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Decision-making, Impulsivity and Self-control: Between-person and Within-person Predictors of Risk-taking Behavior

Emily S. Kuhn
University of New Orleans, ekuhn@uno.edu

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Emily S. Kuhn

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Abstract

This study tested dual-process decision-making models as predictors of between-person and within-person variation in risk-taking behavior. Additionally, the study integrated trait perspectives on self-control and impulsivity with decision-making processes to explain risk-taking. Participants were 580 college students ages 18 and older (M age = 20.45, range = 18 to 52 years). This study involved three parts. First, participants completed a survey assessing decision-making processes, self-control, impulsivity and risk-taking behavior. Second, a sub-set of participants completed laboratory-based measures of self-control and impulsivity. Third, participants completed a longitudinal online assessment of their risk-taking behavior. Dual-process models explained concurrent risk-taking, but only the reasoned decision-making process explained longitudinal risk-taking. The dual decision-making processes appear to operate through similar pathways, with components from each pathway exhibiting indirect effects through the other pathway. Impulsivity was linked to higher levels of risk-taking because of higher levels of behavioral intentions and willingness, whereas self-control was linked to lower levels of risk-taking because of lower levels of behavioral intentions. Between-person effects were as common as within-person effects, so future researchers are urged to consider decision-making processes averaged across forms of risk-taking and within each form of risk-taking. Altering decision-making pathways may be an effective way to intervene with individuals at high risk for engaging in risk-taking behavior.

Keywords: risk-taking behavior; dual decision-making processes; self-control; impulsivity; between-person; within-person

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Introduction

Many late adolescents drink alcohol, have unprotected sex and drive over the speed limit (Centers for Disease Control and Prevention, 2012). While such risk-taking behavior is common among late adolescents, risk-taking is quite dangerous and many late adolescent deaths can be attributed to engagement in risk-taking behavior (Centers for Disease Control and Prevention, 2012). Individuals who engage in one form of risk-taking are likely to engage in other forms of risk-taking as well (Osgood, Johnston, O'Malley & Bachman, 1998), but not all adolescents who engage in one form of risk-taking will engage in another form of risk-taking. The present study first investigates which adolescents are most likely to engage in substance use, criminal behavior, risky sex and reckless driving, averaged across forms of risk-taking. Second, the present study considers why an adolescent may engage in one form of risk-taking but not another form of risk-taking. In this dissertation, risk-taking behavior in late adolescence will first be discussed with a focus on four forms of risk-taking relevant to the present investigation. Decision-making models will then be introduced with an emphasis on dual decision-making processes. Next, trait models of risk-taking will then be introduced focusing on individual differences in impulsivity and self-control. Then, decision-making models and trait perspectives will be integrated in a model that considers both simultaneously. Subsequently, the advantages of modeling between-person and within-person differences in risk-taking will be described and the specific approach to assessing between-person and within-person differences used in the current study will be outlined. Finally, hypotheses will be presented.

Risk-taking Behavior in Late Adolescence

There are different perspectives regarding what constitutes risk-taking behavior. For instance, risk-taking has been conceptualized as behavior which, if undertaken, is typically associated with an increased chance of adverse consequences (Haydon, McRee & Halpern, 2011). From a different perspective, risk-taking is defined as behavior which has uncertain outcomes (Haydon et al., 2011). The present study focuses on behavior that is undertaken volitionally and is typically associated with an increased chance of experiencing adverse consequences rather than behavior that has uncertain outcomes. Although risk-taking behavior is associated with an increased chance of adverse outcomes, risk-taking is typically seen by individuals engaging in the risk-taking behavior as being associated with potentially desirable outcomes such as short-term pleasure (Olson-Madden, Brenner, Corrigan, Emrick, & Britton, 2012). For instance, smoking marijuana may lead to adverse health consequences and trouble with the law, but individuals may perceive short-term benefits from smoking marijuana.

The present study focuses on four forms of risk-taking behavior: substance use (alcohol, tobacco, drugs), risky sexual behavior, criminal behavior and reckless driving. These four forms of risk-taking were selected because many late adolescents' deaths can be attributed to engagement in these forms of risk-taking (Centers for Disease Control and Prevention, 2012), but involvement in these forms of risk-taking is quite common (Steinberg, 2007). All four forms of risk-taking selected for this study are engaged in at high rates during the late teens and early twenties (Arnett, 2000; Bachman, Johnston , O'Malley & Schulenberg, 1996; Cicchetti & Rogosch, 2002; Ingersoll & Ewing, 2011; White & Jackson, 2006). Criminal involvement peaks at ages 18-19 (White, 1992). Likewise, diagnoses of alcohol and drug use disorders (Kessler, Berglund, Demler, Jin & Walters, 2005) and diagnoses of sexually transmitted diseases (Centers for Disease Control and Prevention, 2008) are also elevated during the late teens and early

twenties. The rate of car accidents is higher among individuals ages 20-24 than among older adults (United States Census Bureau, 2012). Also, engagement in these forms of risk-taking is discouraged by society and is not considered socially acceptable. In addition, there is variability in these four forms of risk-taking in terms of the typicality of engagement in and social acceptability of these forms of risk-taking. According to the Youth Risk Behavior Surveillance 2011 report (Centers for Disease Control and Prevention, 2012), 32% of high school students engage in reckless driving behavior, 23% report currently using marijuana and 40% of sexually active high school students reported not using a condom during their last sexual intercourse. While these forms of risk-taking are prevalent among late adolescents, there is variability in how common engagement in these forms of risk-taking is (Centers for Disease Control and Prevention, 2012). Specifically, risky sexual behavior is most common, followed by reckless driving. Drug use is least common (Centers for Disease Control and Prevention, 2012). Analyses will focus on predicting specific forms of risk-taking and testing whether findings generalize across the range of risk-taking behavior.

While individuals who engage in one form of risk-taking are more likely to engage in other forms of risk-taking as well (Burfeind & Bartusch, 2011), the relationship between different forms of risk-taking is imperfect. For instance, while substance use may be associated with criminal behavior, not everyone who engages in crime uses substances and not everyone who uses substances engages in crime. This pattern suggests that some individuals selectively engage in specific forms of risk-taking while choosing not to engage in other forms of risk-taking (Burfeind & Bartusch, 2011). The moderate to high, but imperfect, correlation between different forms of risk-taking has led some people to focus on risk-taking generally (e.g., Biglan, Brennan, Foster & Holder, 2004) and some people to focus on specific forms of risk-taking such

as substance use (e.g., Rawson et al., 1995; Stahler et al., 2005). The present study is an attempt to develop a flexible model which enables consideration of both the factors that predict risk-taking generally and factors that predict involvement in specific forms of risk-taking. Specifically, the present study examines between-person and within-person differences in risk-taking. Between-person analyses will reveal which people are at risk for engaging in risk-taking behavior and within-person analyses will reveal for which forms of risk-taking each person is at risk.

In sum, the present study defines risk-taking behavior as behavior that is undertaken volitionally and is associated with an increased chance of adverse consequences (Haydon et al., 2011). Specifically, four forms of risk-taking will be investigated: substance use, risky sexual behavior, criminal behavior and reckless driving. These forms of risk-taking were selected because they are quite common among late adolescents but they contribute to adolescent morbidity and mortality (Centers for Disease Control and Prevention, 2012). In addition, there is variability in terms of the commonality and social acceptability of these forms of risk-taking (Centers for Disease Control and Prevention, 2012). The present study investigates between-person and within-person variability in risk-taking behavior.

Risky Decision-Making Models

Individuals' decision-making regarding risk-taking behavior is best conceptualized from a dual-process perspective (Albert & Steinberg, 2011; National Research Council, 2011). According to dual-process models, decision-making involves both a cognitive, reasoned component as well as a reactive, intuitive and affective process which work together to produce decisions (Halpern-Felsher, 2011; Reyna & Farley, 2006). The cognitive, reasoned decision-making system involves deliberative planning and forethought to engage in or avoid risk-taking

(Wills, Pokhrel, Morehouse & Fenster, 2011). The reactive pathway is characterized by quick, intuitive responding (Steinberg, 2007; Wills et al., 2011). In the following sections, the reasoned and reactive pathways will be more thoroughly reviewed.

Reasoned decision-making. Models focusing on a rational, deliberative approach to decision-making that have received empirical support include the Health Belief Model, the Theory of Planned Behavior and the Rational Choice Model. Each of these models incorporates multiple rational evaluations to explain how people make decisions. This section will review three reasoned decision-making models.

The first model is the Health Belief Model which is used to explain why people engage in health promoting behavior (Rosenstock, 1974; Rosenstock, Strecher, & Becker, 1988) as compared to risk-taking models that explain why individuals engage in risk-taking or health destructing behavior. The Health Belief Model's components are perceived susceptibility to health threats, perceived severity of health threats, beliefs that certain behavior will benefit health and perceptions of barriers to engaging in healthy behavior (Rosenstock, 1974; Rosenstock et al., 1988). The Health Belief Model can apply to substance use, dieting and other health-related risky behaviors (Rosenstock et al., 1988). While several of the Health Belief Model's components are related to health behaviors, the correlations are low and the Health Belief Model accounts for little variance in health behaviors (Carpenter, 2010; Harrison, Mullen & Green, 1992). Two meta-analyses of studies testing the Health Belief Model demonstrated that the Health Belief Model's components were unrelated to moderately related to behavior (Carpenter, 2010; Harrison et al., 1992). Carpenter (2010) concluded that using the Health Belief Model is not recommended.

The second model is the Theory of Planned Behavior which was developed based on a previously-existing model, the Theory of Reasoned Action (Ajzen, 1991). Components of the The Theory of Planned Behavior include one's attitudes towards the behavior, subjective norms, perceived behavioral control and behavioral intentions. Attitudes represent an individual's beliefs or feelings concerning a behavior. Subjective norms refer to perceptions of social pressures to perform or not perform the behavior such as an individual's friends encouraging them to attend a party where many attendees will be drinking alcohol. Perceived behavioral control includes self-efficacy, or confidence in one's ability to perform the behavior, as well as controllability, or the perception that one has the resources, skills and opportunities to perform the behavior. Behavioral intentions or plans to perform or not perform the behavior are conceptualized as the outcome of attitudes, subjective norms and perceived behavioral control. As such, behavioral intentions serve as the proximal predictor of individuals' increased or decreased likelihood of performing a behavior.

In a meta-analysis of 185 studies, behavioral intentions accounted for 31% of the variance in self-reported behavior (Armitage & Conner, 2001). Only behavioral intentions is conceptualized to directly predict risk-taking behavior, but attitudes, subjective norms and perceived behavioral control together accounted for 39% of the variance in behavioral intentions and predicted risk-taking behavior indirectly (Armitage & Conner, 2001). Thus, the Theory of Planned Behavior is evidenced to effectively predict risk-taking behavior (Armitage & Conner, 2001).

The third model is the Rational Choice Framework (Nagin & Paternoster, 1993). The Rational Choice Framework proposes that individuals make decisions based on inducements and impediments to behavior (Nagin & Paternoster, 1993). According to Rational Choice models,

individuals are expected to engage in criminal behavior when they perceive the benefits of the behavior to outweigh the costs associated with it (Nagin & Paternsoter, 1993). The principal component in the Rational Choice Theory is perceived cost or harm of engaging in a behavior, with individuals who perceive more harm expected to be less likely to perform the behavior than individuals who perceive less harm. Some versions of the Rational Choice Framework also incorporate personal moral beliefs regarding whether involvement in a behavior is wrong, with the assumption that these moral beliefs impede risk-taking behavior (Paternoster & Simpson, 1996). Like the theories of reasoned action and planned behavior, the Rational Choice model incorporates intentions to commit crime as a predecessor to actual behavior (Nagin & Paternoster, 1993; Paternoster & Simpson, 1996). In tests of Rational Choice Theory, perceived costs and benefits and personal moral beliefs significantly predicted intentions to engage in risk-taking as expected, including corporate crime, drunk driving, theft and sexual assault (Nagin & Paternoster, 1993; Paternoster & Simpson, 1996). Thus, the Rational Choice Framework effectively predicts risk-taking behavior (Nagin & Paternoster, 1993; Paternoster & Simpson, 1996).

The Health Belief Model, Theory of Reasoned Action, Theory of Planned Behavior and Rational Choice Theory share a common assumption that individuals have a rational decision-making process wherein they are able to weigh the costs and benefits of engaging in a risk-taking behavior. Each of the theories incorporates rational processes though processes differ across models. For instance, the theories of reasoned action and planned behavior and Rational Choice Theory include behavioral intentions in their models. The variable subjective norms is unique to the theories of reasoned action and planned behavior while personal moral beliefs is unique to Rational Choice Theory.

The models also have different predictive utility. The Health Belief Model and its components are weakly related to behavior and researchers do not recommend utilizing the model (e.g., Carpenter, 2010). The Theory of Planned Behavior and the Rational Choice model both account for more variance in risk-taking than the Health Belief Model but limited empirical research was found testing the Rational Choice model. Because the most empirical support seems available for the Theory of Planned Behavior, the Theory of Planned Behavior serves as the primary framework for the reasoned decision-making pathway in the present study's conceptualization of decision-making processes. As such, the present study's conceptualization of the reasoned decision-making process will include behavioral intentions, attitudes, subjective norms and perceived behavioral control.

Reactive decision-making. In addition to the reasoned pathway, dual-process models recognize a second, parallel pathway – the less planned, intuitive, affective and reactive pathway – which does not rest on elaborate cognitive processing but works in tandem with the reasoned pathway to produce decisions (Albert & Steinberg, 2011). In general, the reactive decision-making pathway has received less theoretical and empirical attention than the reasoned decision-making pathway. The two most studied models of the reactive pathway are the Fuzzy-Trace Theory (Reyna & Farley, 2006) and the Prototype Willingness Model (Gerrard, Gibbons, Houlihan, Stock, &Pomery, 2008). This section will review both of these models and the evidence of their effectiveness.

According to Fuzzy-Trace Theory, the intuitive decision making process is guided by gist representations, which capture the overall meaning of a situation (Reyna & Brainerd, 2011). Whereas the reasoned decision-making pathway is conceptualized as being guided by precise thought processes, gist representations are vague and based on intuition (Reyna & Brainerd,

2011). The gist of a situation is the subjective interpretation based on emotion, education, culture and experience (Reyna & Brainerd, 2011). Fuzzy-Trace Theory differs from other dual-process models by emphasizing gist-based processing as a more advanced form of decision-making than reasoned decision-making because there are increases in gist-processing with age (Reyna & Brainerd, 2011; Reyna & Rivers, 2008). Also in contrast to other dual-process models which conceptualize either the reasoned or reactive pathways as capable of leading to increased or decreased levels of risk-taking, Fuzzy-Trace Theory posits that reasoned decision-making may lead individuals to engage in more risk-taking behavior whereas gist-based decision-making may be more risk averse (Rivers, Reyna & Mills, 2008).

Experiments with children, adolescents and adults have observed increased reliance on gist-based processing with age, consistent with fuzzy trace theory (Reyna & Farley, 2006; Reyna, Lloyd & Brainerd, 2003). For instance, when presented with a choice to win some money ($2,000) and a risky option (to win $2000 or nothing depending on the outcome of a coin flip) adults do not focus on the magnitude of money to be won but instead view the options as representing that they may win some money for sure versus possibly win some money or win nothing depending on the coin flip (Rivers et al., 2008). In contrast, children focus on the magnitude of money to be won, in support of fuzzy trace theory's hypothesis that with development comes increased reliance on gist-based processing rather than reasoned processing which is evident at earlier developmental stages (i.e., the details; Reyna & Farley, 2006). In support of fuzzy trace theory's hypothesis that gist-based processing is more risk averse than reasoned decision-making, children, who use more reasoned processing, prefer to choose the option with the potential of winning a larger sum of money but with the potential to win nothing whereas adults, who use more gist-based processing, prefer the sure, smaller sum of money

option (Rivers et al., 2008). Although fuzzy trace theory works well in artificial, lab-based decision-making studies, its predictions are mostly developmental and cognitive and it has not been used to predict real-world risk-taking. Fuzzy trace theory proponents use Prototype Willingness Model as evidence of the predictive utility of gist processing for real world risk-taking behavior (Gibbons, Gerrard & Lane, 2003; Rivers et al., 2008).

According to the prototype willingness model (Gerrard et al., 2008), the reactive, intuitive decision-making process is guided by a unique component that is not included in the reasoned pathway – individuals' prototypes or schematic images of typical risk-takers their age. For example, within the prototype willingness perspective, individuals who hold more favorable views of smokers are expected to be more likely to smoke than individuals who hold less favorable views of smokers (Gerrard et al., 2008). The outcome of the reactive, intuitive decision-making process is that social prototypes are expected to predict willingness to engage in a risky behavior if presented with an opportunity (e.g., Pomery, Gibbons, Reis-Bergan & Gerrard, 2009). To be clear, willingness indicates that individuals may not plan on performing the behavior (i.e., experience behavioral intentions) but given a context which affords them the opportunity to perform the behavior – such as presence at an unsupervised party where alcohol and drugs are available – they would be willing to engage in the behavior (Gerrard et al., 2008).

Prototype perceptions are evidenced to predict willingness to engage in substance use (Andrews, Hampson, Barclay, Gerrard & Gibbons, 2008), unprotected sex (Thornton, Gibbons & Gerrard, 2002) and reckless driving (Gibbons, Lane, Gerrard, Pomery & Lautrup, 2002). Willingness, in turn, predicts individuals' engagement in many forms of risk-taking such as smoking, drinking, substance use, unprotected sex and reckless driving (Gerrard et al., 2008).

The fuzzy trace theory's predictions are mostly developmental and cognitive and it has not been used to predict real world risk-taking behavior. In contrast, the prototype-willingness model is evidenced to significantly predict real world risk-taking (e.g., Gerrard et al., 2008). Because of the evidence linking the Prototype Willingness Model with risk-taking behavior, the Prototype Willingness Model serves as the primary framework for the reactive decision-making process in the present study's conceptualization of decision-making. As such, the present study's conceptualization of the reactive decision-making process includes prototype perceptions and willingness to engage in risk-taking.

Concluding, dual process decision-making models posit that individuals choose to engage in risk-taking behavior via two decision-making processes – a reasoned process and a reactive process. Reasoned decision-making models demonstrated to effectively predict risk-taking behavior include the Theory of Planned Behavior and the Rational Choice model, although most evidence is available for the Theory of Planned Behavior. As such, the Theory of Planned Behavior will serve as the primary framework for the reasoned decision-making process in the current study. For the reactive pathway, the prototype willingness model has the most empirical support for predicting real world risk-taking behavior and it will serve as the primary framework for the reactive pathway in the current study.

Trait Models of Risk-Taking

Trait models conceptualize risk-taking as a product of stable, situation-invariant individual differences. Risk-takers are distinguished from non-risk-takers on the basis of between-person differences in propensity for risk-taking such as impulsivity and low self-control. This section begins by reviewing the evidence for impulsivity and self-control as being distinct but interrelated processes that work in tandem. Next, an overview of the

conceptualization of impulsivity and self-control in psychological literature is provided. Subsequently, the present study's conceptualization and measurement of impulsivity and self-control is outlined. This section concludes with a summary of the measurement of impulsivity and self-control in the psychological literature and a description of how impulsivity and self-control will be measured in the present study.

Impulsivity and self-control as distinct but inter-related. Impulsivity and self-control are believed to stem from different neurological bases (Lieberman, 2007; Steinberg, 2008). The neural structures involved in impulsivity are activated under conditions that promote automatic, implicit or non-conscious processing of information (Lieberman, 2007). The neural structures involved in impulsivity also tend to be the phylogenetically older subcortical regions (Lieberman, 2007). As such, the structures involved in impulsivity are the amygdala, basal ganglia, lateral temporal cortex, ventromedial prefrontal cortex and dorsal anterior cingulate cortex (Lieberman, 2007). In contrast, self-control is reflected in higher cognitive processes that are experienced as intentional and effortful including implementation of goals and plans and inhibition (Cabeza & Nyberg, 2000). The structures involved in self-control are the anterior cingulate cortex, lateral prefrontal cortex, posterior parietal cortex and the hippocampus and surrounding medial temporal lobe region (Lieberman, 2007).

The neural split between impulsive and self-controlled processes is in line with the neural distinction between the reasoned and reactive decision-making processes. That is, there is evidence for a neural division between the reasoned and reactive decision-making processes that lines up with the neural separation between impulsivity and self-control. The reactive system corresponds to subcortical structures including the amygdala, and basal ganglia – similar to impulsivity – while the reasoned system corresponds to frontal cortical structures such as the

lateral prefrontal cortex, similar to self-control (e.g., Satpute & Lieberman, 2006). Thus, both impulsivity and self-control are likely involved in the decision-making processes leading to risk-taking behavior and it may be important to consider both impulsivity and self-control simultaneously when studying the etiology of risk-taking (Chen & Vazsonyi, 2011).

