

EVALUATION OF RISK ATTITUDE  
AS A PREDICTOR OF SUBSTANCE RELATED  
RISK TAKING BEHAVIORS

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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

EVALUATION OF RISK ATTITUDE AS A PREDICTOR OF SUBSTANCE  
RELATED RISK TAKING BEHAVIOR

presented by Kayleigh N. McCarty,

a candidate for the degree of Master of Arts,

and hereby certify that, in their opinion, it is worthy of acceptance.

Professor Denis McCarthy
Professor Clinton Davis-Stober
Professor Matthew Martens

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## INTRODUCTION

Risk taking behaviors can be broadly defined as those that involve a probability of negative and undesirable consequences (Boyer, 2006). This definition encompasses a wide range of behaviors, but those with the potential to result in highly undesirable and otherwise avoidable consequences (e.g., risky sexual behaviors, substance misuse, and drinking and driving) attract the greatest interest due to the personal and societal costs. Despite the potential for adverse outcomes, engaging in these types of behaviors is quite common. For instance, 25% of adults report at least one binge drinking episode over the past year (SAMHSA, 2014), and there were 121 million self-reported alcohol-impaired driving incidents among U.S. adults (Jewett et al., 2015). Given the potential costs of risk taking behaviors, research into the factors contributing to increased risk taking has been a prime area of interest across research domains including psychology, public health, and economics (Boyer, 2006; Grable, 2000; Resnick et al., 1997).

Models of risk taking behavior have focused on a wide variety of factors that might increase the likelihood of engagement, including neural development (Galvan et al., 2006), peer influence (Gardner & Steinberg, 2005), affective state (Loewenstein, Weber, Hsee, & Welch, 2001), personality traits (Cyders et al., 2007), and decision making (Levin, Hart, Weller, & Harshman, 2007). Decision making is a complex process influenced by many factors. One method for identifying these factors is mathematical modeling, which is well-suited for deconstructing the decision making process into key components (Lane, Yechiam, & Busemeyer, 2006). Risk Attitude (RA), a decision maker's perception of risk and/or their preferred level of risk, has been identified by mathematical modeling as an important component of the decision making processes

related to risk taking (Hillson & Murray-Webster, 2007; Luce, 2010). Mathematical models of RA have suggested that people can be classified in one of three ways: risk averse, risk seeking, or risk neutral (Luce, 2010). The importance of these RA classifications as determinants of choice and behavior has been well established, particularly in the fields of economics and finance (Ghosh & Ray, 1992).

Despite the large body of judgment and decision-making studies on RA, this construct has only been minimally applied to substance related risk taking behaviors (Anderson & Mellor, 2008; Dohmen, Falk, & Huffman, 2011). Further, the construct validity of RA as a measure of risk taking propensity has only narrowly been examined within specific domains of risk taking, such as financial risk taking or ethical risk taking (Pennings & Smidts, 2000; Weber, Blais, & Betz, 2002). The goal of this study was to test the construct validity of RA as a measure of risk taking propensity for behaviors outside the realm of finance, specifically those related to substance use. First, I aimed to test whether RA demonstrates the expected relationships with conceptually similar constructs, such as impulsivity and delay discounting. Second, I examined whether RA is associated with the perceived risk and benefits associated with engaging in specific risk taking behaviors (outcome expectancies). Finally, I tested whether RA's association with a risk taking behavior is mediated by outcome expectancies for that behavior.

### **Risk Attitude**

Risk attitude (RA) can be formally modeled as the shape of a decision maker's utility function (Yechiam & Ert, 2011). Utility functions compare the actual value of a commodity to the utility the commodity has for a given person. For individuals who are risk neutral, the utility function would be linear with a slope of one, as the commodity

always has the same value and utility. Risk seeking individuals will display a concave utility function, where the utility of the commodity rises slower than its actual value. Risk averse individuals exhibit the opposite pattern where the utility of the commodity rises quicker than the actual value. Models of decision making under risk measure risk attitude using behavioral tasks or self-report measures. Self-report measures directly query individuals about their preferences in specific risky situations (e.g., “Please indicate the likelihood you would engage in the following activities or behaviors... betting a day’s income at the horse races.”; Blais & Weber, 2006). Behavioral tasks determine risk attitude based on the choices made on the task. These tasks often involve choices between monetary gambles, with risk seeking individuals preferring the “risky” gambles and risk averse individuals indicating preference for “safe” gambles (Davis-Stober & Brown, 2013).

