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Risk-Taking Behavior and Suicidality: The Unique Role of Adolescent Drug Use

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Abstract

Objective: Research has supported an association between suicidal thoughts / behaviors and risk-taking, which may be particularly strong during adolescence when risk-taking is known to increase. However, extant research has focused on individual risk-taking behaviors (e.g., alcohol use), limiting our ability to evaluate the unique association between different risk-taking behaviors and suicidal thoughts / behaviors. The current study aimed to fill this gap by examining the simultaneous influence of multiple risk-taking behaviors (i.e., risky sexual behavior, tobacco/alcohol use, illicit drug use, delinquent behavior, violent behavior) on adolescent suicidal thoughts / behaviors.

Method: Data from the National Longitudinal Study of Adolescent Health was utilized. The sample consisted of 4,834 adolescents who completed home interviews at two time points. At the first time point, participants' mean age was 15.15, with 48% ($n = 2315$) identifying as male. Participants provided information about suicidal thoughts / behaviors and multiple risk-taking behaviors at an initial interview and at a second interview, approximately 11 months later.

Results: When independently examined, nearly all assessed risk-taking behaviors were independently associated with suicidal ideation concurrently and prospectively, and with suicide attempts concurrently. When all risk-taking behaviors were examined simultaneously, illicit drug use was the only significant concurrent and significant prospective, albeit negative, predictor of suicidal thoughts and only concurrent predictor of suicidal behavior.

Conclusions: The current findings suggest that illicit drug use may have a stronger association with suicidal thoughts and behaviors than other risk-taking behavior. These findings have implications for prevention and intervention programs for adolescents.

Keywords

adolescents; risk-taking; suicide attempts; suicide ideation; drug use

Suicide is the second-leading cause of death among those aged 15–24, with nearly 5,500 youth aged 10–24 committing suicide each year (CDC, 2014). Further, it is believed that for every completed suicide in this age group there are between 100 and 200 suicide attempts (Goldsmith et al., 2002). One of the most well-cited risk factors for suicidal behavior is suicidal ideation; roughly one-third of those experiencing suicidal ideation go on to attempt suicide (Nock et al., 2009). Even more alarming is that these rates may be on the rise: according to the CDC's Youth Risk Behavior Survey, the percentage of high school students who reported seriously considering suicide increased from 13.8% to 17.0% between 2009 and 2013, and the number who reported attempting suicide during the previous year increased from 6.3% to 8.0% during the same period (Centers for Disease Control and Prevention, n.d.).

Increased suicidal ideation and behavior is of concern not only due to the potential detrimental consequences, but also because adolescent suicidal ideation and behavior are associated with several other negative outcomes, both concurrently and prospectively. For example, at the time of suicidal thoughts and behaviors, 89% and 96% of individuals, respectively (Nock et al., 2013), meet criteria for at least one DSM mental disorder, primarily those related to elevated fear, anger, anxiety, depression, or substance use (Andover et al., 2012; Nock et al., 2013). Engaging in suicidal behaviors during adolescence is also predictive of later psychopathology, poorer adjustment, risky sex, and psychiatric treatment in adulthood (Briere et al., 2015). Given the high prevalence rates and related negative consequences, a rich literature has focused on identifying risk factors for suicide among adolescents. One area deserving of further attention is risk-taking.

Though several theories of adolescent risk-taking have been proposed (see Furby & Beyth-Marion, 1992; Millstein & Igra, 1995; Steinberg 2004), it is generally agreed that adolescence is a developmental period marked by the emergence and escalation of risk-taking (Collado et al., 2014; Gullo & Dawe, 2008; Smith et al., 2013; Steinberg, 2004), and that these behaviors increase from early to late adolescence (Arnett, 1992; Reyna & Farley, 2006). For example, increases in the use of tobacco, alcohol, and illicit drugs (Chen & Jacobson, 2012; National Institute on Drug Abuse, 2009), unprotected sex and sexually transmitted infections (CDC, 2012; Steinberg, 2008), driving crashes and fatalities (CDC, 2014a; National Highway Traffic Safety Administration, 2012), and violent and non-violent crimes (Pastore & Miguire, 2006; Piquero, 2008) have all been found during adolescence. Though some increase in risk-taking behavior in adolescence can be normative, high levels of risk-taking behavior are associated with poorer academic achievement and role performance (Costa et al., 1995; Newcomb & McGee, 1991), increased psychopathology (Dishion, 2000; Tubman et al., 2003) and suicide risk (Pena, Matthieu, Zayas, Masyn, & Caine, 2012).

