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Planned Versus Unplanned Risks: Evidence for Subtypes of Risk Behavior in Adolescence

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Abstract

Risk behavior escalates during adolescence, contributing to substantial morbidity and mortality. This study examined whether individual differences in personality and neurocognitive function previously shown to be associated with overall frequency of risk behavior are differentially related to two proposed subtypes of adolescent risk behavior: planned and unplanned. Adolescents (N = 69, 49% male, M = 15.1 years, SD = 1.0), completed a battery of self-report measures and neurocognitive tasks. Several personality and neurocognitive variables predicted membership in the planned versus unplanned risk group: perceiving the benefits of risk behaviors to outweigh risks, more accurately identifying beneficial choices in a modified Iowa Gambling Task (IGT), and performing more advantageously on the IGT and the Game of Dice Task. This study supports the hypothesis that planned versus unplanned risk behavior comprise distinct subtypes in adolescence. Understanding the mechanisms underlying these subtypes may inform prevention programs targeting specific contributors to adolescent risk behavior.

Risk behavior during adolescence contributes to the leading causes of morbidity and mortality during this developmental period (Sells & Blum, 1996). Risk behavior is defined to include any behavior that jeopardizes health or well being of the self or another, either through immediate risk of physical harm or by violating rules or norms established to prevent this harm. 71% of deaths among 10- to 24-year-olds are due to risk-related outcomes such as motor vehicle crashes, accidental injury, homicide, and suicide (National Center for Chronic Disease Prevention and Health Promotion, 2006). Research to date has generally treated risk behavior as a singular construct (e.g., Jessor, 1991). However, given that the term “risk behavior” can include any number of behaviors, and considering the heterogeneity of the adolescent experience, it is likely that risk behavior is a multidimensional construct (Gibbons, Gerrard, Blanton, & Russell, 1998; Reyna & Farley, 2006). The current study proposes and tests a distinction between risk behavior that is planned and that which is unplanned.

Past research has revealed a set of individual differences that predict the frequency of adolescents’ risk behavior, including impulsivity (Zuckerman, 1994), sensation seeking (Horvath & Zuckerman, 1993; Rolison & Scherman, 2002), perceived benefits of risk behavior (Fromme, Katz, & Rivet, 1997), and decision making as measured by neurocognitive task performance (Lejuez, Aklin, Daughters, Zvolensky, Kahler, & Gwadz, 2007). Impulsivity, the tendency to react to the immediate environment with little deliberation before action, is positively related to risk behavior (Zuckerman, 1994). In risky situations, impulsivity may lead one to engage in a behavior before thinking through its potential consequences. Further, positive mood can enhance impulsivity and increase its relationship to risk behavior (Cyders, Smith, Spillane, Fischer, Annus, & Peterson, 2007).

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This may be particularly relevant given the heightened affective salience of situations in which risk behavior often occurs during adolescence. Although adolescents show advanced reasoning skills in hypothetical or neutral situations, real-world risky situations are neither hypothetical nor emotionally neutral (Keating, 2004). In the heat of the moment, failure to inhibit an impulsive response may lead to impulsive decisions and engagement in risk behavior (Steinberg, 2003).

A second personality characteristic that positively relates to risk behavior is sensation seeking (Roberti, 2004; Zuckerman & Kuhlman, 2000). Zuckerman (1994) defines sensation seeking as “the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experiences” (p.27). In adolescents, sensation seeking has been found to be both a concurrent and prospective predictor of engagement in risk behavior. In two large, longitudinal samples, sensation seeking was related to initial rate of smoking, alcohol use, and marijuana use during middle school and to rate of increase in these behaviors through high school (Crawford, Pentz, Chou, Li, & Dwyer, 2003). One potential mechanism by which sensation seeking relates to risk behavior is offered by Romer and Hennessy (2007). They suggest that a biologically-driven increase in sensation seeking during adolescence leads to more positive affective evaluation of the benefits of risk behavior and a subsequent increase in participation in the behavior. This relationship seems plausible in light of recent research that has shown perceptions of benefits of a behavior to be a strong predictor of engagement in that behavior (Fromme et al., 1997; Parsons, Siegl, & Cousins, 1997).

Some previous research has suggested that high rates of risk behavior are due to adolescents’ underestimation of the risks associated with these behaviors (Arnett, 2000; Romer & Jamieson, 2001). However, several studies have demonstrated that adolescents judge the risks of their behavior relatively accurately (Ellen, Boyer, Tschann, & Shafer, 1996; Johnson, McCaul, & Klein, 2002; Parsons, Halkitis, Bimbi, & Borkowski, 2000). Importantly, those adolescents who were most involved in risk behavior rated their likelihood of negative consequences highest, indicating an appreciation of the relative risks involved (Ellen et al., 1996; Fromme et al., 1997).