Historically, RA has been applied to the domains of finance and economics to better understand risk taking behavior. These studies find that risk seeking individuals are more likely to engage in activities involving financial risk, such as investing in stocks (Fellner & Maciejovsky, 2002). More recently, RA has been studied with regard to health related risk taking behaviors. Individuals who are risk averse are less likely to purchase and eat risky (i.e., genetically modified) food than those who are risk seeking (Lusk & Coble, 2005). Others have found that risk aversion is negatively associated with being obese or failing to wear a seatbelt (Anderson & Mellor, 2008; Szrek, Chao, Ramlaga, & Peltzer, 2012). With a few notable exceptions, RA has not been studied in relation to substance use, and these studies have been inconsistent. Szrek et al. (2012) found that RA

was associated with problem drinking behavior and smoking. In contrast, Anderson & Mellor (2008) failed to find an association between RA and smoking or heavy drinking.

While some consider RA to be stable across contexts, there are many instances in which RA varies as the conditions surrounding the decision change (Yechiam & Ert, 2011). Of these, perhaps the most well-known is the *reflection effect* described by Kahneman & Tversky (1979). The reflection effect refers to the phenomenon in which individuals are risk seeking for outcomes involving losses and risk averse for outcomes involving gains (Kahneman & Tversky, 1979). Recently, models of RA have improved to accommodate this and other decision making inconsistencies while still allowing individuals to be classified by a single RA representative of observed decision making behavior (Davis-Stober & Brown, 2013). This method allows for more predictive specificity than traditional models of RA, though these classifications have not yet been evaluated in relation to real world risk taking.

### **Convergent Validity: Impulsivity and Executive Function**

Evidence for the construct validity of RA would be indicated by convergence between RA classifications and conceptually similar constructs related to risk taking. For substance related risk taking, these constructs include impulsivity traits and components of executive functioning (de Wit, 2008; Dick et al., 2010; Lejuez et al., 2010; Zucker, Heitzeg, & Nigg, 2011). It was expected that RA would be associated (e.g., demonstrate convergent validity) with conceptually similar dimensions of impulsivity (e.g., positive urgency, negative urgency, sensation seeking) and executive functioning (e.g., delay discounting) related to substance related risk taking. Failure to support this hypothesis

might suggest that RA influences engagement in risk taking behaviors through a different mechanism than that of impulsivity-like traits.

Impulsivity is a broad personality trait frequently associated with involvement in risk taking behaviors, particularly substance misuse (de Wit, 2008; Lejuez et al., 2010; Verdejo-García, Lawrence, & Clark, 2008). Models of impulsivity have disaggregated the trait into five distinct factors: positive urgency, negative urgency, lack of planning, lack of perseverance, and sensation seeking (Cyders et al., 2007). Studies based on this five-factor model have found that the distinct dimensions of impulsivity have unique relationships with risk taking behaviors (Smith et al., 2007).

Studies suggest that positive urgency, negative urgency, and sensation seeking have the most consistent associations with substance use and substance related problems. Positive and negative urgency involve taking rash action when in a positive or negative mood, respectively (Cyders & Smith, 2008), whereas sensation seeking refers to a tendency to seek out novel or thrilling stimulation (Dick et al., 2010). The urgency traits are most associated with problematic drinking behaviors, such as binge drinking or experiencing negative consequences (Coskunpinar, Dir, & Cyders, 2013; Cyders, Flory, Rainer, & Smith, 2009; Fischer & Smith, 2008; Smith et al., 2007). Sensation seeking, in contrast, is associated with frequency of drinking (Coskunpinar, Dir, & Cyders, 2013; Cyders, Flory, Rainer, & Smith, 2009; Fischer & Smith, 2008; Smith et al., 2007). The urgency traits are associated with other substance use behaviors, including cigarette smoking, marijuana smoking, and drinking and driving (Spillane, Smith, & Kahler, 2010; Zapolski, et al 2009; Treloar et al., 2012).