Extant research supports the association between suicidal behavior and several risk-taking behaviors during adolescence. Suicidal behavior in adolescence is linked to substance use, with adolescent girls being three times more likely and adolescent males being seventeen times more likely to attempt suicide while under the influence of alcohol (Groves, Stanley, & Sher, 2007; McManama et al., 2014; Wong, Zhou, Goebert, & Hishinuma, 2013). Adolescents who engage in risky acts of physical violence (Greening et al., 2010; Zhang et

al., 2012) and/or criminal behavior (Bauer et al., 2014; Bjorkenstam et al., 2011) are also at increased risk for suicidal behavior. Not surprisingly, two latent class analyses found that adolescents belonging to a higher risk-taking class, compared to adolescents in lower risk-taking classes showed an increased likelihood of attempting suicide (Sullivan, Childs, & O'Connell, 2010) as well as an increased likelihood of making multiple suicide attempts (Pena et al., 2012). Although these findings demonstrate a clear connection between risk-taking and suicidal thoughts and behaviors, the cross-sectional nature of the majority of findings leaves the directionality of these associations unclear.

Despite strong evidence of a link between risk-taking and suicidal behavior, little research has examined multiple risk-taking behaviors concurrently in the prediction of suicidal thoughts and behaviors. However, one study found that, among four latent classes of individuals, the class endorsing the greatest amount of risk-taking behaviors (i.e., drug use, drinking behavior, risky sexual behavior, violence perpetration) also reported the highest levels of suicide attempts (Thullen, Taliaferro, & Muehlenkamp, 2015). These risk-taking behaviors were more associated with suicide attempts than other well-established correlates of suicidal thoughts and behaviors, such as maladaptive dieting and non-suicidal self-injury (Andover & Gibb, 2010). Thus, the consideration of multiple risk-taking behaviors may be integral to the prediction of suicidal thoughts and behaviors.

There is a dearth of literature examining the presence of multiple risk-taking behaviors as a predictor of suicidal behavior (e.g., Harel-Fisch, Abdeen, Walsh, Radwan, & Fogel-Grinvald, 2012; Thullen et al., 2015). This is highlighted by the fact that no study to date has simultaneously examined multiple risk-taking behavior. Thus, the current study aimed to simultaneously examine multiple risk-taking behaviors in association with suicidal thoughts and behaviors both contemporaneously and prospectively. It was expected that each type of risk-taking assessed in the present study (i.e., risky sexual behavior, tobacco and alcohol use, illicit drug use, delinquent behavior, violent behavior) will each be associated with the presence of suicidal ideation and the presence of suicide attempts. Such hypotheses are based on previous research suggesting that the aforementioned risk-taking behaviors are associated with attempted suicide (Thullen et al., 2015); given this, we would also expect such risk-taking behaviors to be associated with suicidal ideation. However, given the lack of previous research simultaneously examining risk-taking behaviors in relation to both suicidal ideation and attempts, no specific hypotheses were made when considering all risk-taking behaviors together.

Method

Sample

Data for the present analyses come from the National Longitudinal Study of Adolescent Health (Add Health; Harris et al., 2009), comprising 7th-12th grade adolescents from 134 U.S. schools. The study design consisted of four different waves; the present analyses only utilized data from Wave I and Wave II. The first wave of in-home computer-assisted interviews was conducted from April to December 1995 and completed by 20,745 students. From this in-home sample, 14,738 students completed the second wave of interviews, conducted between April and August 1996. The mean time between these two data collection