While the brain structures involved in impulsivity and self-control are discriminable, they are also inter-related. The prefrontal cortex involved in self-control is linked via the orbitalmedial prefrontal circuit with the subcortical structures involved in impulsivity (Salloway & Cummings, 1994). The orbitalmedial prefrontal circuit between the structures involved in self-control and the impulsive brain structures modulates impulses (Salloway & Cummings, 1994) and corrects and regulates emotional and behavioral responses by exerting control over limbic pathways involved in impulsivity via extensive reciprocal connections with the amygdala and other limbic structures (Herpertz et al., 2001). Thus, limbic-orbiotofrontal circuit dysfunction is thought to be involved in impulsivity for some individuals via under activation of prefrontal areas involved in inhibiting behavior, overstimulation of the limbic regions involved in drive, or both (Van Reekum, 1993).

Impulsivity and self-control operate simultaneously and interact to influence behavior (Bickel, Miller, Kowal, Lindquist & Pitcock, 2007; Chen & Vazsonyi, 2011; Romer, Duckworth, Sznitman & Park, 2010; Steinberg, 2007; Wills et al., 2011). Impulsivity has been demonstrated to be less strongly related to substance use and other problem behavior when individuals reported higher rather than lower levels of self-control (Chen & Vazsonyi, 2011; Wills et al., 2011). The trait-level perspective assumes that risk-taking behavior occurs in the absence of self-control (e.g., Bickel et al., 2007). Assuming that individuals with high levels of self-control will always choose to not engage in risk-taking behavior, risk-taking behavior results when the influence of

self-control is undermined by impulsivity (Bickel et al., 2007). Engagement or non-engagement in risk-taking behavior may result from different combinations of impulsivity and self-control. If an individual experiences impulsivity, self-control would be required in order for that person to not engage in risk-taking behavior. As such, an individual who experiences impulsivity combined with low levels of self-control, or low abilities to resist their impulsive drives, would be expected to engage in risk-taking. However, an individual who experiences impulsivity as well as self-control would not be expected to engage in risk-taking behavior because their ability to control themself can override or alter their impulsive tendencies. If an individual does not experience impulsivity, self-control may not be required to resist engaging in risk-taking behavior. Individuals who are low on both impulsivity and self-control are not expected to engage in risk-taking. Instead, individuals low in both impulsivity and self-control are evidenced to experience internalizing problems rather than externalizing problems (Eisenberg et al., 2001). Concluding, impulsivity and self-control work in tandem and it is necessary to assess both constructs to better understand why risk-taking behavior occurs.

The pattern of increased risk-taking, reduced self-control and heightened impulsivity during adolescence relative to both childhood and adulthood has been explained as a consequence of neural maturation (e.g., Nelson, Leibenluft, McClure, & Pine, 2005; Ernst, Pine & Hardin, 2006; Casey, Getz & Galvan, 2008; Steinberg, 2008). According to the triadic model, reduced self-control, heightened impulsivity and elevated risk-taking associated with adolescence are attributable to an imbalance in the functional maturity between the striatum and amygdala and in their regulation by the prefrontal cortex during adolescence (Ernst et al., 2006). More primitive areas necessary for basic motor/sensory processes including the striatum mature earlier than regions associated with cognition such as the prefrontal cortex (e.g., Giedd, 2004).

Reduced self-control and heightened impulsivity during adolescence are attributable to a strong reward system (nucleus accumbens), a decreased harm-avoidance system (amygdala) and "poor brakes" (prefrontal cortex; Ernst et al., 2006). In functional imaging studies, adolescents' have mature adult-like responses of the nucleus accumbens but less mature (more child-like) responses of the orbital frontal cortex to rewarding stimuli (Galvan et al., 2006; Durston et al., 2006). The orbital frontal cortex is involved in appraisal of outcome (Knutson, Adams, Fong, & Hommer, 2001) so this immature response predisposes adolescents to value more immediate short-term over long-term gains (Ernst et al., 2006).

The amygdala, involved in processing emotions, is mature early in life as indicated by mature (adult-like) responses of the amygdala to affective stimuli such as emotional faces in childhood (Baxter & Murray, 2002). However, connections from the amygdala to the cortex – which helps inhibit inappropriate or dangerous behavior – develop gradually from adolescence to adulthood rendering adolescents less capable of inhibiting behavior (Cunningham, Bhattacharyya, & Benes, 2002). The connections between the amygdala and cortex that emerge very late in adolescence or early in adulthood may foster the emergence of the behavioral brake of the prefrontal cortex, and may be associated with the improvement in self-control and reduction of impulsivity seen over time (Halperin & Schulz, 2006).

Conceptualization of impulsivity and self-control in psychological literature. The inter-relatedness of impulsivity and self-control leads to conceptual ambiguity in the literature, particularly the literature that relies on self-report measures of impulsivity and self-control. Individuals' behavior may be influenced both by their impulsive drives towards the behavior as well as by their self-control mechanisms that attempt to inhibit the behavior (Schmeichel, Harmon-Jones & Harmon-Jones, 2010). Because impulsivity and self-control are related it is

difficult to disentangle the effects of impulsivity versus self-control in contributing to real-world behavior. Generally, both impulsivity and low self-control are related to increased levels of risk-taking behavior such as aggression, substance use, criminal behavior, reckless driving and risky sexual behavior (Feil, Sheppard, Fitzgerald, Yücel, Lubman & Bradshaw, 2010; Griffin, Scheier, Acevedo, Grenard & Botvin, 2012; Jones & Quisenberry, 2004; Stanford, Greve, Boudreax, Mathias & Brumbelow, 1996). Impulsivity may be associated with risk-taking because impulsive individuals are enticed by immediate, short-term gratification (Hofmann, Friese & Strack, 2009) and risky behavior often provides short-term gratification (Olsen-Madden et al., 2012). Low self-control may be related to risk-taking behavior because individuals with low self-control have difficulty suppressing actions which are inappropriate (Verbruggen & Logan, 2008), in accord with the proposition that impulsivity and self-control work together to influence behavior.

Models of impulsivity and self-control in the psychological literature often blend the two constructs and include additional components. Models of impulsivity and self-control are generally quite broad and cover many processes thought to lead to or be involved in impulsivity and self-control (e.g., Dick et al., 2010; Gottfredson & Hirschi, 1990; Whiteside & Lynam, 2001). For instance, recent models of impulsivity include five processes thought to lead to impulsivity: positive and negative urgency or acting rashly when experiencing extreme positive or negative moods, respectively; lack of premeditation or a tendency to act without deliberation; lack of perseverance or an inability to complete dull tasks or filter out distractions and sensation-seeking or the tendency to seek out novel or exciting stimulation (Dick et al., 2010; Whiteside & Lynam, 2001). Some definitions of self-control include impulsivity (Gottfredson & Hirschi, 1990). According to Gottfredson and Hirschi (1990), low self-control is characterized by risk seeking, preference for physical activities, non-verbal communication, shortsightedness, volatile

temper and impulsivity. In sum, current models of impulsivity, which include five different processes thought to underlie impulsivity, are quite broad and tap more constructs than just impulsivity. Further, some conceptualizations blend impulsivity and self-control. Here, Gottfredson and Hirschi (1990) purported that impulsivity is a characteristic of low self-control individuals. The present study utilizes a more narrow definition of impulsivity and self-control than the broad conceptualizations often employed in the psychological literature in order to distinguish impulsive and self-controlled processes.

The present study's conceptualization of impulsivity and self-control. The present study conceptualizes impulsivity and self-control as distinct processes which work together. In the present study, impulsivity is considered an indicator of an inclination to approach or perform a certain behavior (Hofmann et al., 2009; Rothbart, Ahadi & Hershey, 1994). Impulsivity is directed towards stimuli with incentive values that enable immediate, short-term gratification and the incentive value of the tempting stimulus diminishes as temporal or spatial distance increases (Ainslie, 1975; Hofmann et al., 2009). In other words, individuals who are highly impulsive tend to act spontaneously and without deliberation and they have a heightened responsiveness to rewards and immediate behavioral cues (Carver, 2005).

Self-control is conceptualized in the present study as referring to a person's ability to override, inhibit and regulate socially unacceptable and undesirable impulses (e.g., Tangney, Baumeister, & Boone, 2004). Self-control includes delay of gratification which is the capacity to decline immediate, less preferred outcomes to attain more preferred outcomes in the future (Finkenauer, Engels, & Baumeister, 2005). Individuals high in self-control tend to be reflective and deliberative in their actions, can continue behavior in the absence of reward and exhibit high levels of forethought and planning (Carver, 2005).

Measurement of impulsivity and self-control in psychological literature and in the current study. Impulsivity and self-control have been measured via response inhibition and other executive function tasks, delay of gratification tasks and self- and other-informant report questionnaires (Duckworth & Kern, 2011). Laboratory tasks measuring impulsivity and self-control are typically better able to distinguish the two constructs than self-report measures. Self-report measures often blend the constructs or tap additional constructs rather than just impulsivity and self-control. Because laboratory measures seem better able to differentiate impulsivity and self-control than self-report measures, in the current study, two laboratory tasks will be used to index impulsivity and self-control. However, many researchers use self-report measures of impulsivity and self-control. To assess whether findings are generalizable using self-report measures, the present study will also include two self-report measures of impulsivity and self-control. Thus, in the current study, two laboratory tasks and two self-report measures will be used to assess impulsivity and self-control.

A delay discounting paradigm (Richards, Zhang, Mitchell, & De Wit, 1999) will be used to index impulsivity in the present study. Delay discounting tasks are based on the principle that as a reward is delayed, the reward value is reduced and impulsive individuals prefer smaller, immediate rewards over larger, delayed rewards (Ainslie, 1975; Kirby, Petry & Bickel, 1999). Adverse consequences are considered in the same framework as rewards, with larger, delayed consequences often preferred over smaller, immediate consequences (Ainslie, 1975; Kirby, Petry & Bickel, 1999). Considering both desirable and aversive outcomes, impulsive individuals will likely choose small, immediate rewards with large, delayed adverse consequences over large, delayed rewards with small, immediate adverse consequences (Kirby et al., 1999). Indeed, the limbic brain system reflective of impulsivity is preferentially activated by decisions involving

immediately available rewards (McClure, Laibson, Loewenstein & Cohen, 2004). As such, greater influence of the impulsive system should be evidenced by participants' preference for immediate rewards (McClure et al., 2004). In accord with impulsive individuals' preference for immediate rewards on delay discounting tasks, impulsive individuals often align themselves with the likelihood of experiencing large long-term costs in exchange for modest short-term gains (Bornovalova, Daughters, Hernandez, Richards, & Lejuez, 2005; Kirby et al., 1999).

The stop-signal reaction-time task is a paradigm used to measure response inhibition or self-control and will be used to index self-control in the present study (e.g., Duckworth & Kern, 2011; Logan, 1994; Wood & Neal, 2007). In the stop-signal paradigm, participants perform a go task such as pressing a button for a certain symbol (Verbruggen & Logan, 2008). On some trials, the go stimulus is followed by a stop signal, which instructs participants to withhold a response (Verbruggen & Logan, 2008). Stopping a response requires a control mechanism that prevents the execution of the motor response and thus indexes response inhibition or self-control (Logan, 1994). The time between the presentations of the go stimulus and the stop-signal varies, providing a sensitive estimate of the time taken for individuals to inhibit responses (Chamberlain & Sahakian, 2007).

Evidence implicates the prefrontal cortex and basal ganglia in stop signal response control and the interaction between the prefrontal cortex and the basal ganglia is especially involved in successful response inhibition in the stop-signal reaction-time task (e.g., Band & van Boxtel, 1999). Individuals with lesions of the right frontal lobe exhibit much slower response inhibition on the stop-signal reaction-time task than controls (Aron, Fletcher, Bullmore, Sahakian, & Robbins, 2003). In particular, inferior frontal gyrus damage was evidenced to be especially disrupting to stop-signal response inhibition because damage to the inferior frontal

gyrus was highly correlated with slower stop-signal reaction-time speeds whereas damage to adjacent regions was not or not as highly correlated with stop-signal reaction-time speed (Aron et al., 2003). The basal ganglia also plays a role in inhibiting responses on the stop-signal reaction-time task because individuals with lesions to the basal ganglia show slower response inhibition on the stop-signal reaction-time task than controls (Rieger, Gauggel & Burmeister, 2003). Furthermore, frontostriatal circuits that connect the frontal lobe with the basal ganglia are involved in response inhibition (Chambers, Garavan, & Bellgrove, 2009; Rieger et al., 2003). To implicate frontostriatal involvement, a lesion to any area of the frontostriatal circuit should lead to the same deficits in performance and thus the deficits of individuals with frontal and basal ganglia lesions should be comparable (Chambers et al., 2009; Rieger et al., 2003). Indeed, individuals with frontal and basal ganglia lesions do show comparable deficits in response inhibition on the stop-signal reaction-time task, in support of the role of frontostriatal circuitry in response inhibition (Rieger et al., 2003). Thus, the prefrontal cortex which is implicated in self-control is activated by response inhibition on the stop-signal reaction-time task. Also, subcortical regions including the basal ganglia that are involved in impulsive processes are activated by stop signal responses. In addition, the frontalstriatal circuitry that connects the brain regions implicated in impulsivity and self-control are activated by response inhibition on the stop-signal reaction-time task. Because response inhibition on the stop-signal reaction-time task activates areas of the brain implicated in self-control as well as the circuitry that connects the brain regions involved in self-control and impulsivity, the stop-signal reaction-time task seems to be a good measure of self-control for the present study's purpose.

Integrating Trait and Decision Making Models

Trait models emphasize time-stable individual differences between people in propensity to engage in risk-taking whereas decision-making models emphasize processes that may vary both across people and within people across behavior. In other words, trait models posit that behavior is due to general traits such as impulsivity and self-control that vary only between people. For instance, a highly impulsive individual is conceptualized as being more likely than a person low in impulsivity to engage in many forms of risk-taking (e.g., Gottfredson & Hirschi, 1990). In contrast, according to dual-process models, behavior is the joint outcome of two different processes within each individual – reasoned and reactive processes (e.g., Wiers, Ames, Hofmann, Krank & Stacy, 2010). Between-person, trait models are not able to explain within-person variability. Within-person models explain why individuals engage in one risk-taking behavior but not another risk-taking behavior. The limitation of trait models is that an individual may experience high levels of trait impulsivity but still not experience favorable feelings towards certain forms of risk-taking that are not of interest to the individual (Friese & Hofmann, 2009; Friese, Hofmann, & Wänke, 2008). In other words, not every impulsive individual engages in all types of risk-taking behavior. Integrating decision-making processes and individual trait differences into the same model can account for both within-person and between-person variation.

It is also possible that broad trait-level factors moderate how the more specific decision-making processes function. In prior research, self-control interacted with decision-making processes to influence risk-taking behavior. Only self-control was assessed and no studies tested how impulsivity aligns with decision-making pathways. For instance, in Thush et al.'s (2008) study, implicit arousal to alcohol, similar to prototype perceptions in the reactive decision-making process, predicted alcohol use and problems among individuals with low self-control (as

indexed by low working memory capacity) but not among individuals with high self-control or high working memory capacity (Thush et al., 2008). Two other studies that indexed self-control by working memory capacity (Grenard et al., 2008) and response inhibition on the Stroop task (Houben & Wiers, 2009) confirmed Thush et al.'s (2008) finding that implicit associations indicative of the reactive decision-making process, and similar to the Prototype Willingness Model's image of risk takers, predicted substance use among individuals with low levels of self-control but not or not as strongly among individuals with high levels of self-control. Only one study tested the alignment of self-control with both the reactive and reasoned decision-making processes. Explicit arousal to alcohol, similar to deliberative, thought-out attitudes or weighing of pros and cons in the reasoned decision-making process, predicted alcohol use and problems among individuals with high self-control but not among individuals with low self-control (Thush et al., 2008). In sum, prior research has yielded significant interactions between self-control and decision-making processes in predicting risk-taking behavior. Accordingly, an interaction between self-control and reasoned decision-making processes is hypothesized in the present study.

Between-person and Within-person Levels of Analyses

Much research has focused on between-person differences in risk-taking and there has been relatively less research investigating within-person differences in risk-taking. While between-person analyses can account for why individuals who are at risk for engaging in one form of risk-taking are at risk for engaging in other forms of risk-taking as well, within person analyses can account for why the same person is at risk for engaging in certain forms of risk-taking but not others (Fleeson, 2004). Between-person analyses identify individuals who are more likely to engage in risk-taking than other individuals. For example, between people, more

willingness to engage in general risk-taking, aggregated across forms of risk-taking, is expected to predict which individuals are more likely to engage in risk-taking behavior than others. Within-person analyses reveal which forms of risk-taking each person is most likely to engage in. Within people, more willingness to use drugs than engage in risky sex is expected to predict greater frequency of drug use than sexual behavior because of behavioral specificity. According to the specificity matching principle, researchers using global attitudes towards risk-taking as a predictor should focus on global outcome measures, such as several outcomes bundled together or general risk-taking (Swann, Chang-Schneider, & McClarty, 2007). Similarly, researchers interested in predicting specific outcomes such as drug use should use a specific predictor such as attitudes towards drug use (Swann et al., 2007). In the present study, to account for who is at risk as well as for which forms of risk-taking each person is at risk, a mixed effects model is utilized to test both between-person and within-person variation in risk-taking.

In the present study, impulsivity and self-control serve as trait-level, between-person predictors of risk-taking. That is, impulsivity and self-control are only assessed at the between-person, aggregate level and are not assumed to vary across specific forms of risk-taking. Decision-making constructs are assessed at both the between-person and within-person levels. As between-person predictors, decision-making variables represent an aggregation of values that differ across forms of risk-taking. Mean levels (aggregated across all four forms of risk-taking behavior) of willingness is an example of this type of between-person predictor. Individuals more willing to engage in risk-taking behavior are hypothesized to engage in more risk-taking behavior than individuals less willing to engage in risk-taking behavior. As within-person predictors, decision-making variables are able to assume different values for each form of risk-taking. Willingness to engage in specific forms of risk-taking relative to other forms of risk-

taking is an example of a within-person predictor. Here, an individual who is more willing to drive recklessly than to use drugs would be hypothesized at greater risk for driving recklessly than using drugs.

Hypotheses

Hypotheses will be tested at both the between-person and within-person levels. Between-person hypotheses aim to predict why some individuals engage in more risk-taking behavior than others and focus on associations among variables averaged across all four forms of risk-taking (see Figure 1). Within-person hypotheses aim to explain why each individual is more likely to engage in some forms of risk-taking than others and focus on form-specific associations among variables (see Figure 2). Hypotheses one through six will have between-person and within-person variations. Hypotheses seven through 11 are only between-person hypotheses because impulsivity and self-control are only measured at the between-person level.

Reasoned decision-making model.

Hypothesis 1:

Between-person: Participants reporting higher behavioral intentions will engage in more frequent risk-taking behavior relative to other participants.

Within-person: Participants will engage more frequently in those forms of risk-taking for which they report higher behavioral intentions relative to other forms of risk-taking.

Hypothesis 2:

Between-person: Participants reporting higher favorable attitudes will report higher behavioral intentions relative to other participants. Behavioral intentions will account for the link between attitudes and risk-taking behavior.

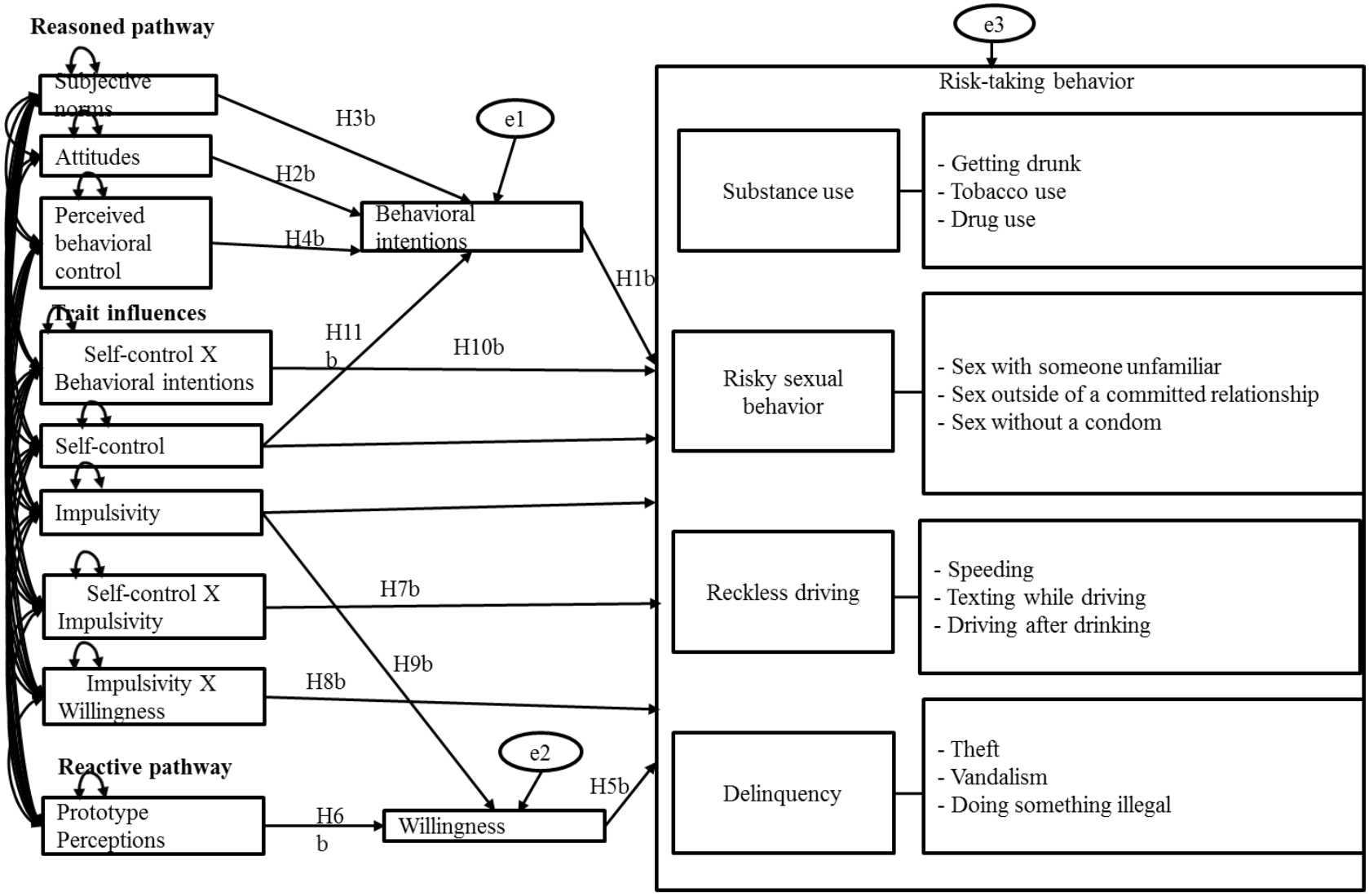

Figure 1. Structural model at the between-person level.