Weighing short-term versus long-term outcomes is a component of executive function commonly studied in relation to substance use behaviors (Bickel, Jarmolowicz, Mueller, Gatchalian, & McClure, 2012). This construct is frequently measured by delay discounting tasks (Bickel et al., 2012). Delay discounting tasks involve making choices between smaller, immediate rewards and larger, delayed rewards and yield a curve which describes how much individuals “discount” rewards based on the length of the delay (Dick et al., 2010). Shallower curves reflect lower rates of delay discounting, indicating a willingness to make sacrifices for delayed benefits, whereas higher rates of delay discounting (i.e., steeper curves) are associated with engaging in more immediately rewarding behaviors at the expense of future health or wellbeing. Failure to value delayed rewards is associated with engaging in risk taking behaviors (Bickel et al., 2012). For instance, drink drivers are more likely to prefer smaller and immediate rewards over larger, delayed rewards than those who do not drink and drive (Rossow, 2008), particularly while intoxicated (McCarthy, Niculete, Treloar, Morris, & Bartholow, 2012). Rates of delay discounting can also be used to differentiate individuals who abuse substances from those who do not. Individuals who are alcohol or drug dependent are more likely to discount future rewards more steeply than those without dependence (Bickel et al., 2007).

### **Substance Use Outcome Expectancies**

Individuals with impulsive personality traits or steeper rates of delay discounting do not engage in all varieties of risk taking behaviors. Outcome expectancies can distinguish between which risk taking behaviors an individual is willing to engage in. Expectancies represent an individual’s history of learning about the outcomes of a

specific behavior (Bolles, 1972). Studies have demonstrated that expectancies are strong predictors of engaging in risk taking behaviors, specifically substance use behaviors (Goldman, Del Boca, & Darkes, 1999). Individuals who hold positive outcome expectancies about substances are likely to use those substances more frequently (Aarons, Brown, Stice, & Coe, 2001; Smith, Goldman, Greenbaum, & Christiansen, 1995). The evidence for negative expectancies is less conclusive, but some studies suggest that negative expectancies are associated with more problematic substance use, such as substance dependence (Connor, Gullo, Feeney, & Young, 2011; Jones, Corbin, & Fromme, 2001; Li & Dingle, 2012).

Due to the importance of both personality traits and expectancies in predicting behavior, models have been developed to better describe the relationship between the two. One such model, the Acquired Preparedness Model (APM), suggests that personality traits mediate the relationship between urgency or disinhibition and alcohol use (McCarthy, Kroll, & Smith, 2001; Settles, Cyders, & Smith, 2010; Smith & Anderson, 2001). The APM proposes that personality traits are partially responsible for the alcohol-related learning process (Smith & Anderson, 2001). Personality traits might allow two individuals to experience a common event in different ways, and as a result, learn different things from the event (Smith & Anderson, 2001). Said differently, individuals are differentially prepared for learning experiences based on the personality traits they possess. Preliminary tests of the APM involved alcohol use, but later studies have included cigarette smoking and marijuana use and have shown the model to accurately predict outcomes (Doran et al., 2013; Hayaki et al., 2011; Vangsnæs, Bry, & LaBouvie, 2005). Most empirical tests of this model have utilized impulsivity-like personality traits

(e.g., urgency, behavioral disinhibition, sensation seeking; Anderson, Smith, & Fischer, 2003; Corbin, Iwamoto, & Fromme, 2011; Scott & Corbin, 2014; Settles et al., 2010).

### **Present Study**

Despite the apparent conceptual overlap between RA and disinhibited personality traits, RA classification has not been studied in relation to these traits. Furthermore, the mechanism by which RA affects engagement in risk taking behavior remains unclear. RA can be conceptualized as an indicator of a general willingness to take risks (Dohmen et al., 2011), and if this holds true, different RA classifications would likely lead individuals to select different environments and engage in different behaviors. RA classification might also influence learning about the outcomes of risk taking behaviors, similar to the role of impulsivity-like traits in the APM. For instance, a person with a risk seeking classification might be more likely to learn to expect positive outcomes from risk taking behaviors, whereas a risk averse person might learn negative outcomes more readily.