Although adolescents can demonstrate an accurate understanding of the risks involved in many behaviors, several studies have found that perceived riskiness of a behavior is not related to whether or not individuals engage in it. Instead, perceived benefits of a behavior are more reliably associated with engagement in that risk behavior. In a sample of college students, having unprotected sex was predicted only by its perceived benefits, not by its perceived risks (Parsons et al., 2000). In a short-term longitudinal study, the perceived benefits of risk behaviors, including substance use, unprotected sexual behavior, and dangerous activities, predicted whether or not adolescent participants had engaged in those same behaviors three months later (Parsons et al., 1997). Thus, in adolescence, it appears that the extent to which behaviors are perceived as rewarding is more predictive of the likelihood of engaging in the behavior than the risks perceived to be involved.

In addition to self-report measures of risk perception and consequent decision making, neurocognitive tasks are also commonly used to assess these characteristics. Decision making in some such tasks, wherein participants choose among various risky and non-risky alternatives to earn a reward, has been found to predict real-life risk behavior. One task commonly used to assess risk preference and decision making is the Iowa Gambling Task (IGT). The IGT involves choosing between low and high risk decks of cards to gain monetary reward. This task measures the participant's ability to analyze costs and benefits and defer immediate gratification for long-term gain (Bechara, Damasio, Damasio, & Anderson, 1994). In adults, preference for high risk decks is correlated with risk behavior in

day to day life, including substance use and abuse (Bechara & Damasio, 2002) and pathological gambling (Cavedini, Riboldi, Keller, D'Annucci, & Bellodi, 2002). The IGT has been also been used as a measure of risk preference and sensitivity to probability of reward versus punishment in adolescents. Although there is an overall developmental trend of improved performance with age on this task (Crone & van der Molen, 2004) there is also substantial within-age variability that is not explained by other cognitive measures such as working memory and IQ (Hooper, Luciana, Conklin, & Yarger, 2004). Such variability in individual neurocognitive characteristics may manifest as individual differences in risk behavior, such as alcohol use (Spear, 2000).

The measures of individual differences in personality and neurocognition described here have previously been studied as predictors of risk behavior. Typically, in prior studies, the dependent variable was frequency of risk behavior, with an implicit assumption that risk behavior is a unitary phenomenon. As suggested above, this unitary assumption is not warranted given the wide range of behaviors, circumstances, motivations, and individual differences that can be subsumed under the term “risk behavior”. Much of the focus on individual differences in risk behavior has been on the frequency of involvement; it is likely that there are also individual differences in the types of risk behavior and their associated personality and cognitive processes.

Reyna & Farley (2006) proposed that adolescent risk behavior is not one general phenomenon but is instead better described by two subtypes. The first type, which they term reasoned risk, is described as the product of deliberately trading off risks and benefits, with benefits given greater weight than risks in decision making. This type of risk behavior is thought to be driven by sensation seeking and purposeful choice of behaviors known to be risky. The second type, termed reactive risk, is described as a nondeliberative reaction to the situational and emotional aspects of the immediate environment. This type of risk behavior occurs as an in-the-moment reaction when one did not seek out the opportunity beforehand. A key distinction between these two subtypes is whether or not the risk behavior was planned. Thus, in the current study, reasoned risk behavior is defined as that which is planned, and reactive risk is defined as that which is unplanned, based on self-reports. The mechanisms underlying each subtype and the possible sequelae of these subtypes of risk appear to be distinct, but no known study has attempted to empirically differentiate these two subtypes of risk behavior.

Research to date has revealed select personality and neurocognitive measures that predict frequency of risk behavior. A logical extension of this research is to test whether these established predictors are differentially related to planned versus unplanned risk. The current study takes this next step by differentiating between risk behavior that entailed prior planning versus that which was unplanned and by testing whether separate characteristics predict these behaviors. The primary research question addressed is: To what extent are two types of adolescent risk behavior, planned and unplanned, differentially predicted by personality, attitude, and neurocognitive measures? Of particular importance, we employed a multi-modal approach to assessing the predictors of risk behavior, important for guarding against self-report measurement bias and covariation as well as for providing a more comprehensive picture of the net of influences surrounding risk behaviors.