points was 11 months. For the current analyses, the sample consisted only of adolescents who completed both the Wave I and Wave II in home interview ($n = 14,738$), and who had sample weights from Wave I ($n = 4,834$); this ensured that the final sample provided responses at both time points of interest (Wave I and Wave II), and, further, that we could obtain unbiased estimates of population parameters and standard errors from our analyses, reducing false-positive statistical test results (Chen & Chantala, 2014). The final sample consisted of 4,834 adolescents. In the final sample, participants' ages at Wave I ranged from 11 to 21 years old, with a mean age of 15.15 ($SD = 1.60$), with 48% ($n = 2315$) identifying as male. The majority of the sample identified as Caucasian (67.5%), followed by African American (23.8%), Asian (4.0%), American Indian (3.8%), and "other" (6.3%; Participants were allowed to identify with more than one race.) Approximately 12% of the sample identified as Hispanic. At Wave I, 12.8% of participants endorsed having suicidal ideation and 3.7% endorsed having made a suicide attempt in the past 12 months. At Wave II, 10.8% of participants endorsed having suicidal ideation and 3.1% endorsed having made a suicide attempt in the past 12 months.

Measures

Risky sexual behavior.—The latent variable of risky sexual behavior comprised four different items assessing participant's engagement in risky sexual activities: unprotected sexual intercourse with romantic partners, sexual intercourse with nonromantic and/or nonrelationship sexual partners, unprotected sexual intercourse with a nonromantic and/or nonrelationship partner, and engaging in solicited sexual intercourse. All items were coded dichotomously, where a score of 1 indicated the presence of the risky sexual behavior. The item of unprotected sex with a romantic partner was created through three questions. Participants were asked if they used birth control every time they had sexual intercourse with a romantic partner, allowing for identification of up to three romantic partners and asked about intercourse with each. If they denied using birth control with any partner, they received a score of 1. The same procedures were used to determine if the participant had engaged in unprotected sex with a nonromantic and/or nonrelationship partner. Participants were also asked if they had engaged in sexual intercourse with a nonromantic and/or nonrelationship partner, and if they had engaged in sexual intercourse in exchange for drugs or money. These items were coded as positive (1) if they reported ever engaging in the behavior. These questions were asked at both Wave I and Wave II and each assessed the lifetime occurrence of these behaviors.

Tobacco and alcohol use.—The latent variable of tobacco and alcohol use comprised five different items: two items were related to tobacco use and three items were related to alcohol use. All items were coded dichotomously, where a score of 1 indicated the presence of the behavior. With regard to tobacco use, participants were asked if they ever smoked cigarettes regularly (e.g., at least one cigarette every day for 30 days) and how old they were when they used chewing tobacco or snuff for the first time. The latter question was coded as positive (1) if the participant endorsed ever using chewing tobacco or snuff. With regard to alcohol use, participants were asked if they ever drink beer, wine, or liquor when they were not with their parents; on how many days in the past 12 months did they drink five or more in a row; and if they have ever driven while drunk. These three items were coded as

positive if participants endorsed ever engaging in these behaviors. These questions were asked at both time points; the questions at Wave I assessed the lifetime occurrence of these behaviors, with the exception of having five or more drinks, and Wave II assessed occurrence since the month of the last interview (e.g., Wave I) or over the past 12 months.

Illicit drug use.—The latent variable of illicit drug use comprised five different items; all were coded dichotomously, where a score of 1 indicated the presence of the behavior. Participants were asked the number of times they had used marijuana, cocaine, inhalants, and other types of illegal drugs. If the participants endorsed ever using the drug, the category was coded as positive (1). Participants were also asked if they had ever driven while high on drugs. This item was coded as positive (1) if they reported ever engaging in the behavior, and was asked at both Wave I and Wave II. Questions at Wave I assessed the lifetime occurrence of these behaviors and Wave II assessed occurrence since the month of the last interview (e.g., Wave I).

Delinquent behavior.—The latent variable of delinquent behavior comprised three items. All items were coded dichotomously, where a score of 1 indicated the presence of the behavior. Participants were asked how many times they engaged in the following behavior in the past 12 months: painted graffiti or signs on someone's property or public place, deliberately damaged property that didn't belong to them, and stole something worth more than \$50. These questions were asked at both Wave I and Wave II; each time point assessed the occurrence of these behaviors in the previous 12 months.