The purpose of the current study was to evaluate RA as a predictor of substance related risk taking behaviors. Assuming RA is a measure of willingness to engage in risk taking behaviors, it is anticipated that RA will be related to conceptually similar constructs associated with substance related risk taking behaviors (e.g., positive urgency, delay discounting). It was also expected that RA will predict involvement in substance related risk taking behaviors. Finally, I expected that the relation between RA and risk taking behavior will be mediated by behavior-specific expectancies. For instance, I hypothesized that the relation between RA and binge drinking will be mediated by alcohol expectancies.

## Method

### Participants

Data were collected from 235 participants. The data from 14 participants were excluded due to a computer glitch ( $n = 12$ ) and lack of fluency in English ( $n = 2$ ), resulting in a final sample size of 221 (mean age = 18.8 [SD = 0.95], 54.3% female, 78% white).

### Measures

**Demographic information.** Age, gender, sexual orientation, ethnicity, SES, and residential status were assessed.

**Risk attitude.** RA was determined based on responses provided during a decision making task (Davis-Stober & Brown, 2013). Participants were presented with a series of hypothetical paired gambles, and they were asked to indicate their preference or indifference for each gamble pair. Within each pair, one gamble contained two equally likely choices that have a larger variance (e.g., 50% chance of winning \$15 or a 50% chance of winning \$7), while the other gamble contained two equally likely choices with a smaller variance (e.g., 50% chance of winning \$10 or a 50% chance of winning \$12). Both of these gambles have the same expected value, but the gamble with the larger variance is considered to be the “risky” choice, and the gamble with the smaller variance is considered to be the “safe” choice. The gambles varied on the magnitude of the potential payouts and whether they are mixed or pure. A pure gamble involves choices with the same variety of outcome. In other words, both choices are losses (e.g., 50% chance of losing \$7 or a 50% chance of losing \$11) or both choices are gains (as in the example above). A mixed gamble involves one loss outcome and one gain outcome (e.g.,

50% chance of winning \$10.50 or a 50% chance of losing \$16.50). There are six possible RA classifications based on responses to this task: *risk seeking* (always prefer the “risky” gamble), *risk neutral* (always indifferent), *risk averse* (always prefer the “safe” gamble), *gain-loss sensitive* (risk averse for gambles involving gains, risk seeking for gambles involving losses), *high stakes sensitive* (risk seeking for gambles involving small gains and all losses, risk averse for gambles involving large gains) or *mixed gamble sensitive* (risk averse for gambles involving pure gains and mixed gambles, risk seeking for gambles involving pure losses).

### **Risk taking behaviors and consequences.**

*Drinking and driving behaviors.* Drinking and driving behavior were measured using four questions. One question asked if participants have driven after consuming 1-6 drinks in two hours in the past three months. A second question asked if participants have driven after consuming 1-6 drinks in two hours in the past year. Similar questions asked about riding with a driver who had been drinking.

*Marijuana use.* Marijuana use was assessed with a 30-item measure related to frequency of use, quantity of use and context of use. Marijuana and alcohol co-use was also assessed.

*Alcohol consumption.* The Drinking Styles Questionnaire (DSQ; Smith, McCarthy, & Goldman, 1995) was used to assess drinking behaviors (drinking/drunkenness scale). The drinking/drunkenness scale is composed of five items that assess quantity and frequency of consumption and the proportion of drinking occasions that result in drunkenness.

***Smoking behavior.*** Smoking was assessed with a variety of questions related to frequency and quantity of tobacco use. Specific smoking behaviors, such as inhaling, were also measured.

***Sexual risk taking and outcomes.*** The Cognitive Appraisal of Risky Events-Revised (CARE-R; Katz, Fromme, & D'Amico, 2000) was used to assess cognitive appraisal of risks and benefits associated with risk taking behaviors. Specifically, this scale was used to assess expected benefits and consequences of risky sexual behaviors. The past frequency, expected benefits and expected risks components of this scale were used. Participants responded to each item on a 7-point Likert scale.