Note: ↶ = variance; e = error; h = hypothesis; b= between-person.

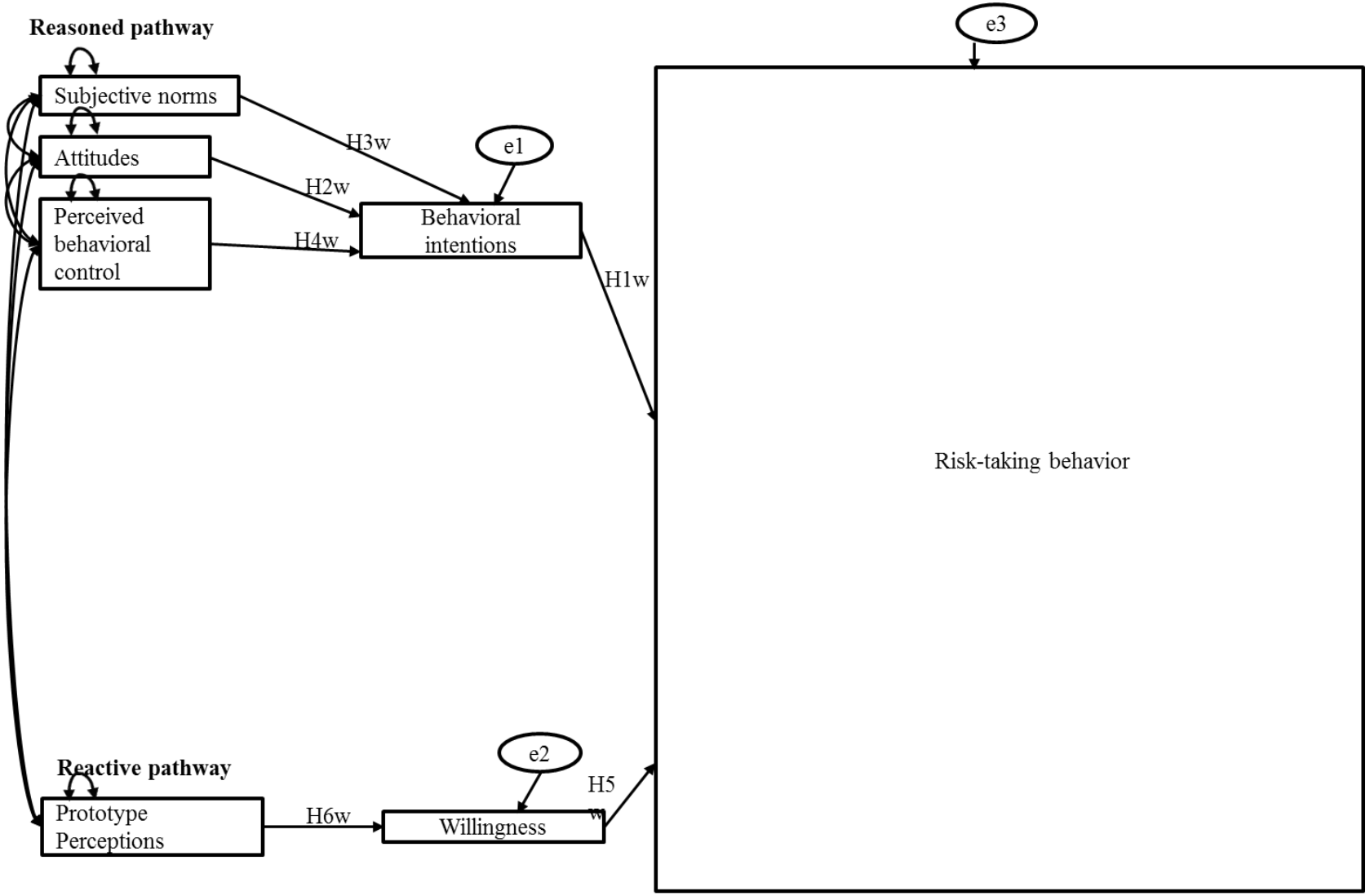

Figure 2. Structural model at the within-person level.

Note. = variance; e = error; h = hypothesis; w = within-person.

Within-person: Participants will report higher behavioral intentions for those forms of risk-taking for which they report higher favorable attitudes relative to other forms of risk-taking. Behavioral intentions will account for the link between attitudes and risk-taking behavior.

Hypothesis 3:

Between-person: Participants reporting higher subjective norms will report higher behavioral intentions relative to other participants. Behavioral intentions will account for the link between subjective norms and risk-taking behavior.

Within-person: Participants will report higher behavioral intentions for those forms of risk-taking for which they report higher subjective norms relative to other forms of risk-taking. Behavioral intentions will account for the link between subjective norms and risk-taking behavior.

Hypothesis 4:

Between-person: Participants reporting higher perceived behavioral control will report higher behavioral intentions relative to other participants. Behavioral intentions will account for the link between perceived behavioral control and risk-taking behavior.

Within-person: Participants will report higher behavioral intentions for those forms of risk-taking for which they report higher perceived behavioral control relative to other forms of risk-taking. Behavioral intentions will account for the link between perceived behavioral control and risk-taking behavior.

Reactive decision-making model.

Hypothesis 5:

Between-person: Participants reporting higher willingness will engage in more frequent risk-taking behavior relative to other participants.

Within-person: Participants will engage more frequently in those forms of risk-taking for which they report higher willingness relative to other forms of risk-taking.

Hypothesis 6:

Between-person: Participants reporting higher favorable prototype perceptions will report higher willingness relative to other participants. Willingness will account for the link between prototype perceptions and risk-taking behavior.

Within-person: Participants will report higher willingness for those forms of risk-taking for which they report higher favorable prototype perceptions relative to other forms of risk-taking. Willingness will account for the link between prototype perceptions and risk-taking behavior.

Moderation of impulsivity by self-control.

Hypothesis 7: The association between impulsivity and risk-taking behavior will be weaker at higher than lower levels of self-control.

Impulsivity and decision-making.

Hypothesis 8: The association between willingness and risk-taking behavior will be stronger at higher than lower levels of impulsivity.

Hypothesis 9: There will be a significant indirect path from impulsivity to risk-taking behavior through willingness.

Self-control and decision-making.

Hypothesis 10: The association between behavioral intentions and risk-taking behavior will be stronger at higher than lower levels of self-control.

Hypothesis 11: There will be a significant indirect path from self-control to risk-taking behavior through behavioral intentions.

Method

Participants

College students were selected to participate in the present study because involvement in various forms of risk-taking such as binge drinking, impaired driving and substance use is very prevalent among college students (e.g., Slutske, 2005). Five-hundred eighty college students ages 18 and older were recruited for this study. Thirty nine percent of adolescents (N = 222) were 18 years old when the study began (M age = 20.45, range = 18 to 52 years). Females comprised 62.6% of the sample. Fifty-three percent of the adolescents were European-American, 17.6% were African American, 8.6% were multiracial, 8.1% were Hispanic/Latino, 7.8% were Asian, and 2.6% were other races. Mothers' education levels varied (i.e., 31.2% completed some college or trade or technical school, 27.8% completed high school, 20.5% earned a college degree, 12.1% earned a graduate degree and 6.7% did not complete high school).

Three types of data were collected from participants. An anticipated sample size of 250 was determined to be adequate to address the objectives of the proposed research based on estimating 25 parameters in between-person models. Recruitment yielded a significantly larger sample than anticipated (i.e., n = 580), and all participants completed the wave 1 questionnaire. However, it was not feasible to schedule all 580 participants to complete the wave 2 lab tasks in the time available (i.e., one semester) to compensate participants for their participation. As such, only 57.4% (n = 333) of the sample completed the lab tasks. Furthermore, although all participants were asked to complete the wave 3 longitudinal online survey, only 67.9% (n = 394) of the sample provided longitudinal data. The types of data collected from participants produced multiple participation patterns. Two primary comparisons were made. Participants who completed versus did not complete the laboratory tasks were compared with one another and

participants who completed versus did not complete the longitudinal online survey were compared with one another to determine whether participants from these groups differed on any variables of interest.

Table 1 compares participation groups on study variables. Participants who did not complete the laboratory tasks reported higher levels of risk-taking at wave 3 than participants who completed the laboratory tasks. Similarly, participants who did not complete the laboratory tasks reported higher levels of behavioral intentions, willingness, more favorable subjective norms and more perceived behavioral control compared to participants who completed the laboratory tasks. However, participants who did not complete the laboratory tasks reported less favorable attitudes towards risk-taking than participants who completed the laboratory tasks. Participants who did not complete the laboratory tasks self-reported lower levels of self-control than participants who completed the laboratory tasks. Analyses comparing participation patterns for the laboratory measures of self-control and impulsivity (i.e., the stop-signal reaction-time task and the delay discounting task) included only those participants who completed the laboratory tasks, so *t*-tests could not compare differences on laboratory tasks between participants who completed and did not complete the laboratory tasks. Participants who did not complete the laboratory tasks were younger than participants who completed the laboratory tasks, and the group of participants who did not complete the laboratory tasks included fewer females than the group of participants who completed the laboratory tasks. Participants who did versus did not complete the laboratory tasks did not differ on risk-taking at wave 1, prototype perceptions, self-reported impulsivity, mother education, race, relationship status or parental status. Supplementary regression analyses were conducted of the questionnaire data using only

Table 1. *Comparison of participation groups' risk-taking, decision-making processes, self-control, impulsivity and demographics.*

	Lab Data		No Lab Data		t/χ2	Longitudinal Data		No Longitudinal Data		t/χ2
	M	SD	M	SD		M	SD	M	SD	
Risk-Taking Time 1	1.68	1.42	1.77	1.55	.79	1.85	1.43	1.44	1.52	-3.12**
Risk-Taking Time 2	1.63	1.52	2.08	1.57	2.47*					
Behavioral Intentions	.85	.63	.97	.64	2.21*	.89	.63	.94	.64	.94
Willingness	.72	.58	.82	.59	1.97*	.75	.58	.79	.59	.82
Attitudes	.87	.50	.75	.47	3.02**	.77	.47	.87	.51	2.41*
Subjective Norms	.64	.47	.74	.54	2.45*	.64	.46	.77	.57	2.90**
Perceived Behavioral Control	2.48	1.03	2.69	.95	2.57*	2.54	1.02	2.63	.97	.99
Prototype Perceptions	.95	.29	.93	.32	-1.04	.94	.30	.95	.32	.71
Self-control	2.31	.73	2.17	.76	-2.25*	2.28	.74	2.18	.76	-1.58
Impulsivity	1.21	.54	1.27	.56	1.25	1.19	.56	1.32	.51	2.48*
Stop-Signal Reaction-Time						159.64	57.72	140.71	43.37	-1.49
Delay Discounting						-3.51	2.64	-3.14	2.29	.72
Age	20.80	4.79	19.97	3.01	-2.34*	20.68	4.42	19.97	3.47	-1.88
Female Gender	68.3%		56.9%		8.37*	66.3%		57.3%		4.42
Mother Education (Some College)	30.2%		32.9%		9.49	29.6%		35.1%		6.69
White or Other Race	81.1%		84.2%		.96	82.0%		83.3%		.16
Committed Relationship Status	50.6%		52.1%		.12	51.0%		51.6%		.02
Non-parent	92.7%		93.8%		.26	93.6%		92.3%		.31

Note: Degrees of freedom (Dfs) for t-tests ranged from 392-578. Dfs for χ2 tests ranged from 1-8. * $p \leq .05$, ** $p < .01$, *** $p < .001$.

participants who provided laboratory data. All conclusions were the same irrespective of lab subgroups.

Participants who provided longitudinal data reported higher levels of risk-taking at wave 1 than participants who did not provide longitudinal data. Levels of longitudinal risk-taking could not be compared between participants who did and did not provide longitudinal data because participants who did not provide longitudinal data had no values for longitudinal risk-taking. Participants who did not provide longitudinal data reported more favorable attitudes and subjective norms towards risk-taking than participants who provided longitudinal data. Participants who did not provide longitudinal data reported higher levels of impulsivity relative to participants who provided longitudinal data. Participants who did and did not provide longitudinal data did not differ on levels of behavioral intentions, willingness, perceived behavioral control, prototype perceptions, self-reported self-control, laboratory measures of self-control or impulsivity, or any demographic variables.

Procedures

After obtaining IRB approval (see Appendix A), participants were recruited in the beginning of the fall of 2012 from freshmen-level Psychology classes at the University of New Orleans. Researchers attended the first classes of the semester to describe what participation would entail and to solicit participants. This project involved three waves of data collection. Individuals age 18 and older who were willing to participate in wave 2 laboratory visits were provided with consent forms and wave 1 surveys to complete during the first class period. During the wave 1 survey (see Appendix B), self-report data was collected on risk-taking behavior, impulsivity, self-control, behavioral intentions, attitudes, subjective norms, perceived behavioral control, willingness, prototype perceptions and demographics. Demographic variables

were assessed using questions based on the recommendations of Entwistle and Astone (1994). Specifically, participants' age, sex, racial background and socioeconomic status (indexed by mother's highest level of education) were assessed. Participants also were requested to provide their relationship status, and to indicate whether or not they were a parent, because being involved in such relationships is related to lower levels of risk-taking behavior (e.g., Sampson, Laub & Wimer, 2006). Additionally, participants responded to items addressing whether they are currently prescribed and taking psychotropic medication, and if so, the name of the medication was requested.

Participants provided their contact information including their phone number and UNO email as part of the wave 1 survey. Researchers subsequently scheduled participants to come into the lab to complete wave 2 computer-administered tasks at a time that was convenient for participants during the semester. Phone calls and/or emails were made to all participants who provided contact information. Participants who responded to contact were scheduled first, and participants who did not respond were pursued by whichever contact method (phone or email) was not attempted first. If participants continued to be unresponsive, researchers moved on to schedule other participants. During the wave 2 lab visit, participants completed delay discounting and stop-signal reaction-time tasks. The computerized tasks each took approximately 15 minutes to complete and each participant was tested individually using the same computer. The delay discounting task, used to index impulsivity, and the stop-signal reaction-time (SSRT) task, used to measure self-control, were presented in a counter-balanced order (i.e., half of the participants completed the delay discounting task first followed by the SSRT task while other participants completed the tasks in the opposite order) to prevent order effects.

At the end of the semester, a link to a wave 3 online survey was e-mailed to all participants. The end-of-semester wave 3 online survey assessed participants' risk-taking behavior over the semester. At the end of the semester, a list of individuals who completed each part of the project was provided to instructors so that instructors could provide extra credit to students in their class.

Measures

The goal of this study was to assess between-person and within-person variability in decision-making processes and risk-taking. Most variables are assessed across the four forms of risk-taking to allow assessment of between-person and within-person variability. For each of the four forms of risk-taking, participants responded to three items. The substance use items referenced getting drunk, using tobacco and using drugs. Criminal involvement items referenced theft, vandalism and doing something illegal. Risky sexual behavior items referenced having sex with someone participants do not know well, having sex outside of a committed relationship and having sex without a condom. Reckless driving items referenced driving over the speed limit, texting while driving and driving after drinking alcohol.

Unfortunately, several items assessed had insufficient variability on the risk-taking behavior outcome measure due to not being frequently endorsed. Two items were omitted from the criminal behavior scale and one item was omitted from the risky sexual behavior scale due to low response rates for these items. Specifically, the items omitted from the criminal behavior scale indexed theft and vandalism. After omission of these items, the criminal involvement measure included one item indexing whether participants had engaged in any general illegal behavior. The item omitted from the risky sex scale tapped whether participants had sex with someone they did not know well. The two items remaining in the sex scale included having sex

outside of a committed relationship and having sex without a condom. No items were omitted from the substance use and reckless driving scales. Although the exclusion of items was based on the risk-taking behavior outcome measure, items referencing theft, vandalism and sex with someone participants did not know well were removed from all decision-making measures as well to keep assessments parallel across all constructs (except self-control and impulsivity).

Risk-taking behavior, behavioral intentions, willingness, attitudes, subjective norms, perceived behavioral control and prototype perceptions were assessed at both the between-person and within-person levels. For all variables except for prototype perceptions, the between-person variables were computed as the mean of the nine items comprising each measure (i.e., the mean across all forms of risk taking). The prototype perceptions measure included nine sets of six items and thus the between-person variable for prototype perceptions was computed as the mean of 54 items. Within-person variables were computed for each form of risk-taking by calculating the mean of the items (or sets of items for prototype perceptions) separately for each form of risk-taking (i.e., separate means for each of the four forms). Evidence of reliability was calculated for the between-person and within-person variables when possible based on multiple items. Reliabilities are shown in Table 2. Self-control and impulsivity were only assessed only at the between-person level. Scoring for the measures is included in the measure description.

Risk-taking behavior. Risk-taking behavior was assessed twice – during the wave one survey and during the wave three longitudinal online survey. The risk-taking behavior measure was adapted from the Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2011) and the Normative Deviance Scale (Vazsonyi, Pickering, Belliston, Hessing & Junger, 2002). Following the format of the Normative Deviance Scale, risk-taking behavior items use the stem “During the past 3 months, on how many days have you (engaged in each of the forms of

risk-taking)?"The risk-taking behavior scale includes 9 items. Responses were made using a 7-point response scale (0 = *0,* 1 = *1,* 2 = *2-3 times,* 3= *4-5 times,* 4 = *6-10 times,* 5 = *11-20 times and* 6 = *20+ times).* The forms of risk-taking were selected based on the literature previously discussed which indicated that many late adolescents engage in these forms of risk-taking although these forms of risk-taking are dangerous (Centers for Disease Control and Prevention, 2012). The most commonly assessed distinct behaviors within each form of risk-taking were selected. That is, items included in the present study are similar to items used on the Centers for Disease Control and Prevention's Youth Risk Behavior Surveillance System (Centers for Disease Control and Prevention, 2012) and the Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention, 2010) as well as on the Add Health questionnaire (Harris et al., 2009). There is considerable evidence supporting the reliability and validity of these or similar items. In Vazsonyi, Pickering, Junger and Hessing's (2001) study, adolescents ages 14 to 22 from four different countries were able to respond to items from the Normative Deviance Scale in a reliable fashion and adolescents who reported lower self-control also reported more risk-taking behavior.

Behavioral intentions. Behavioral intentions were measured during the wave one survey. The behavioral intentions measure was modeled on items described by Piquero and Tibbetts (1996). Behavioral intentions items ask participants "How likely do you think it is that you will ____ one or more times in the next three months?" Participants respond to the nine behavioral intentions items using a four-point response scale (0 = *not at all likely*, 1 = *a little bit likely*, 2 = *somewhat likely* and *3 = very likely*). In prior research, incoming freshmen college students with a mean age of 18 were able to respond to the items in a reliable fashion (Gibbons

& Gerrard, 1995). Behavioral intentions were significantly associated with risk-taking behavior and predicted change in smoking behavior over time (Gibbons & Gerrard, 1995).

Willingness. Willingness to engage in all four forms of risk-taking was measured during the wave one survey. Nine willingness items were newly developed for this study. Willingness items index participants' responses to the questions, "How willing are you to ___ one or more times during the next three months?" Responses were made using a four-point response scale (0 = *not at all willing, 1 = a little bit willing, 2 = somewhat willing* and *3 = very willing).* In prior research, young adults with a mean age of 18 were able to respond to the items in a reliable fashion and willingness to use drugs was related to higher levels of substance use (Stock, Gibbons, Walsh & Gerrard, 2011).