Four hypotheses were formulated and tested. First, we hypothesized that weighing the benefits of risk behavior more heavily than its risks would be related to increased odds of membership in the planned risk group. Second, we hypothesized that more accurate identification of risk probability and more advantageous performance on neurocognitive tasks would be associated with increased odds of membership in the planned risk behavior group. Third, we hypothesized that higher levels of impulsivity would be related to

increased odds of membership in the unplanned risk behavior group. Finally, we hypothesized that higher levels of sensation seeking would be related to increased odds of membership in the planned risk behavior group.

Method

Sample and Procedure

Adolescent participants were recruited from the community using newspaper advertisements and flyers posted in community settings. Informed consent to participate in the study was obtained from a parent or guardian, and assent was obtained from all participants. Participants were paid $30 for their participation in one three-hour session in the laboratory. In addition, they were given the opportunity to earn up to $10 in bonuses on each of two neurocognitive tasks. A total of 69 adolescents participated in the study. Table 1 summarizes the sample characteristics.

Measures

Table 2 contains a summary of the self-report measures used in this study. Neurocognitive tasks are described below. All neurocognitive tasks and self-report measures were administered on a desktop computer. Self report measures were administered using Medialab software (Jarvis, 2002).

Risk behavior—Participants were asked how many times in the past year they had engaged in each of nine risk behaviors: smoking cigarettes, drinking alcohol, using marijuana, using drugs besides marijuana, physical fighting, skipping school, stealing, risking serious injury to self, and having unprotected sex. These items were adapted from the Monitoring the Future study (Johnston, O'Malley, Bachman, & Schulenberg, 2008) where they have been used for several decades in annual, national surveys of adolescent substance use and related behaviors. Frequency of risk behavior was calculated by summing the responses to each of the nine behaviors.

Percentage planned risk behavior—For each risk behavior in which participants reported they had participated at least once in the past year, they were asked, “When you have [done behavior], what proportion of the time did you plan on doing it beforehand, and what proportion of the time was it unplanned?” This item was devised for the purpose of this study and was based on Reyna and Farley's (2006) distinction between reasoned and reactive risk behaviors, which emphasizes whether or not the behavior was planned as a key difference between these proposed subtypes of behavior. This item shows face validity in representing proportion of risk behavior that was planned. Additionally, although participants were permitted to ask for clarification on items if needed, no participant expressed difficulty understanding the content or intention of this item. The value corresponding to percentage planned was extracted from the item response. For example, if a participant indicated that on the occasions when he had smoked cigarettes in the past year, the behavior was planned 75% of the time and unplanned 25% of the time, the value of 0.75 was assigned to that behavior. Overall percentage planned was calculated as the average percentage planned for all behaviors in which each participant had engaged in the past year.

IQ—The Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999) was used to estimate IQ. This brief measure of intelligence estimates full scale IQ and has been normed for ages 6 through 89. The two-subtest format of Vocabulary and Matrix Reasoning was administered. This format correlates .81 and .87 respectively with the Wechsler Intelligence Scale for Children-III and Wechsler Adult Intelligence Scale-III full scale IQs (Wechsler, 1999).

Sensation seeking—The Brief Sensation Seeking Scale (BSSS; Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002), an eight-item short form of the Sensation Seeking Scale-V (Zuckerman, 1994), was used to measure sensation seeking. The BSSS was developed specifically for use with adolescents, and it shows high internal reliability across age, gender, and ethnicity in adolescents (Hoyle et al., 2002). Example items include "I would like to explore strange places" and "I prefer friends who are excitingly unpredictable". In the current study, internal reliability of the BSSS was high, α = .83.

Impulsivity—The Barratt Impulsiveness Scale—15 Item (Spinella, 2007), a short form of the Barratt Impulsiveness Scale (BIS; Barratt & Patton, 1983), was used to measure impulsivity. This short form correlates highly with the original BIS. Its convergent validity was supported by a significant correlation with the Frontal Systems Behavior Scale (Grace & Malloy, 2001), which measures neurobehavioral traits associated with cognitive control. Example items include "I act on the spur of the moment" and "I plan tasks carefully". Items were reverse coded as necessary, such that a higher score reflected higher levels of impulsivity. The mean of the fifteen items was used in analysis. Internal reliability in the current study was moderate, α = .57

Peer pressure—A single item was used to measure peer pressure for each of the nine risk behaviors: "How much pressure do you feel from your friends and schoolmates to do [behavior]?". This item was also adapted from the Monitoring the Future Study (Johnston et al., 2008). The mean of the nine responses was calculated to yield the scale score used in analysis. Internal reliability in the current study was high, α = .89.