***Alcohol consequences.*** The Young Adult Alcohol Consequences Questionnaire (YAACQ; Read, Kahler, Strong, & Colder, 2006) was used to assess consequences experienced as a result of consuming alcohol. Participants respond to 48 items with “yes” or “no,” indicating whether they had experienced each consequence. This questionnaire produces eight subscales: social/interpersonal, impaired control, self-perception, self-care, risky behaviors, academic/occupational, physiological dependence, and blackout drinking.

**Outcome expectancies and attitudes.**

***Drinking and driving attitudes.*** Drinking and driving attitudes was assessed using questions adapted from previous work by Grube & Voas, (1996). These questions queried how dangerous participants believe it would be to drive after consuming 1-6 drinks. Participants were also asked about the favorability of alternatives to drinking and driving.

***Drinking and driving expectancies.*** The Positive Expectancies for Drinking and Driving for Youth (PEDD-Y; McCarthy, Pedersen, Thompsen, & Leuty, 2006) was used

to assess drinking and driving expectancies. This questionnaire is 29 items, and participants responded to each item on a 5-point Likert scale, ranging from *disagree strongly* to *agree strongly*. This measure is composed of four factors: convenience, control, avoiding consequences and excitement seeking.

***Marijuana outcome expectancies.*** The Marijuana Effect Expectancy Questionnaire (MEEQ; Aarons et al., 2001) was used to assess marijuana expectancies. This measure is 48 items and is composed of six factors: cognitive and behavioral impairment, relaxation and tension reduction, social and sexual facilitation, perceptual and cognitive enhancement, global negative effects and craving and physical effects. Participants responded to each item on a 5-point Likert scale ranging from disagree strongly to agree strongly.

***Alcohol outcome expectancies.*** The Comprehensive Effects of Alcohol (CEOA; Fromme, Stroot, & Kaplan, 1993) was used to assess alcohol expectancies. This measure is 41 items with seven factors: sociability, tension reduction, liquid courage, sexuality, cognitive and behavioral impairment, risk and aggression and self-perception. Participants responded to each item using a 4-point Likert scale ranging from disagree to agree.

***Smoking outcome expectancies.*** The Short form of Smoking Consequences Questionnaire (S-SCQ; Myers, MacPherson, McCarthy, & Brown, 2003) was used to measure smoking outcome expectancies. This measure is 21 items and is composed of four factors: negative consequences, positive reinforcement, negative reinforcement and appetite-weight control. Participants responded to each item using a 10-point Likert scale ranging from completely unlikely to completely likely.

**Personality traits and executive functioning.**

**Impulsivity.** The UPPS-P (Lynam, Smith, Cyders, Fischer, & Whiteside, 2007) was used to assess impulsivity-like traits. The UPPS-P is a 58-item questionnaire that measures negative urgency, lack of perseverance, lack of planning, sensation seeking and positive urgency. Participants responded to each item using a four-point Likert scale ranging from *agree strongly* to *disagree strongly*.

**Delay discounting.** The Monetary Choice Questionnaire (MCQ; (Kirby, Petry, & Bickel, 1999) was used to assess delay discounting. The MCQ is composed of 27 items, and each item involves a choice between a smaller, immediate reward and a larger reward that would be received after a specified amount of time (e.g., “would you rather have \$55 today or \$75 in 61 days?”).

**Probability discounting.** The probability discounting questionnaire (Madden, Petry, & Johnson, 2009) was used to assess probability discounting, which reflects how much individuals choices are influenced by the probability of receiving particular rewards. This construct is analogous to delay discounting, but varies only the probability of payoff rather than the delay period. The probability discounting questionnaire is composed of 30 items. Each item involves a choice between a smaller, certain reward and a larger, probable reward [e.g., “which would you prefer: \$20 for sure or a 1-in-10 chance (10% chance) of winning \$80]. Responses to these choices can be scored to calculate a discounting rate.

**Procedure**

Participants reported to the lab, and a research assistant obtained written informed consent. After providing consent, participants completed the RA decision making task.

Finally, participants completed the questionnaire measures. Following completion of the study, participants received course credit as compensation for participating in the study.