Attitudes, subjective norms and perceived behavioral control. Attitudes, subjective norms and perceived behavioral control items were collected during the wave one survey. Attitudes, subjective norms and perceived behavioral control items were adapted from Desrichard, Roché and Bègue (2007). The nine-item attitudes measure uses the stem, "How bad or good do you consider each of the following?" to assess each of the forms of risk-taking. Responses were made using a five-point response scale (0 = *very bad, 1 = a little bad, 2 = not good or bad, 3 = a little good,* and *4 = very good).* The nine subjective norms items ask "what would be the reactions of the people who are important to you if they saw you" engaging in each of the forms of risk-taking. Responses were made using a five-point response scale (0 = *strongly disapprove, 1 = disapprove, 2 = neither approve nor disapprove, 3 = approve,* and 4 = *strongly approve).* The nine perceived behavioral control items ask "how easy is it to" engage in each of the forms of risk-taking. Responses were made using a five-point response scale (0 = *very difficult, 1 = mostly difficult, 2 = not difficult or easy, 3 = mostly easy* and *4 = very easy).*

Desrichard et al. (2007) showed that adolescents ages 13 to 19 were able to respond to the attitudes, subjective norms and perceived behavioral control items in a reliable fashion. Attitudes and subjective norms but not perceived behavioral control were significantly associated with behavioral intentions to violate driving rules (Desrichard et al., 2007). In another study, adults 18 years and older were able to respond to the items in a reliable fashion and again, attitudes and subjective norms but not perceived behavioral control significantly contributed to behavioral intentions to wear safety gear while in-line skating (Deroche, Stephan, Castanier, Brewer & Scanff, 2009).

Prototype Perceptions. Prototype perceptions were measured during the wave one survey. The prototype perceptions measure, adapted from Wills, Gibbons, Gerrard, Murry and Brody (2003), consists of nine sets of six items assessing the forms of risk-taking of interest. Each set of items began with a direction for respondents to "Take a moment to think about people your age who (engage in a specific form of risk-taking). We are not thinking about anyone in particular, just your image of individuals who (engage in the particular form of risk-taking)." The six items following the directive assess how popular, careless, smart, cool, attractive and boring individuals who engage in that behavior are perceived to be by the respondent. Responses were made using a four-point response scale (0 = *not at all, 1 = a little bit, 2 = somewhat* and *3 = very).* In Wills et al.'s (2003) study, adolescents with a mean age of 13 were able to respond to the items in a reliable fashion and favorable prototype perceptions of substance users and sex engagers were related to risk-taking behavior. Prototype perceptions were linked to risk-taking behavior primarily through willingness (Wills et al., 2003). In the present study, items indexing unfavorable descriptors (i.e., careless, boring) were reverse-scored so that high scores indicate favorable impressions of the prototype.

Self-reported self-control. The Brief Self-Control Scale short version (Finkenauer et al., 2005) was used as the self-report index of self-control. The scale measures the ability to override or alter internal responses and to interrupt inappropriate behavior such as resisting acting on impulse (Tangney et al., 2004), which is consistent with the conceptualization of self-control in the present study. The Brief Self-Control Scale short version includes 11 items. For example, one item was "I am good at resisting temptation." Responses were made using a five-point response scale (0 = *strongly disagree, 1 = disagree, 2 = neither agree nor disagree, 3 = agree,* and *4 = strongly agree).* In prior research using the long version of the Brief Self-Control Scale, undergraduate students ranging in age from 18 to 35 were able to respond to the items in a reliable fashion (Tangney et al., 2004). Low self-control was related to higher levels of psychopathology, more problematic relationships and more alcohol abuse (Tangney et al., 2004). Using the short version of the Brief Self-Control Scale, adolescents ages 10-14 years were able to respond to the items in a reliable fashion (Finkenauer et al., 2005). Low self-control was significantly related to higher levels of behavior problems (Finkenauer et al., 2005). In the present study, self-control was only assessed at the between-person level. A between-person self-control composite score was computed as the mean of the 11 Brief Self-Control Scale short version items.

Lab-based self-control. The stop-signal reaction-time task (SSRT task; Verbruggen, Logan & Stevens, 2008) was used as the laboratory measure of self-control. Using the SSRT task, self-control was operationalized as the degree to which participants exhibited inhibitory control. On each trial, participants were presented with one of two possible visual go signals: press the 'D' key for a left-pointing arrow or the 'K' key for a right-pointing arrow (Verbruggen et al., 2008). Participants were instructed to respond as quickly as possible to go stimuli (Aron et

al., 2007). On 25% of trials, randomly dispersed, a stop signal (auditory) was presented after the go signal (Aron et al., 2007). The participants were instructed to do their best to inhibit the response when the stop signal occurred (Aron et al., 2007). If the delay between the primary task stimulus and the stop signal (stop-signal delay, or SSD) is short, participants are more likely to successfully prevent the planned movement (Aron et al., 2007). When the delay between the primary task stimulus and the stop-signal increases, participants are less likely to prevent the planned movement, and are more likely to respond on the stop-signal trials (Verbruggen et al., 2008). According to the horse-race model, response inhibition succeeds or fails depending on the relative finishing time of the go process triggered by the primary task and the stop process that is initiated by the stop signal (e.g., Logan & Cowan, 1984; Verbruggen et al., 2008). If the stop process wins the race (finishes the race prior to the go process finishing), participants inhibit their response (Verbruggen et al., 2008). If the go process finishes before the stop process finishes, participants fail to inhibit their response (Verbruggen et al., 2008). The delay between the presentation of the primary task stimulus and the stop signal varies (Aron et al., 2003). If participants inhibit successfully, the delay for the stop-signal increases by 50 milliseconds on the next trial, making subsequent inhibition more difficult. If participants do not successfully inhibit, the delay decreases by 50 milliseconds on the following trial. The varying delays allow the SSRT program to discover the time that the individual requires to successfully inhibit a response approximately 50% of the time – this is the stop-signal reaction time (Aron et al., 2003; Logan, 1994). In terms of the horse-race model, the race between go and stop processes ends in a tie, providing a sensitive estimate of inhibitory control (Logan, 1994). In prior research, high school students and college students were able to respond to the SSRT task in a reliable fashion (Carlotta, Borroni, Maffei & Fossati, 2011; Witte, 2009). Low self-control explained the link

between childhood Attention-Deficit/Hyperactivity Disorder symptoms and antisocial behavior in a sample of high school students (Carlotta et al., 2011).

The SSRT program estimates variables including the mean stop-signal delay (SSD), which is calculated from all SSD values, and the mean response time (RT) for all no-stop-signal trials, calculated from all the RTs for no-signal trials (Verbruggen et al., 2008). The mean SSD is then subtracted from the mean RT for all no-signal trials, providing an estimate of SSRT (Verbruggen et al., 2008). The SSRT program also calculates *z*-scores and corresponding p-values to indicate whether each participant inhibited significantly more or less than 50% of the time (Verbruggen et al., 2008). Significant *p*-values indicate that the SSRT program was unable to successfully estimate the SSRT for participants because SSRT is estimated based on the assumption that participants successfully inhibit approximately 50% of the time (i.e., that there is a tie in the race between go and stop processes; Logan, 1994; Verbruggen et al., 2008). SSRT values for participants with significant p-values (i.e., those participants who inhibited significantly more or less than 50% of the time) were dropped from the SSRT analyses. Ninety-four participants (28.5% of participants who completed the laboratory tasks) had significant *p*-values associated with their SSRT scores indicating that they inhibited significantly more or less than 50% of the time, so these 94 participants' SSRT values were dropped from analyses. Two-hundred thirty six participants' *p*-values associated with their SSRT scores were valid, and were therefore utilized in the analyses. The likelihood of having valid versus invalid SSRT scores was unrelated to all other variables. Specifically, the groups of participants with valid versus invalid SSRT scores did not differ on self-reported self-control, $t(323) = 1.32$, $p = .19$, or impulsivity, $t(326) = -.535$, $p = .59$. The groups did not differ on behavioral intentions across forms of risk-taking, $t(325) = .054$, $p = .96$, or on willingness across forms of risk-taking, $t(324) = -.123$, $p =$

.90. Additionally, the groups did not differ on attitudes, t(328) = .361, p = .75, subjective norms, t(328) = -.611, p = .541, perceived behavioral control, t(326) = .617, p = .54, or prototype perceptions, t(328) = -.183, p = .86, across forms of risk-taking. Finally, the valid versus invalid SSRT score groups did not differ on risk-taking engagement across forms at wave 1, t(325)= .120, p = .91, or at wave 3, t(299) = -.141, p = .89.

Self-reported impulsivity. The motor subscale of the Barratt Impulsiveness Scale (Patton, Stanford, & Barratt, 1995) was used as the self-report measure of impulsivity. The motor subscale indexes acting on the spur of the moment and fast reactions, which is consistent with the conceptualization of impulsivity in the present study. The Barratt Impulsiveness Scale instructions request that participants respond to items quickly without spending too much time on any one item (for full scale instructions, see appendix). The motor subscale consisted of seven statements such as "I act on the spur of the moment." Responses were made using a four-point response scale (0 = *rarely/never, 1 = occasionally, 2 = often,* and *3 = almost always/always).* In prior research, adolescents ages 11-18 (Gilbert et al., 2011; Nandagopal et al., 2011) and adults with a mean age of 39 (Antonucci et al., 2006) were able to respond to the motor impulsivity subscale items in a reliable fashion. Impulsivity as indexed by the motor subscale of the Barratt Impulsiveness scale was significantly higher among adolescents ages 11-17 with Bipolar Disorder compared to healthy controls (Gilbert et al., 2011) and was significantly higher among adolescents age 11-18 with ADHD compared to healthy controls (Nandagopal et al., 2011), as would be expected. In addition, Antonucci et al. (2006) reported a strong positive relationship between orbitofrontal cortex volume and the motor subscale of the Barratt Impulsiveness scale indicating that the motor subscale taps a brain area that is commonly associated with impulsivity. In another study, only the motor subscale but not the non-planning or attentional subscales of the

Barratt Impulsiveness scale was significantly related to higher levels of risk-taking as measured by the Balloon Analogue Risk Task, which has been found to be related to self-report of substance use and other forms of real-world risk-taking, suggesting that motor impulsivity represents a distinct component of impulsivity that is particularly characteristic of individuals prone to risk-taking (Holmes et al., 2009). Also, adult outpatient problem gamblers have been found to have significantly higher motor impulsivity subscale scores compared to healthy controls (Lawrence, Luty, Bogdan, Sahakian & Clark, 2009). In the present study, self-reported impulsivity was measured only at the between-person level. A between-person impulsivity composite score was computed as the mean of the seven motor impulsivity subscale items.

Lab-based impulsivity. The delay discounting task used to measure impulsivity in the present study is described by Richards, Zhang, Mitchell, and De Wit (1999). Discounting explains how much the value of a reward is decreased when its occurrence is delayed (Richards et al., 1999). In Richards et al.'s (1999) study, healthy adults ages 21 to 35 years were able to respond to the delay discounting task in a reliable fashion. Delay discounting was moderately correlated with personality measures of impulsivity (Richards et al., 1999).

Introduction to and instructions (see Richards et al., 1999 for full task instructions) for the delay discounting task were displayed on the computer screen and read aloud by the researchers to participants. The introduction explained to participants that during this task they will be asked to choose between different amounts of money available after different delays (Richards et al., 1999). A sample item provided to participants as part of the computerized introduction to the test was "would you rather have $10 for sure in 30 days or $2 for sure at the end of the session?" Although the on-screen instructions indicated that participants would receive one of the rewards that they chose, researchers instructed participants not to read the portion of the instructions that

displayed regarding this. Instead the researchers informed participants that they would not receive the outcomes that they chose, but their answers to the questions are important and they should respond as if they would actually receive the rewards. Research indicates no difference between discounting of real and hypothetical monetary outcomes (Johnson, Baker, & Bickel, 2007). When the participants began the task, the researcher left the room for approximately 15 minutes or until the participant completed the task.

The delay discounting task uses an adjusting-amount procedure that derives indifference points between the delayed-standard (delayed $10) and immediate-adjusting (immediate amount adjusts in increments of $\pm$.50) options for each of the five delays assessed (i.e., 0, 2, 30, 180 or 365 days; Richards et al., 1999). Indifference points indicate the smallest amount of money an individual chose to receive immediately instead of the delayed standard amount ($10) at the specific delay (Reynolds & Fields, 2012). Participants' data were fit to the hyperbolic function, Indifference point = $A/(1 + kD)$, to calculate values for *k*. *k* provides a measure of the rate at which each participant discounted reinforcers as a function of delay. In the hyperbolic function, A is the fixed amount of the delayed reward ($10) and D is the length of the delay (0–365 days). The distributions of *k* values were skewed, and this is to be expected because discounting equation parameter estimation typically results in skewed distributions (e.g., Johnson & Bickel, 2002). *k* values were log-10-transformed for the purpose of analysis (Alessi & Petri, 2003). Larger values of k indicate greater discounting and greater impulsivity.

Analysis Plan

Three sets of analyses are presented. First, the means and standard deviations are presented with an emphasis on mean differences at both the between-person level and the within-person level across the four forms of risk-taking. Second, bivariate associations among all

variables at the between-person and within-person levels are reported focusing on the bivariate associations among the predictors and between the predictors and risk-taking behavior. Third, two sets of multivariate results are described. The first set of multivariate analyses tested decision-making processes, self-control and impulsivity as predictors of concurrent and longitudinal risk-taking. The second set of multivariate models tested behavioral intentions and willingness as mediators of the effects of attitudes, subjective norms, perceived behavioral control and prototype perceptions on risk-taking. Analyses presented do not control for demographic variables because analyses were conducted controlling for demographic variables and results were not substantively different.

Between-person and within-person associations were analyzed using multilevel models in Mplus. Multilevel models enable estimation of hierarchical data (Hox & Roberts, 2010). The present study's data has a two-level structure with within-person (level 1) and between-person (level 2) effects. The primary outcomes of interest at both levels were the observed variables risk-taking behavior, behavioral intentions and willingness. Between-person level composites were group-mean centered so that the sample mean was 0 to facilitate interpretation. Within-person composite scores were centered at the within-person level so that each person's mean was 0 and scores were calculated as each person's deviation from that mean to disentangle within-person and between-person effects (Bryk & Raudenbush, 1992).

Results

Means

Table 2 presents reliabilities and descriptive statistics for all variables. Table 3 presents means for the within-person variables for each form of risk-taking with LSD post-hoc test results comparing differences in mean levels across the forms of risk-taking.

Table 2. *Descriptive Statistics and Reliabilities for All Variables*

	M	SD	Skew	Kurtosis	Range	α	Items
Risk-Taking Time 1	1.57	1.19	.79	-.05	0 - 5.42	.78	9
Substance Use	1.39	1.52	1.09	.29	0 - 6	.67	3
Criminal Involvement	1.47	1.96	1.16	.09	0 - 6	N/A	1
Risky Sex	1.05	1.29	1.04	.36	0 - 6	.22	2
Reckless Driving	2.36	1.56	.04	-1.08	0 - 6	.65	3
Risk-Taking Time 2	1.65	1.18	.81	.27	0 - 6	.76	9
Substance Use	1.32	1.48	1.11	.34	0 - 6	.63	3
Criminal Involvement	1.59	2.08	1.09	-.16	0 - 6	N/A	1
Risky Sex	1.16	1.34	.86	-.14	0 - 6	.15	2
Reckless Driving	2.49	1.56	-.13	-1.05	0 - 2.44	.71	3
Attitudes	.80	.48	.56	.21	0 - 2.58	.74	9
Substance Use	.99	.65	.47	-.06	0 - 4	.58	3
Criminal Involvement	.74	.78	.85	.77	0 - 4	N/A	1
Risky Sex	.79	.71	.97	1.29	0 - 2.67	.26	2
Reckless Driving	.69	.49	.82	1.14	0 - 3	.54	3
Subjective Norms	.67	.50	.99	1.02	0 - 2.83	.82	9
Substance Use	.83	.66	.83	.52	0 - 3	.67	3
Criminal Involvement	.37	.65	1.69	2.30	0 - 3	N/A	1
Risky Sex	.65	.68	.91	.17	0 - 3.67	.34	2
Reckless Driving	.86	.59	.51	.58	0 - 4	.66	3
Perceived behavioral control	2.57	1.0	-.41	-.66	0 - 4	.88	9
Substance Use	2.66	1.22	-.64	-.72	0 - 4	.81	3
Criminal Involvement	2.56	1.33	-.56	-.85	0 - 4	N/A	1
Risky Sex	2.37	1.31	-.35	-1.04	0 - 4	.71	2
Reckless Driving	2.69	.94	-.29	-.60	0 - 4	.61	3
Behavioral intentions	.90	.63	.76	-.09	0 - 3	.76	9
Substance Use	.86	.84	.77	-.36	0 - 3	.64	3
Criminal Involvement	.74	1.07	1.16	-.15	0 - 3	N/A	1
Risky Sex	.64	.74	.79	-.55	0 - 3	.20	2
Reckless Driving	1.38	.75	-.10	-.66	0 - 3	.60	3
Prototype perceptions	.94	.31	.22	.50	.06 - 1.99	.92	54
Substance Use	1.03	.35	.19	.24	0 - 2.22	.65	18
Criminal Involvement	.93	.44	.22	.10	0 - 2.17	.37	6
Risky Sex	.89	.40	.44	.94	0 - 2.58	.62	12
Reckless Driving	.90	.34	.56	1.09	.06 - 2.50	.69	18
Willingness	.76	.58	.80	.19	0 - 3	.78	9
Substance Use	.80	.81	.84	-.20	0 - 3	.65	3
Criminal Involvement	.51	.85	1.57	1.46	0 - 3	N/A	1
Risky Sex	.60	.72	.96	.00	0 - 3	.25	2
Reckless Driving	1.14	.74	.18	-.69	0 - 3	.69	18
Impulsivity 1	1.24	.55	.51	.15	0 - 3	.71	7
Delay Discounting	-.35	2.61	.20	.82	-9.78 - 4.85	N/A	N/A
Self-control 1	2.25	.74	.04	-.18	.27 - 4	.83	11
Stop-Signal Task	157.87	56.73	.16	2.40	-102.66 - 351.08	N/A	N/A

Table 3. *Means for Variables Across All Forms of Risk-taking and by Each Form of Risk-Taking.*

	All forms	Substance use	Crime	Risky sex	Risky driving	F(4,1564-4, 3316)
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	
Risk-Taking Time 1	1.57 (1.19)$_a$	1.40 (1.52)$_b$	1.48 (1.96)$_{ab}$	1.05 (1.29)$_c$	2.35 (1.56)	115.29***
Risk-Taking Time 2	1.64 (1.17)$_a$	1.31 (1.46)$_b$	1.59 (2.08)$_a$	1.15 (1.33)$_b$	2.49 (1.55)$_c$	80.81***
Behavioral Intentions	.90 (.64)$_a$	.87 (.84)$_a$	.74 (1.07)$_b$	.64 (.74)$_c$	1.38 (.75)	136.99***
Willingness	.76 (.59)$_a$	.80 (.81)$_a$	.52 (.85)$_b$	.60 (.72)$_c$	1.14 (.74)	123.75***
Attitudes	.80 (.48)$_a$	.99 (.65)$_b$	.74 (.78)$_c$	.79 (.71)$_{ac}$	.68 (.48)$_c$	38.51***
Subjective Norms	.68 (.49)$_a$	.82 (.66)$_b$	.37 (.65)	.65 (.68)$_a$	.86 (.59)$_b$	124.48***
Perceived Behavioral Control	2.57 (1.01)$_a$	2.66 (1.22)$_b$	2.56 (1.33)$_a$	2.37 (1.31)	2.69 (.94)$_b$	19.83***
Prototype Perceptions	.94 (.31)$_a$	1.04 (.35)	.93 (.44)$_{ab}$	.89 (.41)$_b$	.91 (.35)$_b$	33.03***

Note: Within each row, means sharing a common subscript are not statistically different at $\alpha = .05$ according to LSD post-hoc tests. *** $p < .001$.

The means in Table 3 are the same as the means in Table 2. The mean level of overall risk-taking behavior was relatively low for this sample, corresponding to scores of approximately 1 to 3 instances of engagement. Risky sexual behavior was engaged in least frequently and reckless driving was engaged in most frequently relative to the other forms of risk-taking. Corresponding to the low levels of engagement in risk-taking, decision-making processes were relatively unfavorable to risk-taking. The mean level of behavioral intentions and willingness corresponded to respondents being between "not at all" and "a little bit" willing or planning to engage in risk-taking behavior, which is consistent with, although lower than the extent to which participants reported engaging in the risk-taking behaviors. Participants reported the lowest levels of behavioral intentions and willingness for risky sex and crime, respectively. Behavioral intentions and willingness were highest for reckless driving. The mean attitudes score corresponded to responses of considering risk-taking to be between "very bad" and "a little bad" and the mean subjective norms score corresponded to responses indicating that individuals important to the respondents would "strongly disapprove" or "disapprove" of risk-taking behavior. Attitudes were most favorable towards substance use and least favorable towards reckless driving and crime. Subjective norms were least favorable towards crime and most favorable towards reckless driving and substance use relative to the other forms of risk-taking. The mean of perceived behavioral control corresponded to responses considering risk-taking engagement to be between "not difficult or easy" and "mostly easy," with risky sex being considered the least accessible behavior and reckless driving and substance use being considered the most accessible behaviors relative to the other forms of risk-taking.

