delay discounting task. However, no significant correlations were found in this study between any factor scores on the two CARE scales and performance on the delay discounting task. Within this study, perceptions of risk and reward related to high-risk behavior were not significantly related to delay discounting task performance.

In further evaluation of this relationship, it was found that delay discounting task performance was not significantly correlated with past participation in high-risk behaviors as measured by the CARE in this sample. This finding deviates from results found in other studies in which significant correlations between delay discounting task performance and involvement in high-risk behaviors using measures other than the CARE were found (e.g., Petry, 2001). As specific measurement relationships between the delay discounting task and the CARE have not been established in other studies, the relationship between CARE and delay discounting task performance may be a complex one. The CARE assesses high-risk behaviors by examining six different types of high-risk behavior, as opposed to other measures which assess only one type of high-risk behavior or provide one total score rating the risk-taking of an individual. While the multi-factor structure of the CARE provided additional valuable information in other parts of this study, it is possible that examining various types of high-risk behaviors may provide different findings than other studies.

Another possible explanation for the lack of significant relationships found between risk perception and delay discounting task performance is the use of college students in this study. Researchers have found that college students discount rewards less rapidly than non-college students on the delay discounting task (Jaroni, Wright, Lerman, & Epstein, 2004). That is, college students are more likely to accept longer term delayed rewards than individuals who are not in college. However, many studies establishing the relationship between measures of impulsive decision-making and participation in high-risk behaviors have used non-college participants. Differences in delay discounting task performance of college students may have contributed to the lack of significant relationships found in this portion of the current study.

Hypothesis Two

This study also examined the effects of an intervention targeting perceptions or expectations regarding high-risk behavior. It was hypothesized that individuals in the experimental group (i.e., individuals who received an intervention presenting normative information about the six high-risk behaviors presented on the CARE) would report less predicted rewards, more predicted risk, and less predicted involvement in high-risk behaviors on the CARE following the intervention than individuals in the control group. Analyses showed that there were no significant CARE differences between groups prior to the intervention. As predicted, individuals in the experimental group reported significantly different scores than individuals in the control group on a number of CARE factors after the intervention. Individuals in the experimental group reported more risks related to five of six factors on the CARE Expected Risk of Activities scale following intervention than control group participants. Only condition scores on the Expected Risk scale factor for negative academics was not different following intervention. In addition, experimental group participants reported less benefits and less expected involvement in all CARE factors (i.e., high-risk sports, risky sexual practices, drug use, aggressive and illegal behaviors, alcohol use, and negative academic practices) than individuals in the control group following the intervention.

The significant differences found between control and experimental groups demonstrate the effectiveness of a brief intervention presenting normative information within a motivational interviewing framework. Seventeen of 18 CARE factors were significantly different in the experimental group compared to control group participants following the intervention. These results lead further credence to research establishing both normative information and motivational interviewing as credible intervention components for high-risk behaviors (Burke et al., 2002; D'Amico et al., 2000; Dunn et al., 2001).

Hypothesis Three

In addition to comparisons between experimental and control groups, each factor on the CARE Expected Risk of Activities, Expected Benefit of Activities, and Expected Involvement in Activities scales, as well as performance on the delay discounting task, were compared pre- and post-intervention within each group to assess whether these scales significantly changed following the intervention. It was found that 16 of 18 factors across the three CARE scales and performance on the delay discounting task significantly changed following intervention within the experimental group. Specifically, individuals in the experimental group reported more risks, less benefits and expected involvement in high-risk behaviors and accepted more delayed rewards on the delay discounting task than they did pre-intervention. Unexpectedly, five factors of the CARE scales changed post-intervention in the control group as well. The control intervention was an active control where normative information on only one high-risk behavior, dangerous driving, was presented. Individuals in the control group may have improved on these CARE factors due to a reappraisal of their risk habits in general following the intervention, although the effect was less robust than the changes that occurred in the experimental group.