### **Statistical Analyses**

**RA classification.** Bayesian model comparison was used to evaluate each participant's choice data. Bayes factors were computed to assess the fit of the six different models (i.e., risk averse, risk neutral, risk seeking, gain-loss sensitive, mixed gambles sensitive, high stakes sensitive) compared to a reference model. The reference model can be considered a "null" model to which the other models can be compared. For each of the models considered, priors are assigned based on corresponding choice predictions, with a value of five applied to the choice predicted by the given model, and a value of one is applied to remaining choices. For instance, under the risk seeking model, preference for the risky option would receive a prior value of five, and values of one would be applied to indifference or preference for the safe option. These prior values weigh the choice predicted by the model heavily but allow for decision maker error. The prior values for the reference model are set to be equal to 0.5 for all possible choices: *prefer risky option, prefer safe option, indifference*. The prior values of the reference model imply that all choices are equally likely.

The Bayes factor is equal to the ratio of two marginal likelihoods. High Bayes factors indicate good model fit. The model with the highest Bayes factor represented the participant's RA classification. The participants who did not obtain a Bayes factor of three or larger for any one model were coded as "not classified." RA classification was then dummy coded into five variables for additional analyses.

**The association of RA with personality traits, risk taking behaviors, and expectancies.** I hypothesized that RA would be positively associated with personality traits related to risk taking behaviors (e.g., positive urgency, negative urgency) and risk taking behaviors. This hypothesis was tested using path analysis in order to simultaneously test the effect of RA on all variables of interest.

## Results

**RA Classification.** Of the 221 participants included in analyses, 60 participants (27.1%) were unable to be classified. The remaining participants were classified as follows: risk averse ( $n = 62$ , 28.1%), risk seeking ( $n = 46$ , 20.8%), gain-loss sensitive ( $n = 21$ , 9.5%), risk neutral ( $n = 11$ , 5.0%), high stakes sensitive ( $n = 11$ , 5.0%), and mixed gambles sensitive ( $n = 10$ , 4.5%). The gain-loss sensitive, high stakes sensitive, and mixed gambles sensitive classifications are all consistent with the predictions of cumulative prospect theory (Tversky & Kahneman, 1992). Due to this theoretical basis and small sample sizes of each of these individual classifications, these classifications were combined into one classification (named cumulative prospect theory) for analytic purposes. This resulted in the following distributions: risk averse ( $n = 62$ , 28.1%), not classified ( $n = 60$ , 27.1%), risk seeking ( $n = 46$ , 20.8%), cumulative prospect theory ( $n = 42$ , 19.0%), and risk neutral ( $n = 11$ , 5.0%). These classifications were dummy coded for further analyses. For all analyses, risk averse was used as the reference group, as our data and previous research suggests that this classification is most common (Dohmen et al., 2011; Davis-Stober & Brown, 2013).

**RA and Personality Traits.** Path models were specified with one model for all UPPS-P traits, and separate models for probability discounting and delay discounting. The risk seeking classification was the only classification consistently associated with UPPS-P personality traits. Relative to the risk averse group, those who were risk seeking had higher scores on negative urgency ( $\beta = 0.20$ ,  $p = 0.009$ ), lack of premeditation ( $\beta = 0.24$ ,  $p = 0.001$ ), sensation seeking ( $\beta = 0.16$ ,  $p = 0.039$ ), and positive urgency ( $\beta = 0.32$ ,  $p < 0.001$ ). Those classified as consistent with cumulative prospect theory scored higher on

positive urgency ( $\beta = 0.15$ ,  $p = 0.038$ ). Those who were not classified scored higher on lack of premeditation ( $\beta = 0.25$ ,  $p = 0.001$ ) and positive urgency ( $\beta = 0.24$ ,  $p = 0.001$ ). Finally, those in the risk neutral class scored higher on positive urgency ( $\beta = 0.21$ ,  $p = 0.001$ ). No RA classifications differed from risk averse on rates of delay discounting or probability discounting.

**RA and Alcohol.** Separate path models were specified with one model for all alcohol consequences and a separate model for each alcohol use index. No risk attitude classification differed from risk averse on alcohol use indices. However, individuals in the risk seeking classification were more likely to experience alcohol related consequences in the following domains: risky behaviors ( $\beta = 0.22$ ,  $p = 0.001$ ), academic/occupational ( $\beta = 0.19$ ,  $p = 0.009$ ), and physiological dependence ( $\beta = 0.20$ ,  $p = 0.007$ ).