In sum, mean levels of risk-taking were relatively low for this sample, and decision-making processes were generally unfavorable towards risk-taking. Participants endorsed reckless

driving as the most frequently engaged in behavior, and in accord with this, participants reported more behavioral intentions and willingness to engage in reckless driving relative to the other forms of risk-taking. Risk-taking engagement was lowest in the risky sex domain, and behavioral intentions were also lowest for the sexual form of risk-taking.

Correlations

Intraclass correlations, reflecting the proportion of the total variance in responses that is at the between-person level, are shown along the diagonal in Table 4. The intraclass correlations show that most of the variability in risk-taking, behavioral intentions, willingness, attitudes and subjective norms was across forms of risk-taking rather than across individuals (i.e., ICCs < .50). Variability in perceived behavioral control and prototype perceptions was nearly equally distributed across forms of risk-taking and across individuals. The intraclass correlations provide evidence that analyses should test both between-person and within-person associations.

Associations at the between-person level are shown by the correlations above the diagonal in Table 4. When adolescents experienced more behavioral intentions (averaged across more forms of risk-taking), adolescents reported more willingness, more favorable attitudes, more favorable subjective norms, more perceived behavioral control and more favorable prototype perceptions (averaged across more forms of risk-taking). Decision-making processes, self-reported self-control and self-reported impulsivity were consistently associated with risk-taking behavior but laboratory measures of self-control and impulsivity were not consistently linked to risk-taking.

Associations at the within-person level are shown by the correlations below the diagonal in Table 4. Consistent with the between-person correlations, the predictor variables were associated with one another and with risk-taking at the within-person level. The within-person

correlations linked more behavioral intentions, more willingness, more favorable attitudes, more favorable subjective norms, more perceived behavioral control and more favorable prototype

Table 4. *Correlations between Decision-Making Variables, Self-Control, Impulsivity and Risk-Taking.*

	1	2	3	4	5	6	7	8	9	10	11	12
1. Risk-Taking Time 1	.34	.53***	.45***	.40***	.20***	.17***	.25***	.07***	-.17***	.13***	-4.06	-.46***
2. Risk-Taking Time 2	.91***	.30	.54***	.45***	.21***	.16***	.34***	.05**	-.19***	.15*	-1.74	-.39
3. Behavioral Intentions	.52***	.49***	.32	.32***	.17***	.14***	.19***	.06***	-.11***	.08***	-1.97	-.34***
4. Willingness	.41***	.37***	.28***	.35	.17***	.13***	.16***	.06***	-.12***	.09***	-2.55	-.31***
5. Attitudes	.10***	.09***	.08***	.08***	.35	.13***	.09***	.05***	-.09***	.06***	-1.23	-.16*
6. Subjective Norms	.13***	.12***	.10***	.11***	.07***	.39	.06**	.04***	-.08***	.05***	.67	-.15
7. Perceived Behavioral Control	.23***	.22***	.14***	.12***	.08***	.07***	.58	.04***	-.04	.08***	-2.9	-.23
8. Prototype Perceptions	.04***	.04***	.03***	.03***	.02***	.02***	.02***	.49	-.03***	.03***	-2.04	-.03
9. Self-control										-.11***	-3.99	.02
10. Impulsivity											.04	-.04
11. Stop-Signal Task												-12.77
12. Delay Discounting												

Note: Between-person correlations are shown above the diagonal. Within-person correlations are shown below the diagonal. Intraclass correlations (underlined) are shown along the diagonal. *p <.05, **p <.01, ***p <.001.

perceptions with one another. Adolescents engaged more in the forms of risk-taking for which they experienced more behavioral intentions, more willingness, more favorable attitudes, more favorable subjective norms, more perceived behavioral control and more favorable prototype perceptions. In sum, self-reported predictors are consistently associated with one another and with risk-taking at both the between-person and within-person levels. However, laboratory-based measures of self-control and impulsivity are not associated with their self-report counterparts or with other self-reported variables.

Multivariate Analyses Predicting Risk-Taking Concurrently and Longitudinally

Four sets of multi-level regression models were fit to predict risk-taking behavior concurrently and longitudinally, using self-reported self-control and impulsivity data and using laboratory self-control and impulsivity data. Predictors at the between-person level included behavioral intentions, willingness, attitudes, subjective norms, perceived behavioral control, prototype perceptions, self-control and impulsivity. Three two-way interactions – self-control × behavioral intentions, impulsivity × self-control and impulsivity × willingness – also were included in the models. Predictors at the within-person level included behavioral intentions, willingness, attitudes, subjective norms, perceived behavioral control and prototype perceptions. Concurrent models tested wave 1 variables as predictors of wave 1 risk-taking, whereas longitudinal models tested wave 1 predictors of wave 3 risk-taking controlling for wave 1 risk-taking at both the between-person and within-person levels.

Table 5 summarizes results from the univariate and multivariate analyses predicting risk-taking behavior cross-sectionally and longitudinally using self-reported self-control and impulsivity data. Univariate analyses are analogous to, and show the same pattern of results as, the correlations presented in Table 4 and discussed previously. Univariate analyses are provided

Table 5. *Univariate and Multivariate Associations Between Predictors and Risk-Taking (Using Self-reported Self-control and Impulsivity).*

	Cross-sectional						Longitudinal					
	Univariate			Multivariate			Univariate			Multivariate		
	B	SE	B*	B	SE	B*	B	SE	B*	B	SE	B*
	Between-Person Level											
Behavioral Intentions (BI)	1.52	.06	.89***	1.09	.15	.64***	.62	.14	.37***	.61	.20	.36**
Willingness (WL)	1.53	.07	.85***	.52	.17	.28***	.43	.12	.24***	.09	.19	.05
Attitudes	1.12	.09	.56***	-.06	.08	-.03	.11	.09	.05	-.06	.11	-.03
Subjective Norms	.84	.11	.43***	-.04	.09	-.02	.02	.09	.01	-.11	.12	-.05
Perceived Behavioral Control	.34	.04	.35***	.05	.03	.05	.08	.04	.07*	.05	.04	.05
Prototype Perceptions	.85	.17	.27***	-.16	.12	-.04	-.10	.15	-.03	-.19	.14	-.05
Self-control (SC)	-.41	.06	-.31***	-.03	.05	-.02	-.02	.06	-.01	-.01	.06	-.00
Impulsivity (IM)	.60	.09	.34***	.05	.06	.02	.11	.08	.07	.05	.08	.03
Risk-Taking 1							.49	.07	.54***	.48	.07	.53***
SC X BI				-.23	.07	-.12***				-.13	.10	-.07
IM X SC				.02	.10	.00				.05	.10	.02
IM X WL				.09	.10	.03				.00	.14	.00
r^2						80%						76%
	Within-Person Level											
BI	1.24	.04	.63***	.89	.07	.46***	.65	.09	.32***	.60	.09	.30***
WL	1.28	.05	.57***	.52	.08	.23***	.50	.09	.22***	.10	.11	.05
Attitudes	.47	.07	.16***	-.05	.06	-.02	.11	.07	.04	-.09	.07	-.03
Subjective Norms	.62	.07	.21***	-.12	.06	-.04*	.18	.08	.06*	.02	.09	.01
Perceived Behavioral Control	.48	.05	.25***	.09	.04	.05**	.17	.05	.09***	.08	.04	.04
Prototype Perceptions	.64	.12	.11***	.03	.09	.00	.24	.13	.04	.08	.13	.01
Risk-Taking 1							.41	.05	.36***	.38	.05	.34***
r^2						44%						39%

Note: Values in univariate columns report results of analyses when each variable was regressed independently on risk-taking. Multivariate analyses included all main effects regressed on risk-taking simultaneously. Interactions were tested individually as a second step. r^2 values are from multivariate analyses which included all main effects.* p < .05, ** p < .01, *** p < .001.

primarily for comparison to the multivariate analyses. In the concurrent multivariate models, the predictors accounted for 80% of the between-person variance in risk-taking at wave 1. Adolescents reporting more behavioral intentions and more willingness (averaged across forms of risk-taking) reported more risk-taking behavior. The self-control × behavioral intentions interaction was a significant predictor of risk-taking behavior averaged across forms of risk-taking. As shown in Figure 3, simple slopes analyses indicated that behavioral intentions were more strongly associated with higher levels of risk-taking at low levels of self-control, $b = 1.65$, $SE = .05$, $p < .001$, than at high levels of self-control, $b = 1.31$, $SE = .07$, $p < .001$.

The predictors accounted for 44% of the within-person variance in wave 1 risk-taking. Adolescents reported engaging more in the forms of risk-taking for which they reported more behavioral intentions, more willingness, more perceived behavioral control and less favorable subjective norms.

Longitudinally, the predictors accounted for 76% of the between-person variance in wave 3 risk-taking. Adolescents who reported more risk-taking at wave 1 also reported more risk-taking at wave 3. Adolescents who reported more behavioral intentions at wave 1 reported more risk-taking at wave 3.

The predictors accounted for 39% of the within-person variance in wave 3 risk-taking. Adolescents reported consistency in the forms of risk-taking at waves 1 and 3. Adolescents engaged more often in the forms of risk taking for which they experienced more behavioral intentions at wave 1.

Table 6 summarizes results from the univariate and multivariate analyses predicting risk-taking behavior cross-sectionally and longitudinally using laboratory measures of self-control and impulsivity. Again, univariate analyses are provided for comparison to the multivariate

Figure 3. Fitted regression equation showing association between behavioral intentions and risk-taking behavior at high and low levels of self-control.

Table 6. *Univariate and Multivariate Associations Between Predictors and Risk-Taking (Using Laboratory-based Self-Control And Impulsivity).*

	Cross-sectional						Longitudinal					
	Univariate			Multivariate			Univariate			Multivariate		
	B	SE	B*	B	SE	B*	B	SE	B*	B	SE	B*
	Between-Person Level											
Behavioral Intentions (BI)	1.52	.06	.89***	1.43	.22	.83***	.62	.14	.37***	.72	.24	.42**
Willingness (WL)	1.53	.07	.85***	.15	.23	.09	.43	.12	.24***	.08	.26	.04
Attitudes	1.12	.09	.56***	-.07	.14	-.03	.11	.09	.05	-.00	.14	-.00
Subjective Norms	.84	.11	.43***	-.12	.12	-.05	.02	.09	.01	-.10	.14	-.05
Perceived Behavioral Control	.34	.04	.35***	.13	.04	.13**	.08	.04	.07*	.05	.05	.05
Prototype Perceptions	.85	.17	.27***	.05	.16	.01	-.10	.15	-.03	-.03	.18	-.01
Self-control (SC)	-.00	.00	-.09	-.00	.00	-.03	.00	.00	.02	.00	.00	.03
Impulsivity (IM)	-.08	.02	-.22***	.01	.02	.02	.00	.02	.00	.03	.02	.08
Risk-Taking 1							.49	.07	.54***	.43	.10	.49***
SC X BI				-.00	.00	-.03				-.00	.00	-.09
IM X SC				-.29	.19	-.13				.00	.00	.12*
IM X WL				.12	.15	.04				-.03	.04	-.05
r^2						86%						81%
	Within-Person Level											
BI	1.24	.04	.63***	.93	.12	.48***	.65	.09	.32***	.60	.09	.30***
WL	1.28	.05	.57***	.50	.14	.23***	.50	.09	.22***	.10	.11	.05
Attitudes	.47	.07	.16***	-.14	.09	-.05	.11	.07	.04	-.02	.10	-.00
Subjective Norms	.62	.07	.21***	-.12	.09	-.04	.18	.08	.06*	-.04	.13	-.01
Perceived Behavioral Control	.48	.05	.25***	.06	.06	.03	.17	.05	.09***	.08	.04	.04
Prototype Perceptions	.64	.12	.11***	.05	.16	.00	.24	.13	.04	.08	.13	.01
Risk-Taking 1							.41	.05	.36***	.38	.05	.34***
r^2						43%						39%

Note: Values in univariate columns report results of analyses when each variable was regressed independently on risk-taking. Multivariate analyses included all main effects regressed on risk-taking simultaneously. Interactions were tested individually as a second step. r^2 values are from multivariate analyses which included all main effects. * p < .05, ** p < .01, *** p < .001.

analyses which will be discussed. Most of the information provided in Table 6 is redundant with the results found using self-reported self-control and impulsivity data. The novel information provided in Table 6 involves the laboratory-based measures of self-control and impulsivity, and thus only the self-control and impulsivity effects will be discussed. Concurrently, the predictors accounted for 86% of the between-person variance in risk-taking at wave 1. Laboratory-based measures of self-control and impulsivity and interactions involving these variables did not predict risk-taking.

Longitudinally, the predictors accounted for 81% of the between-person variance in risk-taking at wave 3. Similar to the cross-sectional findings, laboratory-based measures of self-control and impulsivity did not uniquely predict risk-taking. However, the self-control × impulsivity interaction was a significant predictor of risk-taking behavior averaged across forms of risk-taking. As shown in Figure 4, simple slopes analyses indicated that impulsivity was more strongly associated with higher levels of risk-taking at high levels of self-control, $b = .069$, $SE = .00$, $p < .001$, than at low levels of self-control, $b = -.05$, $SE = .00$, $p < .001$.

Concluding, behavioral intentions and willingness were the primary predictors of risk-taking behavior at both the between-person and within-person levels. These results justify conducting the analyses testing mediation effects of the predictors to risk-taking through behavioral intentions and willingness, which will be reviewed next.

Mediation Analyses Predicting Risk-Taking Concurrently and Longitudinally

Four multi-level mediation models were fit to predict risk-taking behavior concurrently and longitudinally through behavioral intentions and willingness, using self-reported self-control and impulsivity data and using laboratory-based self-control and impulsivity data. The first mediation models tested included only the proposed paths. Specifically, in the proposed, initially

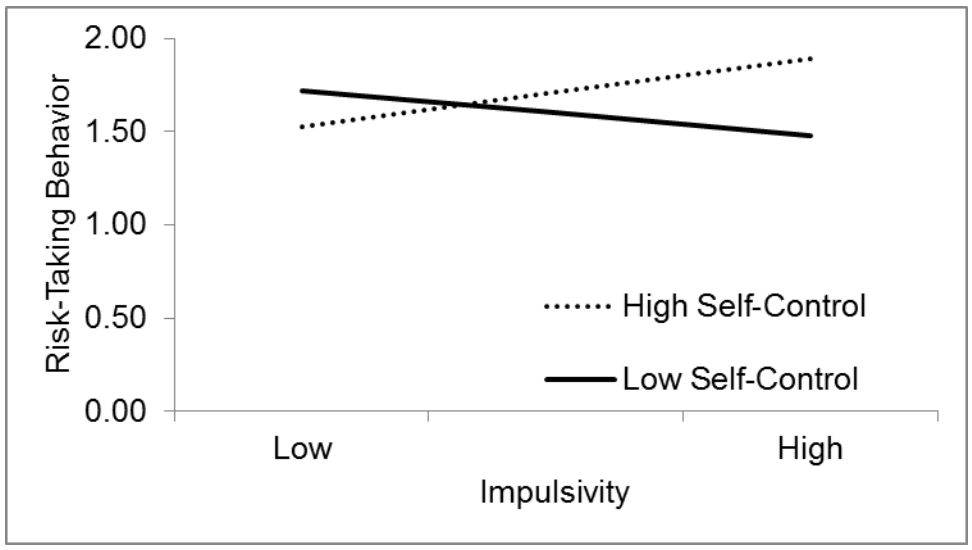

Figure 4. Fitted regression equation showing association between impulsivity and risk-taking behavior at high and low levels of self-control.

tested models, attitudes, subjective norms, perceived behavioral control and self-control were included as predictors of behavioral intentions at the between-person level. Prototype perceptions and impulsivity were included as predictors of willingness at the between-person level. Direct paths from behavioral intentions, willingness, attitudes, subjective norms, perceived behavioral control, prototype perceptions, self-control and impulsivity to risk-taking behavior also were included at the between-person level in the proposed, initially tested models. Predictors at the within-person level were analogous but did not include self-control or impulsivity. These models provided a poor fit to the data. Specifically, the models using self-reported self-control and impulsivity data provided a poor fit both using concurrent, $X^2(12) = 1578.31$, $p < .001$, CFI = .54, RMSEA = .24, and longitudinal risk-taking data, $X^2(16) = 2047.95$, $p = .00$, CFI = .46, RMSEA = .24. Similarly, the models using laboratory-based measures of self-control and impulsivity provided a poor fit both concurrently, $X^2(12) = 797.94$, $p = .00$, CFI = .495, RMSEA = .27, and longitudinally, $X^2(16) = 976.35$, $p = .00$, CFI = .45, RMSEA = .26. Additional paths were added to the proposed mediation models to improve model fit. Specifically, in the modified model predicting concurrent risk-taking, attitudes, subjective norms, perceived behavioral control and prototype perceptions were modeled as predictors of behavioral intentions, willingness, and risk-taking behavior at both between-person and within-person levels. Self-control and impulsivity were modeled as predictors of behavior intentions, willingness, and risk-taking behavior at the between-person level only. Behavioral intentions and willingness were modeled as predictors of risk-taking behavior at both the between-person and within-person levels. Finally, correlation terms were added between behavioral intentions and willingness at both the between-person and within-person levels. The mediation models predicting longitudinal risk-taking were similar to those predicting concurrent risk-taking, with six additional paths.

Specifically, risk-taking behavior at wave 1 was modeled as a predictor of behavioral intentions, willingness and risk-taking behavior at wave 3 at both the between-person and within-person levels.

Concurrent models tested wave 1 variables as predictors of wave 1 risk-taking, whereas longitudinal models tested wave 1 predictors of wave 3 risk-taking controlling for wave 1 risk-taking at both the between-person and within-person levels. The modified models provided a better fit to the data. Specifically, the modified models provided a perfect fit to the cross-sectional and longitudinal data because the models were just-identified.

Table 7 summarizes univariate regression results, multivariate direct effects predicting risk-taking and multivariate indirect effects predicting risk-taking through behavioral intentions and willingness using self-reported self-control and impulsivity data concurrently and longitudinally. The key elements in this table are the results from the multivariate indirect effect analyses which appear in the latter columns of the cross-sectional and longitudinal portions of the table. Interpretation focuses primarily on the indirect effects. Figure 5 presents standardized effects for the cross-sectional modified mediation model at the between-person level. Concurrently, more favorable attitudes, more favorable subjective norms, more perceived behavioral control, more favorable prototype perceptions, lower levels of self-control and higher levels of impulsivity predicted risk-taking (averaged across forms) through more behavioral intentions. More favorable attitudes, more favorable subjective norms, more perceived behavioral control, more favorable prototype perceptions, lower levels of self-control and higher levels of impulsivity significantly predicted more risk-taking (averaged across forms) through more willingness. Because the univariate effects were significant, the indirect effects were significant, and the direct effects were no longer significant when the indirect effects were

Table 7. *Direct and Indirect Effects through Behavioral Intentions and Willingness to Risk-Taking (Using Self-reported Self-control and Impulsivity).*

	Cross-sectional				Longitudinal			
		Multivariate				Multivariate		
	Univariate	Direct to Risk-Taking	Indirect through BI	Indirect through WL	Univariate	Direct to Risk-Taking	Indirect through BI	Indirect through WL
	Between-Person Level							
Behavioral Intentions (BI)	.89***	.65***			.37***	.37**		
Willingness (WL)	.85***	.28***			.24***	.06		
Attitudes	.56***	-.03	.21***	.12**	.05	-.01	.05*	.01
Subjective Norms	.43***	-.02	.11***	.04*	.01	-.06	.03*	.00
Perceived Behavioral Control	.35***	.05	.12***	.04**	.07*	.05	.02	.00
Prototype Perceptions	.27***	-.05	.06*	.04*	-.03	-.07	.02	.01
Self-control	-.31***	-.02	-.07**	-.03	-.01	-.00	-.01	-.00
Impulsivity	.34***	.03	.08**	.03*	.07	.02	.02	.00
Risk-Taking Time 1					.54***	.52***	.24**	.03
	Within-Person Level							
Behavioral Intentions	.63***	.46***			.32***	.28***		
Willingness	.57***	.23***			.22***	.05		
Attitudes	.16***	-.02	.05***	.03***	.06	-.03	.02**	.00
Subjective Norms	.21***	-.04*	.11***	.08***	.04*	.00	.04***	.01
Perceived Behavioral Control	.25***	.05**	.11***	.04***	.09***	.04	.03***	.00
Prototype Perceptions	.11***	.00	.04***	.02***	.04	.01	.01*	.00
Risk-Taking Time 1					.36***	.34***	.17***	.03

Note: Values in univariate columns report results of analyses when each variable was regressed independently on risk-taking. Multivariate analyses included all main effects regressed on risk-taking simultaneously. Interactions were tested individually as a second step. * $p < .05$, ** $p < .01$, *** $p < .001$.