Violent behavior.—The latent variable of violent behavior comprised four items. All items were coded dichotomously, where a score of 1 indicated the presence of the behavior. Participants were asked how many times they engaged in the following behaviors in the past 12 months: a physical fight, a physical fight where they were injured and had to be treated by a doctor or nurse, hurt someone else badly enough to need bandages or care from a doctor or nurse, and pulled a knife or a gun on someone. These questions were asked at both Wave I and Wave II; each time point assessed the occurrence of these behaviors in the previous 12 months.

Suicidal thoughts and behaviors.—Participant's suicidal ideation and suicide attempts were assessed. All items were coded dichotomously, where 1 indicated the presence of the behavior. Participants were asked whether they had ever seriously thought about committing suicide in the past 12 months and how many times they had attempted suicide in the past 12 months. The items were coded as 1 if they endorsed ever contemplating or attempting suicide. These questions were asked at both Wave I and Wave II; each time assessing these thoughts / behaviors in the previous 12 months.

Data Analysis

Prior to running the primary analyses, a factor analysis was conducted to assess fit of the observed variables on the five proposed latent variables (e.g., risky sexual behavior, tobacco and alcohol use, drug use, delinquency behavior, violent behavior). Weighted least squares estimation was used because (a) the five latent variables were constructed with non-normally

distributed items, and (b) the suicidal ideation and attempt outcomes variables were non-normally distributed (Muthen & Muthen, 1998–2012). Latent auto-regressive models were utilized to examine the influence of each risk-taking latent variable, independent of other risk-taking latent variables, on suicidal ideation and attempts at Wave I and Wave II. Two models for each risk-taking latent variable were conducted, one examining suicidal ideation and the other examining suicide attempts. This resulted in 10 total models. For example, in the model predicting attempted suicide, the risk-taking latent variable at Wave I and Wave II (allowing for covariation) and attempted suicide at Wave I and Wave II (allowing for covariation) were included in the model. See Figure 1 for an example model. This allowed for consideration of the unique effect of the type of risk-taking on both suicidal ideation and attempted suicide (for overview see Geiser, 2012). Following this, structural equation models (SEM) predicting either suicidal ideation or attempted suicide were conducted including all risk-taking latent variables, which were allowed to covary. Model fit was based on a root mean square error of approximation (RMSEA) below 0.06 and a comparative fit index (CFI) greater than 0.90 (Hu & Bentler, 1999; Steiger, 2007). Additionally, SEM models included the cross sectional grand sample weights from the Add Health Wave I data, based on recommendations put forth by Chen & Chantala (2014). SEM was also used to conduct exploratory analyses of separate models for females and males given differences in suicidal ideation and attempted suicide in preliminary analyses. All analyses were conducted in Mplus Version 7.0 (Muthen & Muthen, 1998–2012). By default in Mplus, robust estimation of standard errors and robust chi-square tests of model fit are provided (Muthen & Muthen, 1998–2012). An alpha level of .01 was utilized given the number of analyses conducted.

Results

Preliminary Results

Item endorsement data for all individual risk-taking behavior questions is presented in Table 1. Participant endorsement ranged from 1% (e.g., unprotected sex with nonromantic partner; solicited sex) to 37% (e.g., drinking without parents) at Wave I and from 2% (e.g., inhalant use) to 37% (e.g., drinking without parents) at Wave II. Suicidal ideation (SI) at Wave I [$t(4789) = 2.04, p = .02$], attempted suicide (SA) at Wave I [$t(5829) = 1.47, p = .14$], SI at Wave II [$t(4797) = -0.74, p = .46$], and SA at Wave II [$t(5829) = -1.51, p = .13$] did not differ by participant age. More females reported SI at Wave I, $\chi^2(1, N = 4791) = 44.11, p < .001$, and Wave II, $\chi^2(1, N = 4799) = 45.16, p < .001$, reported SA at Wave I, $\chi^2(1, N = 4831) = 27.43, p < .001$. However, no differences were found for SA at Wave II, $\chi^2(1, N = 4831) = .87, p = .35$.