Benefits versus risks—The benefits versus risks subscale of the Benthin Risk Perception Measure (Benthin, Slovic, & Severson, 1993) was used to measure participants' view of the relative benefits and risks associated with each behavior. In previous studies, this subscale showed good internal reliability and strong relationships to risk behavior (Gardner & Steinberg, 2005; Magar, Phillips, & Hosie, 2008). For each of the nine risk behaviors, participants were asked, "How much do the benefits or pleasures of [behavior] outweigh the risks of doing it?" The mean of the nine responses was used in analysis. Internal reliability in the current study was moderate, α = .67.

Iowa Gambling Task—The Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994) was used to measure risk preference and risk identification. The version of the task used here is a modified version of the original (Tanabe, Thompson, Claus, Dalwani, Hutchinson, & Banich, 2007). In the original IGT, individuals attempt to earn money by selectively playing from four decks of cards associated with unknown probabilities of win or loss. Favoring disadvantageous decks is interpreted as preferential treatment of immediate gains over long term losses (Bechara, 2003). The version of the IGT used in the current study was modified to increase its developmental appropriateness for use with adolescents. In this version, decks were presented one at a time. The participants chose whether to play or pass on each deck, rather than having the option to play from any deck on each turn, eliminating differential search strategy as a confounding variable in task performance. In addition, at three points during the task, participants were asked to rate each of the four decks as good or bad, indicating whether the participant felt he or she won or lost money overall when playing it. Thus, this version of the task gathers two types information, an indicator of the participant's ability to judge the relative probabilities of benefit or loss associated with each deck and his or her behavioral choice under conditions of uncertainty and risk evaluation.

The task was presented using Eprime software (Psychological Software Tools, Pittsburgh, PA). It consisted of 120 trials divided into 3 blocks of 40 trials each. Participants were told that some decks were good and some decks were bad, and they should try to maximize the amount of money they won by playing more from good decks and less from bad decks. For both neurocognitive tasks, participants were told that the amount of money won during the task would determine the amount of the bonus they received at the end of the study. Number of decks correctly identified as good or bad and number of plays from the objectively good (advantageous) decks were computed.

Game of Dice Task—The Game of Dice Task (GDT; Brand, Fujiwara, Borsutzky, Kalbe, Kessler, & Markowitsch, 2005) was used to measure risk preference when probability of gain or loss is explicitly stated. As in the IGT, participants were instructed to try to maximize their winnings. Unlike the IGT, the probability of winning and the amount to be won or lost that is associated with each choice were presented explicitly throughout the GDT. The GDT showed convergent validity with other neuropsychological assessments of decision-making such as the Wisconsin Card Sorting Task in a sample of alcoholic subjects (Brand et al., 2005). In a sample of healthy participants, performance on the GDT was positively correlated with performance on the later trials of the IGT, in which the probabilities of gain and loss have become known to the participant, as they are known throughout the GDT (Brand, Recknor, Grabenhorst, & Bechara, 2007).

Figure 1 shows the task as it was presented on the computer screen. A single die and a shaker were presented, and participants were informed that they would have eighteen throws of the die. Before each throw, participants chose a combination of one to four digits between one and six, representing the six faces of the die. If the number rolled matched one of the numbers chosen, participants won the amount of money associated with the chosen number of digits. If the number did not match, participants lost that amount. Both the probability of winning or losing and the amount of money that could be won or lost were present on the screen throughout the task. The amount of potential gain or loss was inversely related to the probability of winning, with highest gain/loss associated with lowest probability of winning. Playing one or two digits (which are associated with less than 50% probability of winning and high gains/high losses) was coded as a risky play; playing three or four digits was coded as a safe play. The results of the throws were pseudorandomized, with each of the six possible numbers occurring three times during the task. The variable used in the analysis was the number of safe plays made.

Results

Data were analyzed using logistic regression to predict membership in dichotomous outcome categories of planned and unplanned risk behavior and high and low frequency risk behavior. To account for different scales of measurement, all continuous predictor variables were standardized ($M = 0$, $SD = 1$). Two sets of analyses were performed. The first set of analyses predicted membership in the planned versus unplanned risk behavior groups. To address whether planned and unplanned risk behaviors were distinct from frequency of risk behavior, the second set of analyses predicted membership in the high versus low frequency risk behavior groups. Table 3 contains the correlations among the variables.

The participants included in the analyses were those who reported that they had engaged in at least one of the measured risk behaviors in the past 12 months ($N = 55$). Those participants who reported that they had not engaged in any risk behavior were excluded because they did not provide any data for the follow-up question regarding how often their risk behavior was planned versus unplanned. Excluded participants did not differ from those in the analysis sample in regards to gender ($\chi^2(1) = 0.29$, $p > .05$), age ($t(67) = -0.36$, $p >$.