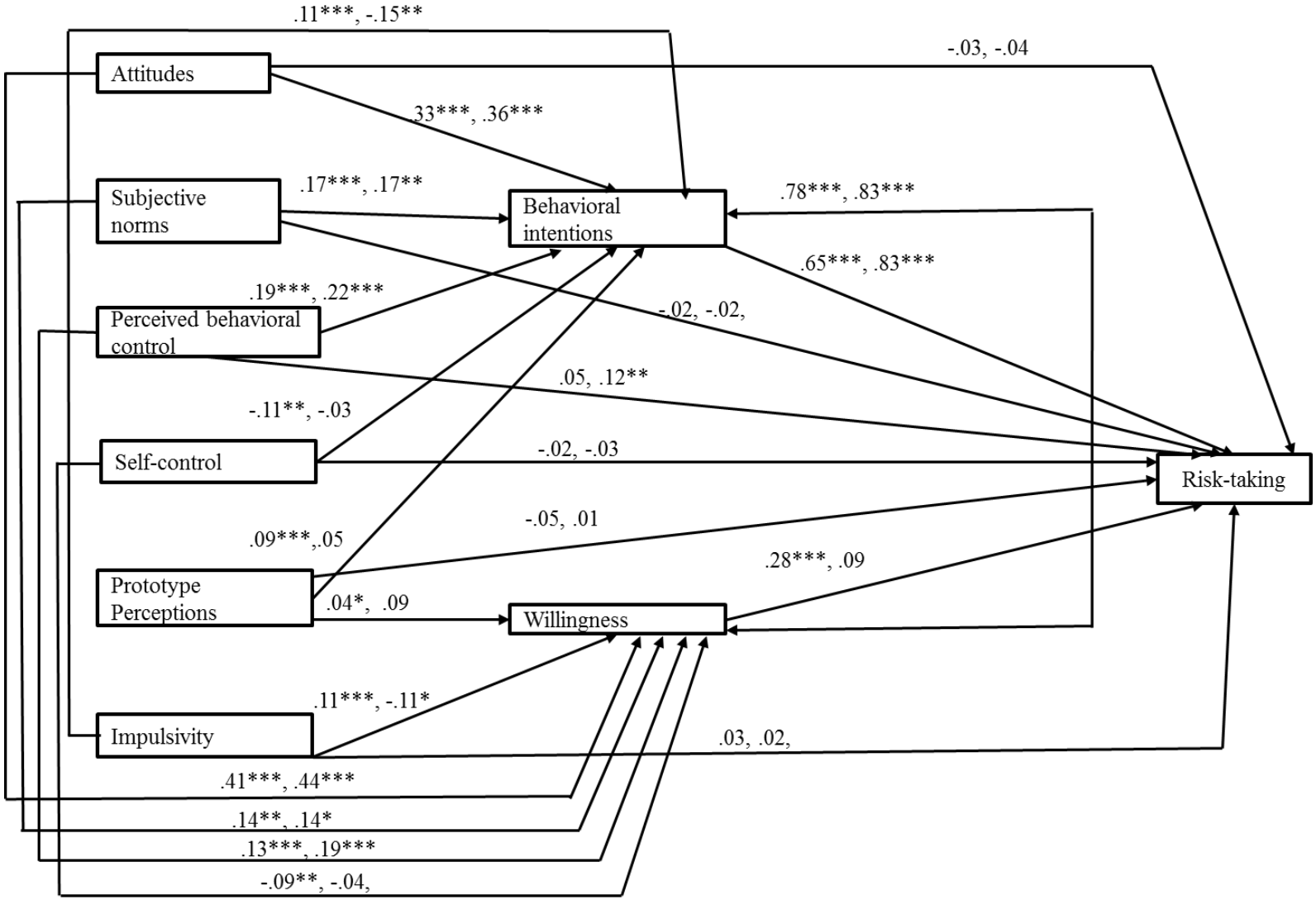

Figure 5. Standardized effects for cross-sectional modified mediation model at the between-person level.

Note: Standardized betas are listed in order for self-report and laboratory-based cross-sectional analyses. * $p < .05$, ** $p < .01$, *** $p < .001$.

included in the model, the effects of attitudes, subjective norms, perceived behavioral control, prototype perceptions and impulsivity on risk-taking were fully mediated through the combination of behavioral intentions and willingness. The effect of self-control on risk-taking was fully mediated through behavioral intentions.

Figure 6 presents standardized effects for the cross-sectional modified mediation model at the within-person level. Within-people, engagement in the forms of risk-taking was predicted by more favorable attitudes, more favorable subjective norms, more perceived behavioral control and more favorable prototype perceptions through behavioral intentions. Engagement in the forms of risk-taking was also predicted by more favorable attitudes, more favorable subjective norms, more perceived behavioral control and more favorable prototype perceptions through more willingness. The effects of attitudes and prototype perceptions were completely mediated through the combination of behavioral intentions and willingness. Because the indirect effects were significant and the direct effects were still significant with the indirect effects in the model, the effects of subjective norms and perceived behavioral control on risk-taking were partially mediated through the set of behavioral intentions and willingness.

Figure 7 presents standardized effects for the longitudinal modified mediation model at the between-person level. Longitudinally and between-people, more favorable attitudes, more favorable subjective norms and more risk-taking at wave 1 predicted risk-taking at wave 3 through more behavioral intentions (averaged across forms of risk-taking). Because the univariate effects were not significant but the indirect effects were significant, attitudes and subjective norms exhibited significant indirect effects on risk-taking through behavioral intentions. Risk-taking at wave 1 exhibited a significant indirect effect on risk-taking at wave 3 through behavioral intentions.

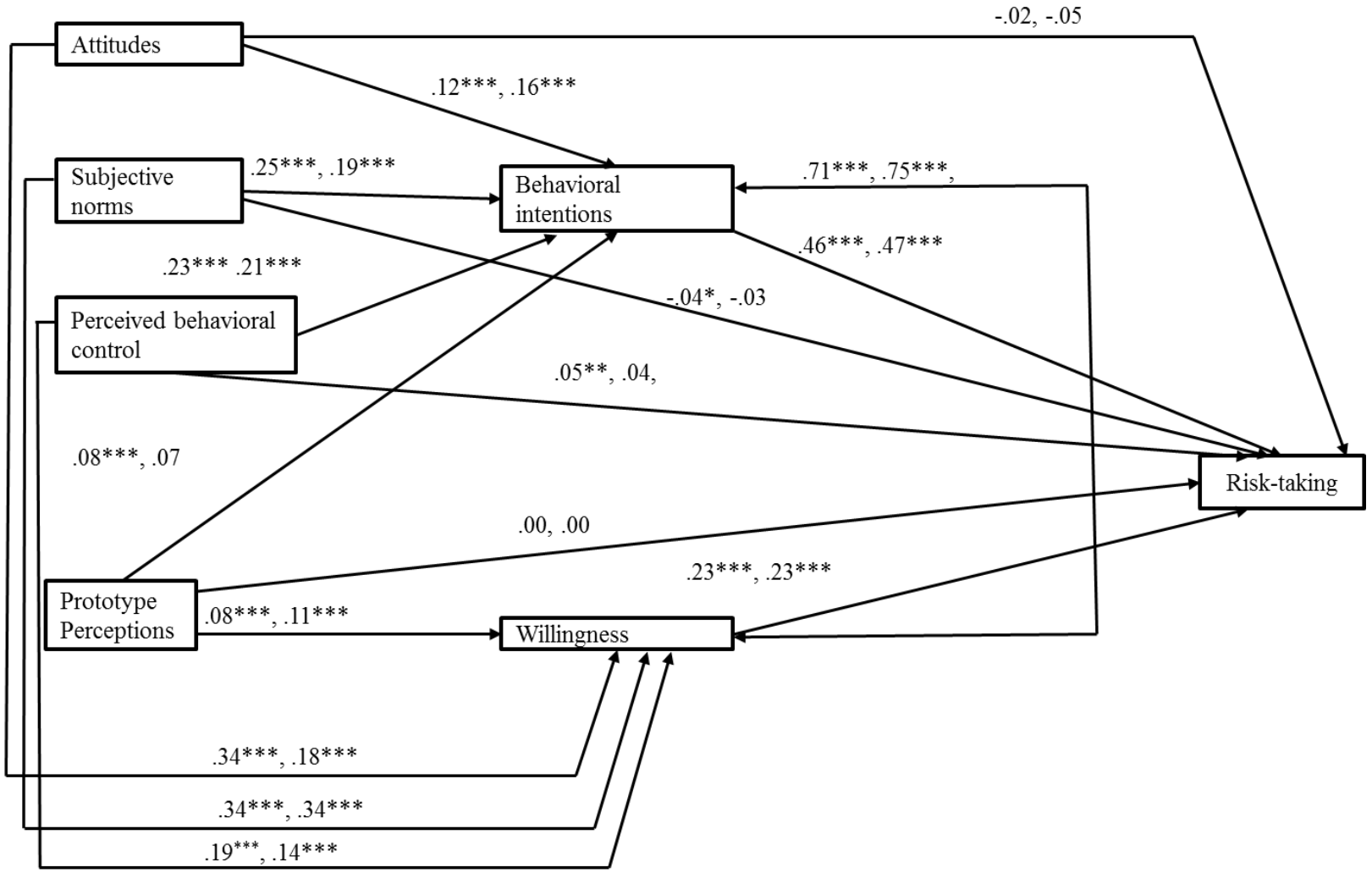

Figure 6. Standardized effects for cross-sectional modified mediation model at the within-person level.

Note: Standardized betas are listed in order for self-report and laboratory-based cross-sectional analyses. * $p < .05$, ** $p < .01$, *** $p < .001$.

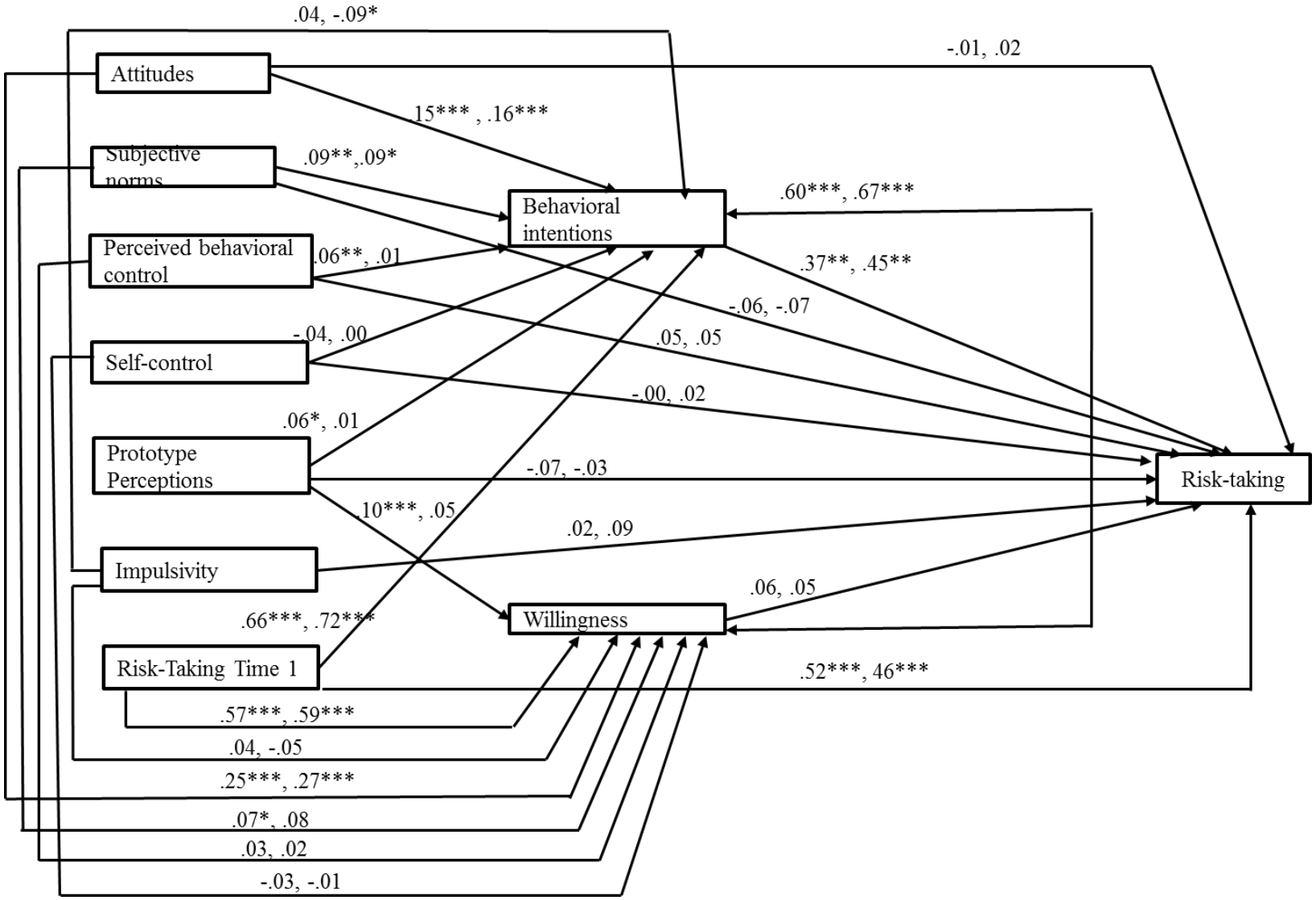

Figure 7. Standardized effects for longitudinal modified mediation model at the between-person level.

Note: Standardized betas are listed in order for self-report and lab-based longitudinal analyses. * p < .05, ** p < .01, *** p < .001.

Figure 8 presents standardized effects for the longitudinal modified mediation model at the within-person level. Within-people, engagement in the forms of risk-taking was predicted by more favorable attitudes, more favorable subjective norms, more perceived behavioral control, more prototype perceptions and more risk-taking at wave 1 through more behavioral intentions. The effects of subjective norms and perceived behavioral control on risk-taking were completely mediated through behavioral intentions. Attitudes, prototype perceptions and risk-taking at wave 1 exhibited significant indirect effects on risk-taking at wave 3 through behavioral intentions.

Table 8 summarizes univariate regression results, multivariate direct effects predicting risk-taking and multivariate indirect effects predicting risk-taking through behavioral intentions and willingness using laboratory measures of self-control and impulsivity concurrently and longitudinally. The key elements in this table are the results from the multivariate indirect effect analyses which appear in the latter two columns of the cross-sectional and longitudinal portions of the table. Interpretation focuses primarily on the indirect effects. Most information provided in Table 8 is redundant with results just discussed. The novel information in Table 8 involves the laboratory-based measures of self-control and impulsivity, and interpretation will focus on self-control and impulsivity. Concurrently, higher levels of impulsivity predicted more risk-taking (averaged across forms of risk-taking) through less behavioral intentions. The effect of impulsivity on risk-taking was fully mediated through behavioral intentions.

Concluding, decision-making processes predicted risk-taking more consistently through behavioral intentions than through willingness. Attitudes, subjective norms and perceived behavioral control consistently predicted risk-taking through behavioral intentions, in concurrent and longitudinal models, using self-reported and laboratory-based self-control and impulsivity data, and at both the between-person and within-person levels. Prototype perceptions predicted

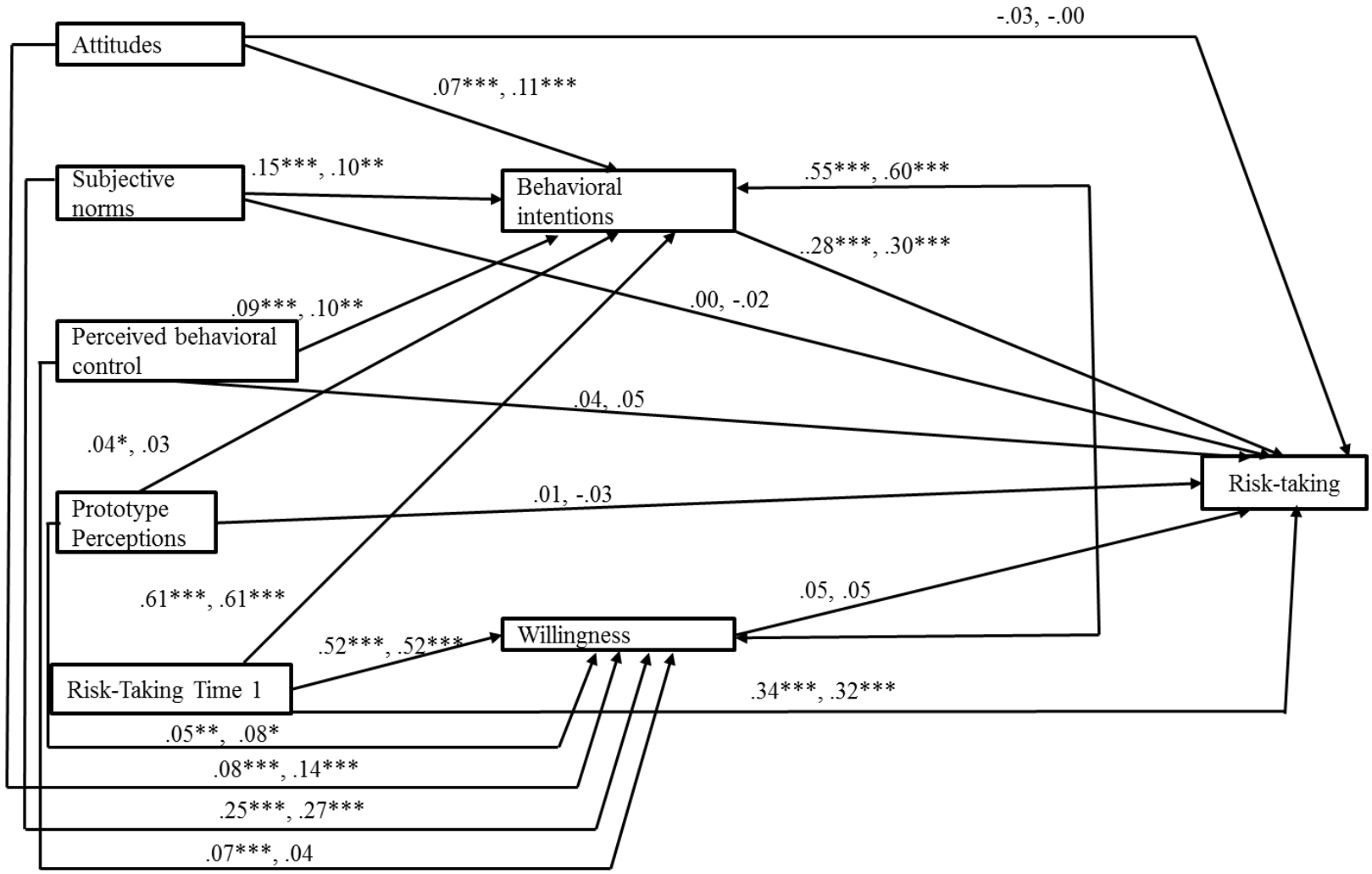

Figure 8. Standardized effects for longitudinal modified mediation model at the within-person level.

Note: Standardized betas are listed in order for self-report and laboratory-based longitudinal analyses. * p < .05, ** p < .01, *** p < .001.

Table 8. Direct and Indirect Effects through Behavioral Intentions and Willingness to Risk-taking (Using Laboratory-based Self-control and Impulsivity).

	Cross-sectional				Longitudinal			
		Multivariate				Multivariate		
	Univariate	Direct to Risk-Taking	Indirect through BI	Indirect through WL	Univariate	Direct to Risk-Taking	Indirect through BI	Indirect through WL
	Between-Person Level							
Behavioral Intentions (BI)	.89***	.83***			.37***	.45**		
Willingness (WL)	.85***	.09			.24***	.05		
Attitudes	.56***	-.04	.29***	.04	.05	.02	.07*	.01
Subjective Norms	.43***	-.02	.14**	.01	.01	-.07	.04	.00
Perceived Behavioral Control	.35***	.12**	.18***	.02	.07*	.05	.00	.00
Prototype Perceptions	.27***	.01	.04	.00	-.03	-.03	.00	.00
Self-control	-.09	-.03	-.03	-.00	.02	.02	.00	.00
Impulsivity	-.22***	.02	-.13**	-.01	.00	.09	-.04	-.00
Risk-Taking 1					.54***	.46***	.33**	.03
	Within-Person Level							
Behavioral Intentions	.63***	.47***			.32***	.30***		
Willingness	.57***	.23***			.22***	.05		
Attitudes	.16***	-.05	.07***	.04***	.04	-.00	.04*	.00
Subjective Norms	.21***	-.03	.09***	.08**	.06*	-.02	.03**	.01
Perceived Behavioral Control	.25***	.04	.09***	.03*	.09***	.05	.03*	.00
Prototype Perceptions	.11***	.00	.03	.03*	.04	-.03	.00	.00
Risk-Taking 1					.36***	.32***	.19***	.02

Note: Values in univariate columns report results of analyses when each variable was regressed independently on risk-taking. Multivariate analyses included all main effects regressed on risk-taking simultaneously. Interactions were tested individually as a second step. * $p < .05$, ** $p < .01$, *** $p < .001$.

risk-taking through both behavioral intentions and willingness in some but not all models. Impulsivity predicted risk-taking through behavioral intentions in more models than self-control predicted risk-taking through behavioral intentions.