Although no significant correlations were found between pre-intervention CARE factor scores and performance on the delay discounting task, this study also examined if a relationship existed among changes in CARE factor scores and changes in delay discounting task performance following the intervention within the entire sample. Only a change in one of the CARE factors assessed was correlated with changes in delay discounting task performance following the intervention. Changes in an individual's predicted involvement in high risk sports were significantly positively correlated with changes in delay discounting task performance. While this factor's relationship to changes in delay discounting task performance was statistically significant, it is unlikely that this relationship is clinically significant and may be a product of variability in the sample used in this study. The absence of significant correlations between changes in CARE factor scores and changes in delay discounting task scores further demonstrates the lack of relationship between these variables in this study. However, scores on both measures did significantly change in the experimental group following intervention. Importantly, this study demonstrated that an intervention presenting normative information about six high-risk behaviors within a motivational interviewing framework was successful at creating changes in individuals' delay discounting, perceptions of risk, and predicted involvement in high-risk behaviors.

Hypothesis Four

Another component to the present study was an examination of the differences between daily smokers (i.e., individuals who smoke at least one cigarette daily) and never-smokers (i.e., individuals who have never smoked a cigarette) on delay discounting task and CARE performance. As 29% of college students smoke, cigarette smoking is one of the most common high-risk behaviors in college students (Douglas et al., 1997; Wechsler et al., 2002). Cigarette smoking has also been linked to participation in other high-risk behaviors (e.g., Coogan et al., 1998; Wang, 2001; Zakarian et al., 2000). It was predicted that daily smokers would accept significantly more immediate rewards on the delay discounting task prior to the intervention than never-smokers, as evident by higher delay discounting task indifference scores. This was not found to be the case, however. Daily smokers and never-smokers performed similarly on the delay discounting task prior to the intervention. In addition, it was hypothesized that daily smokers' delay discounting task scores would change significantly less than never-smokers following the study intervention. This was also not found. Daily smokers and never-smokers did not demonstrate significantly different changes between groups or experimental/control condition. Additional analyses also confirmed that there was not a significant correlation between the number of cigarettes smoked per day and performance on the delay discounting task.

These results differ from past research (e.g., Heyman & Gibb, 2006; Johnson et al., 2007) in which daily cigarette smokers and current non-smokers differed significantly. However, these studies typically used samples of smokers who smoked more cigarettes per day than this study's sample. In the current study, individuals in the Daily Smoker Group smoked an average of 7.7 cigarettes per day. This is well below the samples of some other studies which used a minimum of 20 cigarettes smoked per day to be considered a smoker (e.g., Reynolds et al., 2004). Also, FTND scores of the Daily Smoker group in this study indicated that smoking participants had low levels of nicotine dependence. It is possible that the current sample of daily smokers did not smoke enough cigarettes daily to report a significantly different delay discounting score from never-smokers.

Hypothesis Five

It was also hypothesized that daily smokers and never-smokers would differ on performance on the CARE. Specifically, it was predicted that daily smokers would report less risks, more rewards, and more anticipated involvement in high-risk behaviors than never-smokers. This was true for a number of CARE scale factors. Daily smokers reported significantly less risk associated with drug and alcohol use, as well as high-risk sports, than never-smokers. Additionally, daily smokers reported significantly more rewards from participation in drug and alcohol use than never-smokers. Daily smokers also reported higher predicted involvement and high actual past involvement with drug and alcohol use than never-smokers. Patterson and Copeland (2006) found similar results using the CARE with daily smokers who smoked at least one cigarette daily and current non-smokers. Interestingly, most CARE factors that differed in the current study between daily smokers and never-smokers were related to substance use. Similarly, in the current study it was found that the number of cigarettes smoked per day significantly correlated with expected risks associated with drug use and high risk sports, expected rewards from drug and alcohol use, and predicted involvement in drug and alcohol use, but not other CARE high-risk factors. Past research has shown that individuals who use one substance, such as cigarettes, often use multiple substances (e.g., Emmons et al., 1998). This finding is corroborated in this study. However, other researchers have found that substance users report more general involvement in other high-risk behaviors as well (e.g., Bailey et al., 2006; Beadnell et al., 2005; Crowley et al., 2006; Kelly, Donovan, et al., 2005) which was not the case in the current sample.