05) race ($\chi^2(5) = 11.08$, $p > .05$), IQ ($t(67) = -0.49$, $p > .05$), or parental education level (father's education level: $\chi^2(3) = 1.86$, $p > .05$; mother's education level: $\chi^2(3) = 2.67$, $p > .05$).

Frequency of engagement in risk behaviors was calculated by summing the responses to each of the nine risk behaviors. Participants in this sample reported engaging in moderate levels of risk behavior. On average, they engaged in approximately nine occasions of risk behavior in the past twelve months ($M = 9.36$, $SD = 10.45$, median = 6.0). Percentage planned was calculated as the mean percentage planned of all risk behaviors in which the participant had participated in the past year. On average, participants reported that their engagement in risk behavior was planned 34% of the time ($M = 0.34$, $SD = .24$, median = 0.33).

To form dichotomous outcome groups of planned versus unplanned risk behavior and high versus low frequency risk behavior, a median split was performed on each variable. Those at or above the median for percentage planned risk behavior were placed in the planned risk behavior group, and those below the median were placed in the unplanned risk behavior group[1]. Likewise, those at or above the median for frequency of risk behavior were placed in the high frequency risk behavior group, and those below the median were placed in the low frequency risk behavior group.

Although dichotomization of continuous variables has been criticized, these criticisms generally refer to dichotomization of predictor variables (e.g., MacCallum, Zhang, Preacher, & Rucker, 2002). Farrington & Loeber (2000) described the associated benefits of dichotomization of outcome variables, particularly in psychiatric and criminological research, where the results have clear implications for practice. They demonstrated that logistic and OLS regression analyses led to comparable conclusions about the relationship of predictor variables to the outcome of interest. In addition, dichotomous outcome variables produce results that are easily understandable to a wide audience. For these reasons, we chose to describe the outcome variables in this study as dichotomous categories.

Planned versus unplanned risk behavior

Bivariate analyses were conducted to determine the individual relationships between each independent variable and membership in planned versus unplanned risk group. The bivariate relationships of gender, age, and IQ to planned versus unplanned risk behavior group membership were not significant. In addition, the overall frequency of risk behavior was not associated with membership in one risk group over the other, indicating that planned and unplanned risk behavior may represent a separate construct from frequency of risk behavior. Impulsivity, perceived benefits versus risks of the behavior, more decks correctly identified as good or bad in the IGT, and more advantageous choices made in the GDT predicted significantly greater likelihood of membership in the planned versus unplanned risk behavior group. The results of these analyses are presented in Table 4.

The multivariate analysis was conducted with a reduced set of predictor variables. Due to the relatively small sample size, only the hypothesized variables and key covariates were used in this model. The test of the overall model against a constant-only model was significant, $\chi^2(8) = 34.17$, $p < .001$, indicating that the predictors, as a set, reliably

[1]A parallel analysis was performed in which the cutoff for membership in the planned risk behavior group was reporting that 50% or more of one's risk behavior had been planned. In this analysis, the pattern of results, both bivariate and multivariate, remained the same as in the current analysis, although some estimates were no longer significant due to smaller sample size in the planned risk behavior group.

distinguished between the planned and unplanned risk behavior groups. Additionally, the amount of variance explained was relatively large, Nagelkerke R^2 = .62 (Nagelkerke, 1991).

Consistent with our hypothesis, rating the benefits of engaging in risk behaviors as outweighing the risks of those behaviors predicted higher odds of membership in the planned group than the unplanned group. It increased the odds of membership in the planned group by nearly 7 to 1, making it the most powerful predictor of group membership. Performance on the two neurocognitive tasks was also significantly predictive of group membership. Correctly identifying more good and bad decks and choosing to play more of the good decks in the IGT were associated with significantly higher odds of membership in the planned risk group. Making more safe choices in the GDT was associated with higher odds of membership in the planned risk group. Impulsivity and sensation seeking were not significant predictors of membership in the planned versus unplanned risk group.

High versus low frequency risk behavior

To further explore the distinction between high and low frequency of risk behavior and planned versus unplanned subtypes, parallel bivariate and multivariate analyses were conducted with high and low frequency risk behavior as the dichotomous outcome. The results of these analyses are presented in Table 5. The bivariate results of this model were comparable to the planned versus unplanned model: sensation seeking, impulsivity, peer pressure, and perceived benefits versus risks of the behavior predicted greater likelihood of membership in the high frequency versus low frequency risk behavior group. The multivariate results, however, were somewhat different. The test of the overall model against a constant-only model was not significant, $\chi^2(8) = 13.78$, $p > .05$, indicating that the predictors, as a set, did not reliably distinguish between the high and low frequency risk behavior groups. In addition, none of the individual predictors was related to the odds of membership in the high versus low frequency risk groups. Finally, Nagelkerke R^2 for this model was moderate, $R^2 = .29$.