A summary of all results relevant to the hypotheses is provided in Table 9. There was much support for the effect of behavioral intentions on risk-taking. Behavioral intentions consistently accounted for the link between perceived behavioral control and risk-taking, and to a lesser extent behavioral intentions accounted for the links between attitudes and risk-taking and between subjective norms and risk-taking. Willingness was linked with risk-taking less so than was behavioral intentions. Only some to minimal support was provided for the hypotheses that willingness would account for the links between prototype perceptions and risk-taking and between impulsivity and risk-taking. There was some support for the hypothesis that behavioral intentions would account for the effect of self-control on risk-taking. There was minimal support that the association between behavioral intentions and risk-taking would be stronger at higher than lower levels of self-control.

Discussion

This study tested reasoned and reactive decision-making processes, self-control and impulsivity as predictors of which adolescents are most likely to engage in risk-taking and why an adolescent may engage in one form of risk-taking but not another form of risk-taking. The study addressed three themes. It tested dual-process decision-making models, assessed between-person and within-person variations in risk-taking behavior, and attempted to integrate decision-making models and trait models of risk-taking. Results will be discussed according to themes.

Between-person and Within-person Variations in Risk-Taking

The present study addressed why some individuals take more risks than other individuals and why an individual may engage in one form of risk-taking but not another form of risk-taking.

Table 9. *Summary of Results.*

Hypothesis	Level of Support	Explanation
1. Behavioral intentions → Risk-Taking	Consistent	Significant multivariate cross-sectional & longitudinal, between-person & within-person
2. Attitudes → Behavioral Intentions	Consistent	Significant direct effects from attitudes to behavioral intentions concurrently and longitudinally, between-person & within-person
Attitudes → Risk-Taking through Behavioral Intentions	Consistent	Indirect effects through behavioral intentions concurrently & longitudinally, between-person & within-person
3. Subjective Norms → Behavioral Intentions	Consistent	Significant direct effects from subjective norms to behavioral intentions concurrently and longitudinally, between-person & within-person
Subjective norms → Risk-Taking through Behavioral Intentions	Consistent	Indirect effects through behavioral intentions concurrently & longitudinally, between-person & within-person
4. Perceived Behavioral Control → Behavioral Intentions	Consistent	Significant direct effects from perceived behavioral control to behavioral intentions concurrently and longitudinally, between-person and within-person
Perceived Behavioral Control → Risk-Taking through Behavioral Intentions	Consistent	Indirect effects through behavioral intentions concurrently and longitudinally, between-person & within-person
5. Willingness → Risk-Taking	Inconsistent	Significant multivariate between-person & within-person effects concurrently but not longitudinally
6. Prototype perceptions → Willingness	Consistent	Significant direct effects from prototype perceptions to willingness concurrently and longitudinally at both between-person & within-person levels.
Prototype Perceptions → Risk-Taking through Willingness	Inconsistent	Indirect effect through willingness at between-person & within-person levels concurrently. No significant indirect effects through willingness longitudinally.

Table 9 Continued. *Summary of Results.*

7. Impulsivity X Self-control → Risk-Taking	No support	No interaction effects were found consistent with this hypothesis.
8. Willingness X Impulsivity → Risk-Taking	No support	No interaction effects were found consistent with this hypothesis.
9. Impulsivity → Risk-Taking through Willingness	Inconsistent	Indirect effect on risk-taking through willingness only concurrently and using self-reported impulsivity
10. Behavioral Intentions X Self-control → Risk-Taking	No support	No interaction effects were found consistent with this hypothesis.
11. Self-control → Risk-Taking through Behavioral Intentions	Inconsistent	indirect effect through behavioral intentions concurrently & longitudinally using self-reported self-control

Results yielded approximately equal variability in risk-taking between-people averaged across forms and within-people looking at each specific form of risk-taking. In other words, individuals who engaged in one form of risk-taking were likely to engage in other forms of risk-taking as well, but within-person results explained the imperfect correlation between different forms of risk-taking. Thus, considering variations in risk-taking at both the between-person and within-person levels comprehensively addressed the questions of interest.

In addition to describing the variability at both the between-person and within-person levels, the present study evaluated whether decision-making processes predicted risk-taking similarly at both the between-person and within-person levels. In most analyses, predictors of risk-taking functioned similarly at both the between-person and within-person levels. For example, individuals with more behavioral intentions engaged in more risk-taking averaged across forms. Also, individuals engaged in the specific forms of risk-taking for which they experienced higher behavioral intentions. Some effects were apparent only at the within-person level and not at the between-person level. For instance, engagement in the forms of risk-taking was predicted by prototype perceptions through behavioral intentions, but prototype perceptions did not predict risk-taking between-people averaged across forms. An exclusive emphasis on risk-taking averaged across forms would have led to erroneous inferences (Nesselroade, 2002).

Most research focusing on predictors of risk-taking has been dominated by a between-person orientation (e.g., Ford & Blumenstein, 2013; Gottfredson & Hirschi, 1990; Zuckerman & Kuhlman, 2000). Between-person analyses are beneficial for explaining why individuals who engage in one form of risk-taking are likely to engage in other forms of risk-taking as well (Fleeson, 2004). For instance, individuals with higher levels of behavioral intentions across forms of risk-taking are more likely to engage in substance use, criminal behavior, risky sexual

behavior and reckless driving. Mean-level differences averaged across forms of risk-taking provide the most useful information when the correlation between different risk-taking behaviors is strong (MacDonald, Li & Bäckman, 2009). However, the correlation between different forms of risk-taking is usually modest (Figner & Weber, 2011), as was the case in the present study. Within-person analyses are beneficial for explaining why an individual may choose to engage in one form of risk-taking but not another form of risk-taking. The present study demonstrates the value of adopting a comprehensive approach to understanding multiple forms of risk-taking. Future research should include assessments of between-person as well as within-person variability in risk-taking behavior.

Dual Process Models of Decision-Making

This study tested dual process models of decision-making as predictors of risk-taking behavior. It assessed the evidence for the predictive power of the reasoned and reactive decision-making processes, and whether the two processes contribute to risk-taking through distinct pathways.

This study provided strong evidence supporting the use of rational decision-making processes – specifically processes from the Theory of Planned Behavior (Ajzen, 1991) – for predicting behavioral intentions and risk-taking. Behavioral intentions were the most consistent unique predictor of risk-taking. Specifically, behavioral intentions were associated with risk-taking in the concurrent and longitudinal multivariate models at both the between-person and within-person levels. Attitudes, subjective norms and perceived behavioral control were associated with-risk-taking indirectly through behavioral intentions at both the between-person and within-person levels. Additionally, at the within-person level, subjective norms and perceived behavioral control contributed to risk-taking directly, although the contribution of

these variables to risk-taking was smaller when behavioral intentions was included in versus excluded from the model. Because behavioral intentions accounted for the effects of attitudes on risk-taking and partly accounted for the effects of subjective norms and perceived behavioral control on risk-taking, prevention/intervention efforts should emphasize reducing behavioral intentions in order to reduce risk-taking. However, the direct effects of subjective norms and perceived behavioral control on risk-taking even when behavioral intentions were included in the model suggest that reducing favorable subjective norms and reducing perceived behavioral control should also be a focus of treatment.

Reactive decision-making processes, from the Prototype Willingness model (Gerrard et al., 2008), were associated with concurrent but not longitudinal risk-taking. That is, willingness was uniquely associated with concurrent but not longitudinal risk-taking in multivariate models. Similarly, prototype perceptions contributed indirectly to concurrent but not longitudinal risk-taking through willingness at the between-person and within-person levels. When considering concurrent risk-taking, dual process models which include the Prototype Willingness model's components offer additional value compared to considering the reasoned decision-making process alone.

While the current study supports the use of dual process models to explain concurrent risk-taking, the reasoned decision-making process was associated with risk-taking more consistently than was the reactive decision-making process. In other words, the reasoned decision-making process was associated with both concurrent and longitudinal risk-taking whereas the reactive decision-making process was associated with concurrent risk-taking only. Much literature argues that the reasoned decision-making process does not solely adequately explain risk-taking (Albert & Steinberg, 2011; Churchill, Jessop & Sparks, 2008; Pomery et al.,

2009). The present study's results are consistent with this assertion in that the reactive decision-making process, and the Prototype Willingness model's components, added additional value to the reasoned process in terms of explaining concurrent risk-taking. In prior research, willingness has been evidenced to predict longitudinal risk-taking (Andrews et al., 2008; Thornton et al., 2002). For instance, prototype perceptions predicted willingness, which in turn predicted engagement in unprotected sex 6 months later among late adolescents ages 18 to 24 (Thornton et al., 2002). Also, prototype perceptions in the elementary years (2nd through 5th grade) were related to substance use in adolescence through willingness (Andrews et al., 2008). Unfortunately, the present study is not consistent with this prior research because willingness was not predictive of longitudinal risk-taking.

There are several potential explanations for the finding that behavioral intentions more consistently predicted risk-taking than did willingness. First, the late adolescent stage of the present study's participants may explain the more consistent predictive effect of behavioral intentions than willingness on risk-taking. Prior research has indicated that the predictive power of behavioral intentions surpasses that of willingness as adolescents approach adulthood (Pomery et al., 2009). In Pomery et al.'s (2009) study, willingness was the only significant predictor of risk-taking in early adolescence (age 13), but behavioral intentions was the only significant predictor of risk-taking in middle adolescence (age 16). Additionally, behavioral intentions was a better predictor for students more experienced with engaging in risk-taking whereas willingness was the superior predictor of risk-taking for students less experienced in risk-taking (Pomery et al., 2009). Based on these results, it seems that as adolescents age and gain experience, they begin to better understand their behavioral tendencies, allowing them to more accurately predict their decisions and behavior (Albert & Steinberg, 2011; Pomery et al., 2009). A second potential

explanation is that behavioral intentions and willingness have been suggested to indicate different time frames (Andrews et al., 2008; Gibbons et al., 2003), which may explain the association of behavioral intentions with longitudinal risk-taking and the association of willingness with concurrent risk-taking. Willingness suggests a concurrent time frame – i.e., "I would be willing to smoke a cigarette if someone offered me one right now" – whereas behavioral intentions suggest a longitudinal time frame – i.e., "I plan to drive recklessly when I am on my way home today" (Andrews et al., 2008; Gibbons et al., 2003).

Consistent with the evidence supporting the utility of dual process models to explain concurrent risk-taking, variables from the reasoned and reactive decision-making pathways were associated with risk-taking indirectly through both the reasoned pathway, behavioral intentions, and the reactive pathway, willingness. Variables from the reasoned pathway – attitudes, subjective norms and perceived behavioral control – seem to not simply reflect a solely reasoned, well-thought out, cognitive process, but to also reflect an affect-laden, emotionally charged, intuitive reactive processes. Similarly, prototype perceptions seem to involve both reactive processing as well as reasoned processing. Longitudinally, most variables (except perceived behavioral control, prototype perceptions, self-control and impulsivity at the between-person level) were associated with risk-taking only through the reasoned, well-thought out process, behavioral intentions. These results suggest that the reasoned and reactive decision-making processes are not distinct and instead influence risk-taking through similar pathways. Some prior research is consistent with this conclusion. For instance, in Andrews et al.'s (2008) study, components from the Theory of Planned Behavior (i.e., subjective norms) were found to lead to subsequent alcohol and cigarette use through both the reasoned pathway, behavioral intentions, and through the reactive pathway, willingness.

Integrating Trait and Decision-Making Models

The present study integrated trait and decision-making models of risk-taking to explain risk-taking behavior. The main difference between decision-making and trait models is that, from a decision-making perspective, it is necessary to assess specific processes related to the different forms of risk-taking of interest (e.g., attitudes towards substance use, or subjective norms regarding reckless driving; Wiers et al., 2010). In contrast, trait models emphasize general or global time-stable individual differences between people (e.g., fast reactions across situations and to various stimuli; Wiers et al., 2010).

In the present study, several moderation effects were hypothesized. The association between impulsivity and risk-taking behavior was expected to be weaker at higher than lower levels of self-control. However, this effect was not found. The lack of support for this hypothesis is inconsistent with prior research in which the effect of impulsivity on substance use and other problem behaviors was less for people with higher than lower levels of self-control (Chen & Vazsonyi, 2011; Wills et al., 2011). These discrepant findings may be due to differences in measurement. In both studies, the operationalizations of self-control and impulsivity were much broader than the operationalizations employed in the current study. In Will et al.'s (2011) study, the self-control measure assessed planfulness, future time perspective, rational problem-solving tendencies and delay of gratification. The measure of impulsivity in Will et al.'s (2011) study tapped distractibility, impulsiveness, and immediate gratification. In Chen and Vazsonyi's (2011) study, self-control was indexed by items measuring future orientation relevant to education, marriage and life. Impulsivity was indexed by items measuring problem-solving styles. The present study's conceptualization of self-control and impulsivity was narrow and did not blend the constructs. In the present study, the self-control scale measured the ability to

override or alter internal responses and to interrupt inappropriate behavior such as resisting acting on impulse (Tangney et al., 2004). The impulsivity measure employed in the current study indexed acting on the spur of the moment and fast reactions (Patton et al., 1995). The different approaches to measuring self-control and impulsivity in the present study versus prior studies (Chen & Vazsonyi, 2011; Wills et al., 2011) may account for discrepant findings. Future research should include more distinct measures of self-control and impulsivity to increase understanding about the lack of effects found in the present study.

The association between behavioral intentions and risk-taking behavior was expected to be stronger at higher than lower levels of self-control. This hypothesis was also not supported. The lack of the hypothesized effect is inconsistent with the one prior study that tested this association. In this prior study, explicit arousal to alcohol, similar to the reasoned decision-making process, predicted alcohol use and problems among individuals with high but not low working memory capacity (working memory capacity was used to index self-control; Thush et al., 2008). Again, it is possible that the discrepant findings between this study and prior research could be due to differences in measurement. That is, the present study utilized self-report and laboratory-based measures of self-control whereas Thush et al. (2008) utilized a measure of working memory capacity to index self-control. Additionally, the present study relied upon self-report measures of behavioral intentions, attitudes, subjective norms and perceived behavioral control to index the reasoned decision-making pathway. In contrast, Thush et al. (2008) employed an expectancy questionnaire to assess alcohol-related cognitions. The expectancy questionnaire included items such as "drinking alcohol makes me feel good," which tap expectations rather than the components from the Theory of Planned Behavior which reflect the reasoned decision-making process in the present study.

The association between willingness and risk-taking behavior was expected to be stronger at higher than lower levels of self-control. This moderation hypothesis was not supported. Prior research did not test how impulsivity aligns with the reactive decision-making pathway, but prior research used working memory capacity as an index of low self-control, which is considered by some to be synonymous with high impulsivity (Maloney, Grawitch & Barber, 2012; Wills, Walker, Mendoza & Ainette, 2006). The present study's failure to find that impulsivity moderates the effect of willingness on risk-taking is not consistent with the literature using working memory capacity to index self-control (or the inverse of impulsivity). In prior research, implicit associations indicative of the reactive decision-making process and similar to prototype perceptions, predicted substance use among individuals with low levels of working memory capacity (i.e., low self-control/high impulsivity) but not or not as strongly among individuals with high working memory capacity (i.e., high self-control/low impulsivity; Friese & Hoffmann, 2009; Grenard et al., 2008; Houben & Wiers, 2009; Thush et al., 2008). Again, the discrepant findings between this and prior research may be due to differences in measurement of impulsivity and the reactive decision-making process. Impulsivity was not directly assessed in prior research as it was in the present research. In addition, prior research did not measure the constructs from the prototype-willingness model (i.e., willingness and prototype perceptions) as did the present study. Instead, implicit association tasks were utilized to index components similar to the reactive decision-making process. As an example of an implicit association task, in one study, participants sorted pictures of alcoholic and non-alcoholic drinks together with words related to positive arousal (e.g., "excitement") and neutral feelings (Thush et al., 2008). The extent to which participants were faster to sort alcoholic drinks with positively valenced words than to sort non-alcoholic drinks with positively valenced words generated the index for the

relative strength of positive affect associations with alcohol (Thush et al., 2008), which could be considered similar to but distinct from prototype perceptions and the reactive decision-making model in the present study. Thus, the studies' methods for measuring the reactive decision-making processes seem quite different and impulsivity was not assessed in prior research testing this association. These methodological differences may account for the discrepant findings. In sum, the present study measured self-control and impulsivity as distinct, relatively narrow constructs and assessed the reasoned and reactive decision-making processes via self-reported assessment of the constructs in the Theory of Planned Behavior and the Prototype-Willingness model, respectively. The present study failed to find any of the hypothesized moderation effects, and discrepant findings between this and prior research may be due to methodological differences between studies.

Although moderation hypotheses were not supported, two significant indirect effect paths were found consistent with expectations. First, a significant indirect path was found from impulsivity to risk-taking behavior through willingness (in the concurrent model using self-reported impulsivity data). The indirect effect of impulsivity to risk-taking through willingness suggests that for individuals high in impulsivity, willingness is integral in affecting risk-taking behavior. In the present study, impulsivity reflected acting on the spur of the moment and employing fast reactions. Individuals high in impulsivity may be likely to employ an affective, intuitive rather quick decision-making process (i.e., the reactive decision-making process) when choosing whether to engage in risk-taking behavior. Further research is needed to understand the implications of this effect, but it implies that an intervention approach for individuals demonstrating high levels of impulsivity should target components from the Prototype-

Willingness model (i.e., reduce prototype perceptions and willingness) to reduce risk-taking behavior.

The second indirect effect that was found consistent with hypotheses was that of self-control to risk-taking behavior through behavioral intentions (in the concurrent model using self-reported self-control data). Individuals high in self-control seem to utilize a reasoned decision-making process ending in behavioral intentions when deciding whether to engage in risk-taking. In the present study, self-control was conceptualized and operationalized as the ability to override or alter internal responses and to interrupt inappropriate behavior including resisting acting on impulse. Using this conceptualization, self-control seems to be aligned with the reasoned decision-making process, which involves explicit consideration and well-thought out weighing of the pros and cons of engaging in risk-taking. Again, more research is needed investigating this association, but implications are that interventions for individuals with high levels of self-control should target components from the Theory of Planned Behavior and reduce individuals' behavioral intentions to reduce risk-taking.

Although not expected, there was a significant indirect path from impulsivity to risk-taking behavior through behavioral intentions (concurrently, using self-report and lab-based self-control and impulsivity data). In addition to employing a reactive process when contemplating risk-taking, individuals with impulsivity also seem likely to employ a reasoned decision-making process. Impulsivity was linked to higher levels of risk-taking because of higher levels of behavioral intentions whereas self-control was linked to lower levels of risk-taking because of lower levels of behavioral intentions. For impulsive individuals, the perceived benefits of engaging in risk-taking may outweigh the negative consequences, leading to more behavioral intentions. For individuals with high self-control, the negative consequences seem more salient

than the positive benefits, leading to reduced behavioral intentions. More research on this effect would enhance understanding about the reasoned decision-making process for highly impulsive versus highly self-controlled individuals. At this point, results suggest that intervention strategies that target the reasoned decision-making process should differ for individuals high in self-control versus high in impulsivity.

There is one more effect that was not hypothesized but is worth mentioning. Specifically, self-control and impulsivity exhibited significant effects on concurrent risk-taking in univariate models using self-reported self-control and impulsivity data (this effect was also significant for impulsivity using lab-based impulsivity data) but the effects were no longer significant when decision-making processes were considered in the multivariate analysis. Adolescents' engagement in risk-taking may be more strongly influenced by decision-making processes than by trait self-control and impulsivity. Prior research using a broad measure of self-control reported that low self-control uniquely explained variation in risk-taking including delinquency and substance in a multivariate analysis (Wood, Pfefferbaum, & Arneklev, 1993). Prior research using a measure of sensation seeking reported that high sensation seeking uniquely explained variation in substance abuse and other risk-taking behaviors in a multivariate analysis (Wagner, 2001). However, no research was found testing the effects of self-control and impulsivity along with decision-making processes in multivariate analyses as was done in the present study. Future research should test the effects of self-control, impulsivity and decision-making process on risk-taking in a multivariate model to follow-up on results from this study.