A single path model was specified for all alcohol expectancy subscales. Individuals in the risk seeking and cumulative prospect theory classifications scored higher on measures of liquid courage ( $\beta = 0.27$ ,  $p = 0.001$  and  $\beta = 0.18$ ,  $p = 0.020$ , respectively). All classifications, with the exception of risk neutral, scored higher on risk and aggression alcohol expectancies relative to those who are risk averse: not classified ( $\beta = 0.23$ ,  $p = 0.004$ ), risk seeking ( $\beta = 0.33$ ,  $p < 0.001$ ), and cumulative prospect theory ( $\beta = 0.22$ ,  $p = 0.003$ ).

**RA and Smoking.** Separate path models were specified for each smoking behavior, and a single model for smoking outcome expectancy scales. No risk attitude classification differed from risk averse on cigarette smoking behavior. There were no significant differences on smoking quantity or frequency, and no RA classification predicted

smoking status. Furthermore, no RA classification differed from risk averse on smoking outcome expectancies.

**RA and Drinking and Driving.** Separate path models were specified for drinking and driving behaviors, and a single model for all driving expectancy subscales. Relative to risk averse, those who were unable to be classified and those who were consistent with cumulative prospect theory were both more likely to drive after consuming 3 or more alcoholic beverages ( $\beta = 0.57, p < 0.001$  and  $\beta = 0.69, p < 0.001$ , respectively). Individuals who were not classified and those who were risk neutral held more positive expectancies about drinking and driving (control subscale;  $\beta = 0.2, p = 0.003$  and  $\beta = 0.16$  and  $p = 0.024$ , respectively). Those in the risk seeking classification had a higher perceived safe limit ( $\beta = 0.20, p = 0.010$ ) and believe driving after drinking to be less dangerous ( $\beta = -0.20, p = 0.012$ ).

**RA and Marijuana.** Separate path models were specified for indices of marijuana use, and a single model for marijuana expectancy subscales. No risk attitude classification differed from risk averse on marijuana use or marijuana expectancies.

**RA and Risky Sex.** Separate path models were specified for sexual behavior, expected positive benefits, and expected negative benefits. Relative to risk averse, those in the risk seeking class were more engaged in risky sexual behaviors with new partners, but not regular partners, relative to those who were risk averse ( $\beta = 0.24, p = 0.003$ ). Individuals who were risk neutral and consistent with prospect theory engaged in risky sexual behaviors with regular partners at greater frequencies ( $\beta = 0.18, p = 0.010$  for RN and  $\beta = 0.17, p = .032$  for PT). Individuals who were risk seeking also held greater positive expectancies about risky sexual behaviors with new partners ( $\beta = 0.26, p = 0.001$ ) and

fewer negative expectancies about risky sexual behaviors with both new and regular partners ( $\beta = -0.25$ ,  $p = .001$  and  $\beta = -0.17$ ,  $p = 0.031$  respectively). Individuals who were not classified also held fewer negative expectancies about sexual behaviors with new partners ( $\beta = -0.23$ ,  $p = 0.005$ ).

## Discussion

The present study provides initial evidence that RA is associated with risk taking behaviors and disinhibited personality traits. Specifically, those who are risk seeking were more likely to engage in a number of risk taking behaviors and were higher on disinhibited personality traits, consistent with hypotheses. Interestingly, individuals consistent with cumulative prospect theory also engaged in some risk taking behaviors with higher frequencies. These results suggest that the assessment of RA can be meaningfully integrated into the existing literature on substance use and risk taking behaviors. Risk attitude has a strong mathematical foundation, and a large body of research exists in the field of judgment in decision making describing this construct and the associated decision making process. To date, the field of substance use has yet to take advantage of these strengths. The results of this study suggest that the assessment of RA can provide additional information about risk taking as it applies to substance use and related behaviors.