Discussion

Previous research has shown that individual differences in personality and neurocognitive characteristics are related to frequency of engagement in risk behavior in everyday life (e.g., Parsons et al., 1997; Verdejo-Garcia, Bechara, Recknor, & Perez-Garcia, 2006; Zuckerman & Kuhlman, 2000). This study examined the distinction between planned and unplanned risk behaviors as subtypes of risk behavior during adolescence. The results revealed a group of personality and neurocognitive predictors related to increased odds of membership in the planned versus unplanned risk behavior group.

The first hypothesis was supported; greater agreement that the benefits of risk behavior outweigh its risks was associated with higher odds of membership in the planned risk group. This is consistent with previous studies that have found perceived benefits to be better predictors of risk behavior than perceived risks (Fromme et al., 1997; Parsons et al., 1997), and it implies that attunement to benefits of behavior may be particularly related to planning one's risk behavior. The second hypothesis was also supported; more advantageous performance on the neurocognitive tasks, as indicated by more decks correctly identified as risky or non-risky in the IGT and more advantageous plays made in both the IGT and the GDT, was associated with higher odds of membership in the planned risk group. Correctly identifying more decks in the IGT may indicate a better ability to gauge the relative risks and benefits of an ambiguous situation. Similarly, playing more from the good decks is consistent with an attunement to the benefits of a situation and an ability to identify beneficial options. Finally, making more safe choices in the GDT, in which the probabilities for gain and loss are explicit, was also predictive of membership in the planned risk group.

This again suggests that seeking benefits and the ability to choose the beneficial option are associated with a greater likelihood of participating in risk behavior that is planned versus unplanned.

The third and fourth hypotheses, that higher impulsivity scores would be associated with greater odds of membership in the unplanned risk group and that higher sensation seeking scores would be associated with greater odds of membership in the planned risk group, were not supported. In the bivariate analyses, both sensation seeking and impulsivity were related to higher odds of membership in the planned risk group. In the multivariate analysis, these variables were not significant predictors. This may indicate that sensation seeking and impulsivity are not differentially associated with planned versus unplanned risk behavior. It is also possible that self report measures are not as sensitive to this distinction as the neurocognitive task variables, which were significant in the multivariate model[2].

It is notable that none of the characteristics that predicted membership in the planned versus unplanned risk behavior groups were predictive of membership in the high frequency versus low frequency risk behavior groups. Similarly, this set of predictors (neurocognitive task performance, perceived benefits versus risks of risk behavior, sensation seeking, impulsivity, peer pressure, and IQ), appeared to explain more variance in predicting planned versus unplanned risk behavior group membership than in high versus low frequency risk behavior group membership. At the very least, this suggests that the variables tested here are more strongly related to subtype than to overall frequency of risk behavior.

In sum, these results reveal a profile of characteristics that predict membership in the planned versus unplanned risk group. While frequency of risk behavior did not predict odds of membership in the planned versus unplanned groups, personality and neurocognitive characteristics did. Weighing benefits more highly than risks and seeking and making choices that appear likely to yield benefits are associated with higher odds of membership in the planned risk group compared to the unplanned risk group. Members of both groups engaged in risk behavior, but the cognitive processes underlying their risk behavior may differ. These results have important implications for future research in the area of adolescent risk behavior. Future studies may consider focusing not only on quantitative aspects of risk behavior, such as how frequently adolescents engage in risk behavior, but on typological distinctions as well, such as what type of behavior they engage in and for what reasons.

This study has several limitations. The primary limitation is the relatively small sample size, which limited both the type of analyses that could be performed and the power to detect possible small effects. This also precluded the examination of predictors of individual risk behaviors; instead, a composite of the nine risk behaviors was examined. It is worth noting, however, that the intensive multi-modal measurement used here, an important advantage of this work, made a larger sample cost prohibitive, reflecting the common trade-off between larger sample sizes and more in-depth measurement. This study is also limited by its cross-sectional design. With this design, the stability of the individual differences in the predictor variables and their relationships to planned and unplanned risk behavior could not be examined.