Two possible explanations for these results are proposed. First, the mean number of cigarettes smoked per day in this study was lower than other studies and individuals reported low levels of nicotine dependence. It is possible that individuals may need to be heavier smokers to demonstrate the differences seen in other studies. Second, college students, regardless of smoking status, participate in more high-risk behaviors than non-college students and older adults (Boyd et al., 2004; Bylund et al., 2005; Kelly et al., 2005; Paschall, 2003). It is possible that college students who have never smoked cigarettes participate in more high-risk behaviors than other populations and that the results of other studies using non-college participant samples may not generalize to college students. Therefore, significant differences between daily smokers and never-smokers may not have been detected in the present sample.

Strengths, Limitations, and Future Research

A number of notable strengths and limitations are present in this study. College students were chosen specifically for this sample because they participate in more high-risk behaviors than non-college enrolled adults and are at specific risk for future smoking related health problems (e.g., Boyd et al., 2004; Bylund et al., 2005; Paschall, 2003). While the selection of college students for this study was supported by past research and clinical need, it should be noted that the results of this study may not be generalizable to other populations. In addition to participating in more high-risk behaviors, college students choose more delayed rewards on delay discounting tasks than non-college attending adults (Jaroni et al., 2004). As such, the relationships or lack of relationships shown in this study should be considered specifically for college students and interpreting the results for the general population should be done with special care. The fact that the college students in this study were mostly Caucasian females may also limit the generalizablity of this study to other college samples. While it is unclear whether ethnicity or sex would affect this study's results, by expanding future research projects to include more racial and gender diversity, the impact of ethnicity and sex may be further explored and more generalizations may be made to other college samples.

Another limitation of the current study is the pattern of cigarette use among individuals in the Daily Smoker Group. The Daily Smoker Group within this study consisted of individuals who smoked at least one cigarette daily and the average was 7.7 cigarettes daily with low levels of reported nicotine dependence. While these findings are representative of college smokers found in other studies (e.g., Vidrine, Simmons, & Brandon, 2007), many of the studies that reported significant relationships in delay discounting task performance among smokers and non-smokers used higher average cigarettes per day. It is possible that differences in delay discounting task scores are more likely to occur with individuals who smoke more cigarettes per day. To further explore the impact of smoking on measures of impulsive decision-making, it would be valuable to include comparisons with heavier smokers in future studies. Additionally, this study used a self-report measurement of smoking. While studies have demonstrated that self-report of smoking provides accurate information (Velicer, Prochaska, Rossi, & Snow, 1992), the addition of biochemical verification to further verify smoking patterns may improve future studies.

An additional limitation of this study is that the CARE has not been previously examined for relationships with the delay discounting task. The CARE's unique structure of measuring high-risk perceptions and involvement, as well as its measurement of six specific high-risk behaviors, makes it different from many other measures which only assess general involvement in high-risk behaviors. While there is little theoretical reason to believe that the lack of relationships found between the delay discounting task and CARE scores in this study is due to variation in the CARE as a measure, these relationships have not been established in other studies. Future research on high-risk behavior would benefit from increased study of the CARE and its relationship with other decision-making measures.

Future research studying high-risk behaviors should consider the findings of this study. Importantly, it was found that a brief intervention presenting normative information within a motivational interviewing framework led to significant change in scores on both the CARE and delay discounting task. Although the CARE and delay discounting task did not change at the same rate, the significance of these findings further supports the use of this intervention in efforts to reduce participation in high-risk behaviors among college students. By expanding this study to include non-college adults and heavier cigarette smokers, the relationships between impulsive decision-making and high-risk perceptions may be better understood. Additionally, by including follow-up measurement (e.g., one month, six month, one year) of perception and participation in high-risk behaviors, the strength of the intervention in maintaining these changes may be studied. This information may be valuable to guide the development of future interventions aimed at lowering many high-risk behaviors, including substance use and other negative health behaviors.

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