Strengths and Limitations

A methodological strength of the current study is the multilevel design, which allowed estimation of between-person and within-person variation in risk-taking behavior. Analyzing

between-person and within-person differences offers a more comprehensive picture of the predictors of risk-taking and improves upon the majority of research which is dominated by a between-person orientation. A second strength of the current study is that it was longitudinal and controlled for prior risk-taking behavior. Controlling for prior risk-taking behavior is beneficial because risk-taking behavior may be quite stable. Controlling for earlier risk-taking behavior provides a test of whether decision-making processes explain change in risk-taking behavior from the previous three months. A third strength of the study is that it utilized both self-report and laboratory-based measures of self-control and impulsivity. This allowed the current study to test whether results generalize across self-report and laboratory-based measures of self-control and impulsivity. A fourth strength of the study is that it measured impulsivity separately from self-control rather than blending the constructs or considering impulsivity to be the inverse of self-control. Distinct measurement of impulsivity and self-control is indicated because the two constructs have been found to be conceptually distinct (Maloney et al., 2012), differentially related to behavioral outcomes (Eisenberg et al., 2001), and to be differentiated in factor analyses (Smith et al., 2007; Whiteside & Lynam, 2001).

This study had two major limitations. First, the laboratory-based measures of self-control and impulsivity did not predict risk-taking behavior (with the exception of an interaction between self-control and impulsivity which predicted risk-taking behavior in a direction opposite of expectations). There are some potential explanations for why the laboratory tasks did not predict risk-taking. As reviewed in the methods section and shown in Table 1, participants who completed the laboratory-based measures reported higher levels of self-control than did participants who did not complete the laboratory tasks. Laboratory measures may not have predicted risk-taking because participants who completed the laboratory tasks exhibited high

levels of self-control. Another explanation for why the laboratory tasks did not predict risk-taking is that the risk-taking behavior outcome measure in this study was based on participants' self-report. Self-report data and laboratory task measures of self-control (as assessed by the stop-signal task) and impulsivity (as assessed by the delay discounting task) have been evidenced to not be correlated (Reynolds, Ortengren, Richards, & de Wit, 2006). In a meta-analysis, the correlation between self-reported and laboratory-based impulsivity measures was .0097 (Cyders & Coskunpinar, 2011). Researchers suggested that self-report and laboratory-based measures tap different constructs and advised future researchers to use different labels for self-report and laboratory-based measures of impulsivity (Cyders & Coskunpinar, 2011). Also, there was a large number of participants whose laboratory-based self-control data (i.e., the stop-signal reaction-time data) was dropped from analyses because it violated the assumption of the horse-race model. A second major limitation is that participation patterns were not consistent across the three waves of data collection. That is, only 57.4% of the sample completed the laboratory tasks and only 67.9% of the sample provided longitudinal data. The incomplete participation across waves reduced the statistical power of longitudinal analyses. Also, to the extent that attrition was selective, this may have led to biased outcomes. For instance, participants who completed the laboratory-based measures reported higher levels of self-control than did participants who did not complete the laboratory tasks so this may have biased outcomes.

This study also had several other limitations. For example, the first other limitation regards the sample selected. College students are not representative of all late adolescents, and this limits generalization of results (Tanner, 2006). Although the demographic composition of the sample was consistent with that of the university from which it was drawn, results may not generalize to other populations of students. Also, some of the items that were selected as

measures – i.e., two criminal behavior items and one risky sexual behavior item – were not frequently endorsed and were dropped from all measures and analyses. Therefore, this study does not provide as thorough information about criminal behavior or risky sexual behavior as intended. Additionally, although this study was longitudinal, the time-period assessed was relatively short – i.e., 3 months prior. A stronger research design would have tested prospective, longitudinal associations over a longer period (i.e., 1 year). Another limitation is that it was not possible to assess predictors of initiation of risk-taking behavior to ascertain whether predictors of continuance versus initiation of risk-taking behavior differ. This would have been a valuable research question to address, but initiation of risk-taking behavior was not assessed because the risk-taking behavior outcome measure only assessed risk-taking engaged in over the past three months, rather than over the lifespan. Few participants reported initiation from time 1 to time 2 (i.e., did not endorse risk-taking at time 1, but endorsed risk-taking at time 2) in the present study and this research question was not able to be addressed. The final limitation is in regard to the age range of participants. Participants varied in age from 18 – 52, and this age range is not exclusive to the late adolescent population of interest. However, analyses were conducted controlling for age and results were not substantively different.

Conclusion

In conclusion, and despite these limitations, this study provides evidence supporting the use of dual process models for explaining concurrent risk-taking, both averaged across forms and looking at each specific form. The reasoned decision-making process was more predictive of risk-taking behavior than the reactive decision-making process, as the reasoned but not reactive decision-making process significantly explained longitudinal risk-taking. The reasoned and reactive decision-making processes appear to operate through similar pathways, as evidenced by

the components of the Theory of Planned Behavior exhibiting significant indirect effects through the reactive pathway, willingness, and the components of the Prototype Willingness model exhibiting significant indirect effects through the reasoned pathway, behavioral intentions. Impulsivity was linked with higher levels of risk-taking through more willingness and more behavioral intentions. Self-control was linked with lower levels of risk-taking through less behavioral intentions. This study demonstrates the importance of altering decision-making processes to reduce risk-taking behavior, as well as considering decision-making processes averaged across forms of risk-taking and by each form of risk-taking.

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Appendix B

University Committee for the Protection of Human Subjects in Research
University of New Orleans

Campus Correspondence

Principal Investigator:	Robert Laird
Co-Investigator:	Emily Kuhn
Date:	August 15, 2012
Protocol Title:	"Decision-making, impulsivity and self-control: Between-person and within-person predictors of risk-taking behavior"
IRB#:	02Aug12

The IRB has deemed that the research and procedures are compliant with the University of Ne w Orleans and federal guidelines. The above referenced human subjects protocol has been reviewed and approved using expedited procedures (under 45 CFR 46.116(a) category (7).

Approval is only valid for one year from the approval date. Any changes to the procedures or protocols must be reviewed and approved by the IRB prior to implementation. Use the IRB number listed on this letter in all future correspondence regarding this proposal.

If an adverse, unforeseen event occurs (e.g., physical, social, or emotional harm), you are required to inform the IRB as soon as possible after the event.

Best wishes on your project!

Sincerely,

Pamela Jenkins, Ph.D.
UNO Committee for the Protection of Human Subjects in Research

Appendix B

Please fill out the survey by marking the appropriate bubble or by writing in your answer. You may mark your answers like this □ or like this □. You may use a pen or pencil. You do not have to completely fill in the bubble, but try to keep your marks from touching other bubbles.

Take a moment to think about people your age who smoke cigarettes. We are not thinking about anyone in particular, just your image of people your age who smoke cigarettes.	Not at all	A little bit	Somewhat	Very
How popular are people who smoke cigarettes?	□	□	□	□
How careless are people who smoke cigarettes?	□	□	□	□
How smart are people who smoke cigarettes?	□	□	□	□
How cool are people who smoke cigarettes?	□	□	□	□
How attractive are people who smoke cigarettes?	□	□	□	□
How boring are people who smoke cigarettes?	□	□	□	□

Take a moment to think about people your age who drive over the speed limit. We are not thinking about anyone in particular, just your image of people your age who drive over the speed limit.	Not at all	A little bit	Somewhat	Very
How careless are people who drive over the speed limit?	□	□	□	□
How popular are people who drive over the speed limit?	□	□	□	□
How boring are people who drive over the speed limit?	□	□	□	□
How cool are people who drive over the speed limit?	□	□	□	□
How attractive are people who drive over the speed limit?	□	□	□	□
How smart are people who drive over the speed limit?	□	□	□	□

How bad or good do you consider each of the following:	Very bad	A little bad	Not good or bad	A little good	Very good

How bad or good do you consider each of the following:	Very bad	A little bad	Not good or bad	A little good	Very good
Doing something illegal	☐	☐	☐	☐	☐
Getting drunk	☐	☐	☐	☐	☐
Having sex with someone you do not know well	☐	☐	☐	☐	☐
Driving a car after drinking alcohol	☐	☐	☐	☐	☐
Vandalizing property	☐	☐	☐	☐	☐
Driving over the speed limit	☐	☐	☐	☐	☐
Having sex outside of a committed relationship	☐	☐	☐	☐	☐
Using illegal drugs	☐	☐	☐	☐	☐
Texting on a cell phone while you are driving	☐	☐	☐	☐	☐
Smoking cigarettes	☐	☐	☐	☐	☐
Stealing something	☐	☐	☐	☐	☐
Having sex without a condom	☐	☐	☐	☐	☐

Take a moment to think about people your age who do illegal things. We are not thinking about anyone in particular, just your image of people your age who do illegal things.	Not at all	A little bit	Somewhat	Very
How smart are people who do illegal things?	☐	☐	☐	☐
How cool are people who do illegal things?	☐	☐	☐	☐
How popular are people who do illegal things?	☐	☐	☐	☐
How careless are people who do illegal things?	☐	☐	☐	☐
How boring are people who do illegal things?	☐	☐	☐	☐
How attractive are people who do illegal things?	☐	☐	☐	☐

Take a moment to think about people your age who get drunk. We are not thinking about anyone in particular, just your image of people your age who get drunk.	Not at all	A little bit	Somewhat	Very

How popular are people who get drunk?	☐	☐	☐	☐
How smart are people who get drunk?	☐	☐	☐	☐
How cool are people who get drunk?	☐	☐	☐	☐
How careless are people who get drunk?	☐	☐	☐	☐
How boring are people who get drunk?	☐	☐	☐	☐
How attractive are people who get drunk?	☐	☐	☐	☐

	Strongly disapprove	Disapprove	Neither approve nor	Approve	Strongly approve
What would be the reactions of the people who are important to you if they saw you having sex without a condom?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you smoking cigarettes?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you stealing something?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you having sex with someone you do not know well?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you vandalizing property?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you texting on a cell phone while you are driving?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you driving over the speed limit?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you doing something illegal?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you driving a car after drinking alcohol?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you using illegal drugs?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you having sex outside of a committed relationship?	☐	☐	☐	☐	☐
What would be the reactions of the people who are important to you if they saw you getting drunk?	☐	☐	☐	☐	☐

Take a moment to think about people your age who have sex outside of a committed relationship. We are not thinking about anyone in particular, just your image of people your age who have sex outside of a committed relationship.	Not at all	A little bit	Somewhat	Very
How attractive are people who have sex outside of a committed relationship?	☐	☐	☐	☐
How cool are people who have sex outside of a committed relationship?	☐	☐	☐	☐
How smart are people who have sex outside of a committed relationship?	☐	☐	☐	☐
How careless are people who have sex outside of a committed relationship?	☐	☐	☐	☐
How popular are people who have sex outside of a committed relationship?	☐	☐	☐	☐
How boring are people who have sex outside of a committed relationship?	☐	☐	☐	☐

	Very difficult	Mostly difficult	Not difficult or easy	Mostly easy	Very easy
How easy is it to drive over the speed limit?	☐	☐	☐	☐	☐
How easy is it to do something illegal?	☐	☐	☐	☐	☐
How easy is it to have sex with someone you do not know well?	☐	☐	☐	☐	☐
How easy is it to have sex without a condom?	☐	☐	☐	☐	☐
How easy is it to steal something?	☐	☐	☐	☐	☐
How easy is it to get drunk?	☐	☐	☐	☐	☐
How easy is it to text on a cell phone while you are driving?	☐	☐	☐	☐	☐
How easy is it to drive a car after drinking alcohol?	☐	☐	☐	☐	☐
How easy is it to vandalize property?	☐	☐	☐	☐	☐
How easy is it to smoke cigarettes?	☐	☐	☐	☐	☐
How easy is it to have sex outside of a committed relationship?	☐	☐	☐	☐	☐
How easy is it to use illegal drugs?	☐	☐	☐	☐	☐

Take a moment to think about people your age who steal. We are not thinking about anyone in particular, just your image of people your age who steal.	Not at all	A little bit	Somewhat	Very
How popular are people who steal?	☐	☐	☐	☐
How cool are people who steal?	☐	☐	☐	☐
How smart are people who steal?	☐	☐	☐	☐
How careless are people who steal?	☐	☐	☐	☐
How boring are people who steal?	☐	☐	☐	☐
How attractive are people who steal?	☐	☐	☐	☐

	Not at all likely	A little bit likely	Somewhat likely	Very likely
How likely do you think it is that you will drive over the speed limit one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will get drunk one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will have sex outside of a committed relationship one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will smoke cigarettes one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will vandalize property one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will have sex without a condom one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will have sex with someone you do not know well one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will text on a cell phone while you are driving one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will steal something one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will drive a car after drinking alcohol one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will do something illegal one or more times in the next three months?	☐	☐	☐	☐
How likely do you think it is that you will use illegal drugs one or more times in the next three months?	☐	☐	☐	☐

Take a moment to think about people your age who text on a cell phone while driving. We are not thinking about anyone in particular, just your image of people your age who text on a cell phone while driving.	Not at all	A little bit	Somewhat	Very
How popular are people who text on a cell phone while driving?	☐	☐	☐	☐
How smart are people who text on a cell phone while driving?	☐	☐	☐	☐
How attractive are people who text on a cell phone while driving?	☐	☐	☐	☐
How cool are people who text on a cell phone while driving?	☐	☐	☐	☐
How carless are people who text on a cell phone while driving?	☐	☐	☐	☐
How boring are people who text on a cell phone while driving?	☐	☐	☐	☐

Take a moment to think about people your age who drive a car after drinking alcohol. We are not thinking about anyone in particular, just your image of people your age who drive a car after drinking alcohol.	Not at all	A little bit	Somewhat	Very
How boring are people who drive a car after drinking alcohol?	☐	☐	☐	☐
How cool are people who drive a car after drinking alcohol?	☐	☐	☐	☐
How attractive are people who drive a car after drinking alcohol?	☐	☐	☐	☐
How smart are people who drive a car after drinking alcohol?	☐	☐	☐	☐
How careless are people drive a car after drinking alcohol?	☐	☐	☐	☐
How popular are people who drive a car after drinking alcohol?	☐	☐	☐	☐

	Not at all willing	A little bit willing	Somewhat willing	Very willing
How willing are you to drive over the speed limit one or more times during the next three months?	☐	☐	☐	☐
How willing are you to have sex without a condom one or more times during the next three months?	☐	☐	☐	☐
How willing are you to text on a cell phone while you are driving one or more times during the next three months?	☐	☐	☐	☐
How willing are you to steal something one or more times during the next three months?	☐	☐	☐	☐
How willing are you to smoke cigarettes one or more times during the next three months?	☐	☐	☐	☐
How willing are you to have sex with someone you do not know well one or more times during the next three months?	☐	☐	☐	☐
How willing are you to drive a car after drinking alcohol one or more times during the next three months?	☐	☐	☐	☐
How willing are you to get drunk one or more times during the next three months?	☐	☐	☐	☐
How willing are you to use illegal drugs one or more times during the next three months?	☐	☐	☐	☐
How willing are you to do something illegal or more times during the next three months?	☐	☐	☐	☐
How willing are you to have sex outside of a committed relationship one or more times during the next three months?	☐	☐	☐	☐

	Not at all willing	A little bit willing	Somewhat willing	Very willing
How willing are you to vandalize property one or more times during the next three months?	☐	☐	☐	☐

Take a moment to think about people your age who have sex with someone they do not know well. We are not thinking about anyone in particular, just your image of people your age who have sex with someone they do not know well.	Not at all	A little bit	Somewhat	Very
How popular are people who have sex with someone they do not know well?	☐	☐	☐	☐
How careless are people who have sex with someone they do not know well?	☐	☐	☐	☐
How smart are people who have sex with someone they do not know well?	☐	☐	☐	☐
How cool are people who have sex with someone they do not know well?	☐	☐	☐	☐
How attractive are people who have sex with someone they do not know well?	☐	☐	☐	☐
How boring are people who have sex with someone they do not know well?	☐	☐	☐	☐

Take a moment to think about people your age who have sex without a condom. We are not thinking about anyone in particular, just your image of people your age who have sex without a condom.	Not at all	A little bit	Somewhat	Very
How cool are people who have sex without a condom?	☐	☐	☐	☐
How boring are people who have sex without a condom?	☐	☐	☐	☐
How attractive are people who have sex without a condom?	☐	☐	☐	☐
How popular are people who have sex without a condom?	☐	☐	☐	☐
How smart are people who have sex without a condom?	☐	☐	☐	☐
How careless are people who have sex without a condom?	☐	☐	☐	☐

People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement and put an X on the appropriate circle on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly.	Rarely/Never	Occasionally	Often	Almost Always/Always
I do things without thinking.	☐	☐	☐	☐
I make-up my mind quickly.	☐	☐	☐	☐
I am happy-go-lucky.	☐	☐	☐	☐
I act "on impulse."	☐	☐	☐	☐
I act on the spur of the moment.	☐	☐	☐	☐
I buy things on impulse.	☐	☐	☐	☐
I spend or charge more than I earn.	☐	☐	☐	☐

Take a moment to think about people your age who use illegal drugs. We are not thinking about anyone in particular, just your image of people your age who use illegal drugs.	Not at all	A little bit	Somewhat	Very
How boring are people who use illegal drugs?	☐	☐	☐	☐
How careless are people who use illegal drugs?	☐	☐	☐	☐
How attractive are people who use illegal drugs?	☐	☐	☐	☐
How cool are people who use illegal drugs?	☐	☐	☐	☐
How smart are people who use illegal drugs?	☐	☐	☐	☐
How popular are people who use illegal drugs?	☐	☐	☐	☐

How much do you agree with each statement?	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I am lazy.	☐	☐	☐	☐	☐
I have a hard time breaking bad habits.	☐	☐	☐	☐	☐

I wish I had more self-discipline.	□	□	□	□	□
I have trouble concentrating.	□	□	□	□	□
I change my mind fairly often.	□	□	□	□	□
Sometimes, I can't stop myself from doing something, even if I know it is wrong	□	□	□	□	□
I have trouble saying "no."	□	□	□	□	□
I get carried away by my feelings.	□	□	□	□	□
I am good at resisting temptation.	□	□	□	□	□
I am able to work effectively toward long term-goals.	□	□	□	□	□
I am easily discouraged.	□	□	□	□	□

On how many days in the last 3 months have you…	0 times	1 time	2 to 3 times	4 to 5 times	6 to 10 times	11 to 20 times	20 + times
Gotten drunk?	☐	☐	☐	☐	☐	☐	☐
Had sex without a condom?	☐	☐	☐	☐	☐	☐	☐
Texted on a cell phone while you were driving?	☐	☐	☐	☐	☐	☐	☐
Done something illegal?	☐	☐	☐	☐	☐	☐	☐
Smoked cigarettes?	☐	☐	☐	☐	☐	☐	☐
Driven over the speed limit?	☐	☐	☐	☐	☐	☐	☐
Driven a car after drinking alcohol?	☐	☐	☐	☐	☐	☐	☐
Vandalized property?	☐	☐	☐	☐	☐	☐	☐
Used illegal drugs?	☐	☐	☐	☐	☐	☐	☐
Stolen something?	☐	☐	☐	☐	☐	☐	☐
Had sex outside of a committed relationship?	☐	☐	☐	☐	☐	☐	☐
Had sex with someone you do not know well?	☐	☐	☐	☐	☐	☐	☐

Take a moment to think about people your age who vandalize property. We are not thinking about anyone in particular, just your image of people your age who vandalize property.	Not at all	A little bit	Somewhat	Very
How boring are people who vandalize property?	☐	☐	☐	☐
How careless are people who vandalize property?	☐	☐	☐	☐
How popular are people who vandalize property?	☐	☐	☐	☐
How attractive are people who vandalize property?	☐	☐	☐	☐
How cool are people who vandalize property?	☐	☐	☐	☐
How smart are people who vandalize property?	☐	☐	☐	☐

Finally, we need some basic information about you and your family. Please remember that only researchers will see these questionnaires, and that your responses will be kept confidential.

1. **What is your age? _____**

2. **What is your sex?**

   □□Male □ Female

3. **What is the highest level of school your mother completed?**

   □ Less than 7th grade □ 10th or 11th grade □ College degree

   □ 7th or 8th grade □ High school□ □ Graduate degree

   □ 9th grade □ Some college or trade or technical school

4. **Please indicate your own racial background. (Multiple answers are ok.)**

   □ American Indian □ Hispanic/Spanish/Latino

   □ Asian or Pacific Islander □ White

   □ African American (Black) □ Other

5. **What is your current relationship status?**

   □ Single (i.e., not in a committed relationship) □ Separated

   □ In a committed relationship (e.g., dating, engaged, etc.) □ Divorced□

   □ Married □ Widowed

6. **Are you taking medications to treat anxiety, depression, attention problems (i.e., ADHD) or any other mental problems?**

   □ No

   □ Yes

Please list:

_____

_____

7. **Do you have children?**

- □ No
- □ Yes, but they do not live with me
- □ Yes, and they live with me

Thank you for participating in the **Risk-taking Behavior Project.**

Vita

Emily S. Kuhn graduated with a B.S. in Psychology in 2009 from the University of New Orleans. She earned a M.S. in Applied Developmental Psychology in 2011 under the supervision of Dr. Robert Laird.