Despite its limitations, this study offers a promising first look at two distinct subtypes of risk behavior during adolescence, planned and unplanned risk behavior. It is a novel attempt to describe these subtypes and the individual characteristics that relate to them. More work is

[2]To ensure that the nonsignificant effects of impulsivity and sensation seeking in the multivariate model were not attributable to their relatively high correlation, the multivariate analysis was rerun including only one of these variables in the model at a time. In these analyses, as in the full multivariate model, neither variable was significantly related to planned versus unplanned risk behavior.

needed to further investigate the validity and significance of these subtypes. Future studies should use a longitudinal design to examine the stability of risk behavior subtypes and their predictors over time, as well as the potentially distinctive sequelae. For example, the current study highlighted the relationship of perceived benefits of risk behavior to planning to engage in those behaviors. Future research could delineate the benefits adolescents hope to gain specifically from risk behavior that they plan in advance. Once the benefits are described, prevention programs could involve alternative activities that offer similar benefits in less risky settings.

Effective prevention in any arena rarely occurs in the absence of a thorough understanding of the underlying causal mechanisms. Adolescent risk behavior is no exception. Understanding the mechanisms of specific subtypes of risk behavior, planned and unplanned, and the characteristics of the individuals who engage in them is the first step toward effective prevention of the potential negative consequences of risk behavior during adolescence.

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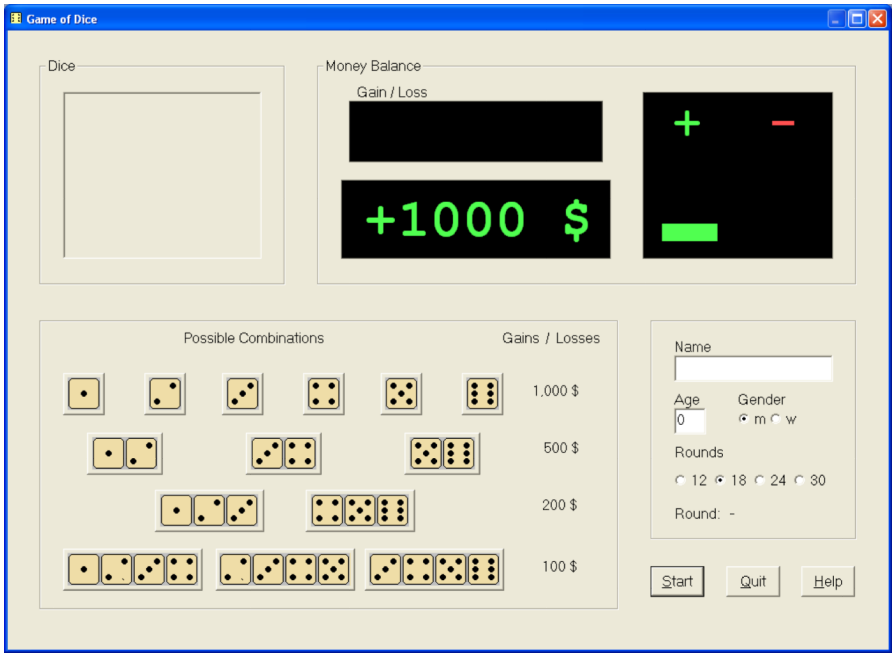

Figure 1.
Game of Dice Task

Table 1

Sample Characteristics

	Full Sample (*N* = 69)	Analysis Sample (*N* = 55)
	M (*SD*)	*M* (*SD*)
Age (years)	15.6 (1.0)	15.6 (1.0)
IQ	111 (12.3)	112 (11.5)
	N (%)	*N* (%)
Gender		
Male	34 (49.3)	28 (50.9)
Female	35 (50.7)	27 (49.1)
Race		
White	44 (63.8)	38 (69.1)
Black	13 (18.8)	9 (16.4)
Hispanic	3 (4.3)	3 (5.4)
Asian-American	3 (4.3)	2 (3.6)
Native American	2 (2.9)	2 (3.6)
Other	4 (5.7)	1 (1.8)
Mother Education		
High School or Less	6 (8.7)	6 (10.9)
Some College	19 (27.5)	14 (25.5)
Four Year College and Beyond	38 (55.1)	31 (56.3)
Missing	6 (8.7)	4 (7.3)
Father Education		
High School or Less	12 (17.4)	9 (16.3)
Some College	12 (17.4)	11 (20.0)
Four Year College and Beyond	39 (56.5)	31 (56.4)
Missing	6 (8.7)	4 (7.3)

Table 2

Description of Self Report Measures

Measure	Scale	# Items	α
Frequency of Risk Behavior	11 point scale, *0* = '*0*' to 10 = '*70+*'	9	.78
Percentage Planned Risk Behavior	5 point scale, 0 = *'0% planned beforehand'* to 1 = *'100% planned beforehand'*	9	-[a]
Sensation Seeking	5 point scale, 1 = '*Strongly disagree*' to 5 = '*Strongly agree*'	8	.83
Impulsivity	4 point scale, 1 = '*Rarely/Never*' to 4 = '*Almost Always/Always*'	15	.57
Peer Pressure	4 point scale, 1 = '*None*' to 4 = '*A lot*'	9	.89
Benefits versus Risks	5 point scale, 1 = '*Risks are much greater than benefits*' to 5 = '*Benefits are much greater than risks*'	9	.67

[a] *Note.* Items only answered if subject engaged in given risk behavior; thus, with numerous "N/A" responses, coefficient alpha was not appropriate.