Factor loadings.—Two separate factor analyses (Wave I and Wave II) were conducted to confirm that the observed variables loaded onto the theorized risk-taking latent variables. The model examining Wave I variables demonstrated good fit, $\chi^2 = 903.19, p < .001$, CFI = .97, RMSEA = .02. All items loaded above .30 on their specified latent variable and below .30 on all other latent variables. A similar pattern of results was found when examining Wave II variables. The model demonstrated good fit, $\chi^2 = 1332.95, p < .001$, CFI = .95, RMSEA = .

03. All items loaded above .30 on their specified latent variables and below .30 on all other latent variables. See Table 2 for Wave I and Wave II factor loadings.

Study variable associations.—At Wave I, correlations between risk-taking latent variables were all significant at $p < .001$, as were all correlations between risk domains at Wave II. See Table 3. There were significant relations between each Wave I risk-taking latent variable and the corresponding risk-taking latent variable at Wave II, ranging from $b = .77$ (risky sexual behavior at Wave I and Wave II) to $b = .95$ (violent behavior at Wave I and Wave II) (all p 's $< .001$). SI at Wave I predicted SI at Wave II ($p < .001$). However, neither SI at Wave I ($p = .93$) nor the presence of a SA ($p = .25$) at Wave I predicted the occurrence of SA at Wave II. SA at Wave I did not predict the presence of SI at Wave II ($p = .96$). See Table 4.

Predicting Suicidal Ideation

Risky sexual behavior (RSB).—RSB at Wave I correlated with SI at Wave I, $b = .22$, $SE = .03$, $OR = 1.30$, $p < .001$, but did not predict SI at Wave II, $b = .16$, $SE = .08$, $OR = 1.07$, $p = .04$. At Wave II RSB was not associated with SI, $b = -.04$, $SE = .07$, $OR = 0.95$, $p = .56$.

Tobacco and alcohol use (TA).—TA at Wave I correlated with Wave I SI, $b = .32$, $SE = .03$, $OR = 1.51$, $p < .001$, but did not predict Wave II SI, $b = -.10$, $SE = .11$, $OR = 0.97$, $p = .34$. At Wave II TA correlated with Wave II SI, $b = .35$, $SE = .10$, $OR = 1.23$, $p < .001$.

Illicit drug use (ID).—ID at Wave I correlated with SI at Wave I, $b = .44$, $SE = .03$, $OR = 1.29$, $p < .001$, but negatively predicted SI at Wave II, $b = -.22$, $SE = .09$, $OR = 0.96$, $p = .01$. Wave II ID correlated with SI at Wave II, $b = .55$, $SE = .09$, $OR = 1.20$, $p < .001$.

Delinquent behavior (DB).—DB at Wave I correlated with SI at Wave I, $b = .32$, $SE = .04$, $OR = 1.3$, $p < .001$, but did not predict SI at Wave II, $b = .01$, $SE = .09$, $OR = 1.07$, $p = .88$. At Wave II DB correlated with SI at Wave II, $b = .25$, $SE = .09$, $OR = 1.16$, $p = .003$.

Violent behavior (VB).—VB at Wave I correlated with SI at Wave I, $b = .31$, $SE = .03$, $OR = 1.18$, $p < .001$, and predicted SI at Wave II, $b = -.51$, $SE = .13$, $OR = 0.87$, $p < .001$. At Wave II VB correlated with SI at Wave II, $b = .71$, $SE = .13$, $OR = 1.72$, $p < .001$.

Combined risk model.—A SEM model including all risk-taking latent variables at Wave I and Wave II, and SI at Wave I and Wave II demonstrated good fit, $\chi^2 = 49006.00$, $p < .001$, CFI = .94, RMSEA = .03. SI at Wave I positively predicted SI at Wave II. Illicit drug use at Wave I was positively associated with SI at Wave I and negatively predicted SI at Wave II. Illicit drug use and tobacco and alcohol use at Wave II were both positively associated with SI at Wave II. Once the impact of illicit drug use and tobacco and alcohol use on SI was taken into account, the other risk-taking latent variables did not predict SI. The combined model is presented in Figure 2. This model was also run for males and females separately, each producing a similar pattern of results (data available upon request). The one gender difference was that for males, Wave I illicit drug use was only positively associated with SI at

Wave I, whereas for females, illicit drug use positively predicted SI at Wave I and Wave II. Tobacco and alcohol use was not associated with SI.