Consistent with hypotheses, individuals in the risk seeking classification engaged in risk taking behaviors more frequently relative to individuals in the risk averse classification. Risk seeking individuals experienced more alcohol consequences in several domains, despite no observed difference in their drinking. Our data suggest that those who are risk seeking are more likely to experience symptoms of dependence on alcohol (e.g., withdrawal, tolerance, role interference), to experience problems at work or school because of their drinking, and to engage in risk taking (e.g., getting into fights, unprotected sex) while drinking. Individuals who were risk seeking also scored higher on the alcohol expectancy subscales associated with risk taking while drinking, suggesting

that risk seeking individuals not only experience these consequences more frequently but also have learned to expect these consequences. Our results suggest that the use of alcohol, smoking, and marijuana are not associated with risk attitude, but that, at least for alcohol, specific behaviors engaged in during drinking episodes are.

Risk seeking was also associated with engagement in and perceptions of sexual risk taking. Risk seeking individuals engage in risky sexual behaviors more frequently, overestimate the potential positive outcomes of risky sexual experiences, and discount the potential negative outcomes of these experiences. The present study does not represent an exhaustive assessment of sexual risk taking and associated consequences. Future research should further investigate the association between risk attitude and negative outcomes associated with sexual risk taking.

Individuals in the cumulative prospect theory (CPT) classification also engaged in some risk taking behaviors at a higher rate than their risk averse counterparts, including drinking and driving and sexual risk taking with regular partners. Cumulative prospect theory is a well-known descriptive model of decisions under risk (Tversky & Kahneman, 1992). This theory predicts that individuals' risk attitude will vary based on the conditions of the decision, being risk averse in some situations and risk seeking in others. In our study, CPT classification was associated with drinking and driving and engaging in sexual risk taking with regular partners. One interpretation of these results is that each of these decisions involves conditional variations on relatively common situations. Both driving and sexual activity with regular partners are not inherently risk taking, and only become so under specific conditions (e.g., after consuming alcohol, without STD/pregnancy protection). An interesting direction for future research is to examine

whether CPT classifications can shed light on decision making about these and other conditional risk behaviors.

Finally, risk seeking individuals scored higher on most subscales of the UPPS-P, but did not differ from risk averse on either delay or probability discounting. Future studies should confirm this distinction among impulsivity-like traits with respect to risk attitude and include other measures of impulsivity. In particular, future studies should consider alternate measures of delay discounting. The current study used a questionnaire based measure of delay discounting in which the discounting rate is inferred. Other measures of delay discounting allow for empirical modeling of the discounting curve, resulting in more precise measurement (MacKillop, 2016).

Despite the strengths of this study, a number of questions remain unanswered. The RA classification task was only administered to participants at a single time, and the temporal stability of these classifications remains unclear. Similarly, contextual influences on risk attitude classification have not been examined. For instance, while risk seeking is associated with negative consequence while drinking, it is not clear whether risk attitude classification is affected by alcohol intoxication. This particular measure of risk attitude has a number of strengths, but it has not been compared to other measures of risk (e.g., Balloon Analogue Risk Task; Lejuez et al., 2002) in empirical studies. In addition, self-report measures of risk attitude have been developed. Future studies should investigate how this measure compares to quicker, less burdensome self-report measures as well as to existing tasks measuring conceptually similar constructs.

The results of this study should be considered in the context of a number of limitations. First, participants in this study were not recruited based on their engagement

in risk taking behaviors. As a result, some behaviors assessed in this study (e.g., marijuana use, cigarette smoking, and drinking and driving) occurred relatively infrequently. These low base rates may partially explain the failure to find any significant associations for these behaviors. Of those behaviors that did occur in a larger portion of the sample (i.e., alcohol use), these behaviors occurred at a relatively low frequency. Similar studies should be conducted in samples that use substances more heavily to replicate the findings of this study. In particular, future research should confirm the association of risk seeking with the experience of alcohol-related negative consequences, as well as the failure to find associations with marijuana use. Second, this study utilized college students as participants, and these students were largely in their first year of college. This study does not allow for inferences to be made about the larger population. Future studies should utilize older samples, or samples of adults not enrolled in college to determine if these patterns hold.

The present study provides initial evidence that risk attitude is related to alcohol-related risk taking behaviors and disinhibited personality traits. The risk seeking classification appears to be particularly important for risk taking behaviors, including the experience of alcohol-related negative consequences and engaging in risky sexual behavior. In addition, this classification is related to higher levels of trait impulsivity. Further research is required to determine the associations of this measure of risk attitude with other measures of risk.

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