Table 3

Correlations of Independent Variables (N = 55)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Percentage Planned Risk Behavior	-											
2. Frequency of Risk Behavior	.12	-										
3. Gender	-.04	.06	-									
4. Age	.03	.10	.26	-								
5. IQ	.17	-.16	.06	-.08	-							
6. Sensation Seeking	.23	.25	-.25	-.19	-.17	-						
7. Impulsivity	.29*	.04	-.09	.01	-.20	.45*	-					
8. Peer Pressure	.27	.24	-.05	-.09	-.20	.42*	.23*	-				
9. Benefits versus Risks	.54*	.24	.01	-.07	.06	.30*	.24	.38*	-			
10. Gambling Task- Decks Correct	.18	-.06	-.07	.17	.54*	-.02	-.06	.05	.11	-		
11. Gambling Task- Good Decks Played	-.03	.08	-.04	.16	-.06	.27*	.16	-.13	-.17	-.29*	-	
12. Dice Task- Safe Choices	.08	-.18	-.04	.10	-.06	-.10	.13	-.11	-.16	.02	-.09	-

*$p < .05$

Table 4

Logistic Regression: Planned Versus Unplanned Risk Behavior

	Bivariate		Multivariate	
	OR	**95% CI**	**OR**	**95% CI**
Frequency of Risk Behavior	1.19	0.69 - 2.07	--	--
Gender	0.93	0.32 - 2.69	--	--
Age	1.41	0.80 - 2.46	--	--
IQ	1.32	0.73 - 2.36	0.88	0.27 - 2.94
Sensation Seeking	1.73	0.96 - 3.12	0.79	0.28 - 2.22
Impulsivity	2.26*	1.15 - 4.47	2.00	0.73 - 5.50
Peer Pressure	1.96	0.98 - 3.90	2.36	0.85 - 6.57
Benefits versus Risks	3.00*	1.38 - 6.54	6.91*	1.70 - 28.15
Gambling Task- Decks Correct	1.85*	1.01 - 3.37	5.58*	1.13 - 27.42
Gambling Task- Good Decks Played	1.10	0.65 - 1.87	3.66*	1.08 - 12.37
Dice Task- Safe Choices	1.87*	1.02 - 3.44	6.31*	1.63 - 24.47

Note. N = 55. Outcome Variable: Planned Risk Behavior = 1; Unplanned Risk Behavior = 0 (Reference Category)

Gender: 1 = Male, 2 = Female. In the multivariate model, Nagelkerke R^2 = .62.

* $p < .05$.

Table 5

Logistic Regression: High Frequency Versus Low Frequency Risk Behavior

	Bivariate		Multivariate	
	OR	**95% CI**	**OR**	**95% CI**
Gender	0.93	0.32 - 2.69	-	-
Age	1.13	0.66 - 1.95	-	-
IQ	1.08	0.61 - 1.92	1.50	0.63 - 3.59
Sensation Seeking	2.32*	1.20 - 4.50	1.82	0.82 - 4.06
Impulsivity	2.16*	1.10 - 4.21	1.64	0.74 - 3.68
Peer Pressure	2.15*	1.04 - 4.45	1.66	0.73 - 3.80
Benefits versus Risks	1.84	0.94 - 3.59	1.21	0.51 - 2.85
Gambling Task- Decks Correct	1.16	0.67 - 2.00	0.95	0.42 - 2.15
Gambling Task- Good Decks Played	1.01	0.60 - 1.72	0.87	0.41 - 1.84
Dice Task- Risky Choices	1.12	0.67 - 1.91	1.20	0.62 - 2.33

Note. $N = 55$. Inclusion of the 14 subjects who reported no risk behavior did not affect the pattern of results.

Outcome Variable: High Frequency Risk Behavior = 1; Low Frequency Risk Behavior = 0 (Reference Category).

Gender: 1 = Male, 2 = Female. In the multivariate model, Nagelkerke $R^2 = .29$.

* $p < .05$