Predicting Attempted Suicide

Risky sexual behavior (RSB).—Wave I RSB correlated with Wave I SA, $b = .28$, $SE = .05$, $OR = 1.71$, $p < .001$, but did not predict SA at Wave II, $b = -.09$, $SE = .13$, $OR = 0.89$, $p = .50$. At Wave II RSB was not associated with Wave II SA, $b = .11$, $SE = .13$, $OR = 1.0$, $p = .42$.

Tobacco and alcohol use (TA).—Wave I TA correlated with SA at Wave I, $b = .32$, $SE = .04$, $OR = 1.54$, $p < .001$, but did not predict SA at Wave II, $b = -.03$, $SE = .17$, $OR = 0.96$, $p = .86$. At Wave II TA and SA were not associated, $b = -.11$, $SE = .16$, $OR = 0.93$, $p = .49$.

Illicit drug use (ID).—Wave I ID correlated with SA at Wave I, $b = .44$, $SE = .04$, $OR = 1.32$, $p < .001$, but did not predict SA at Wave II, $b = .22$, $SE = .19$, $OR = 1.03$, $p = .26$. At Wave II ID was not associated with SA at Wave II, $b = -.26$, $SE = .19$, $OR = 0.96$, $p = .16$.

Delinquent behavior (DB).—Wave I DB correlated with Wave I SA, $b = .26$, $SE = .00$, $OR = 1.24$, $p < .001$, but did not predict Wave II SA, $b = .08$, $SE = .12$, $OR = 1.08$, $p = .68$. At Wave II DB and SA were not associated, $b = -.01$, $SE = .12$, $OR = 0.98$, $p = .92$.

Violent behavior (VB).—Wave I VB correlated with SA at Wave I, $b = .24$, $SE = .05$, $OR = 1.24$, $p < .001$, but did not predict SA at Wave II, $b = .01$, $SE = .16$, $OR = 1.07$, $p = .95$. At Wave II VB did not correlate with Wave II, $b = -.01$, $SE = .18$, $OR = 0.96$, $p = .95$.

Combined risk model.—A SEM model including all risk-taking latent variables at Wave I and Wave II, and SA at Wave I and Wave II was then tested. This model demonstrated good fit, $\chi^2 = 48217.00$, $p < .001$, $CFI = .94$, $RMSEA = .03$. Illicit drug use at Wave I was positively associated with SA at Wave I. No other risk-taking latent variables predicted SA at Wave I or Wave II once illicit drug use was taken into account. The combined model is presented in Figure 3. This model was also run for males and females separately, with each gender producing a similar pattern of results (data available upon request). The one gender difference was that illicit drug use at Wave I was positively associated with SA at Wave I only for males.

Discussion

The purpose of the current study was to examine the influence of risk-taking behaviors on suicidal thoughts and behaviors in adolescence. Further, we assessed these relationships when considering multiple risk-taking behaviors across two time points. Our hypotheses were partially supported. Nearly all risk-taking behaviors, when examined individually, were associated with (a) concurrent suicidal ideation at each time point, and (b) the presence of a suicide attempt at the first time point. However, when risk-taking behaviors were examined simultaneously, illicit drug use and tobacco and alcohol use were the only concurrent predictors and illicit drug use the only prospective predictor associated with suicidal ideation; illicit drug use was the only concurrent predictor of attempted suicide and no risk-taking behaviors were prospective predictors of attempted suicide.

Illicit drug use was independently related to suicidal ideation and attempts across both time points. Although illicit drug use was positively associated with suicidal ideation concurrently, contrary to our predictions, illicit drug use at Wave I was a negative prospective predictor of suicidal ideation at Wave II in both the independent and combined models. That is, greater illicit drug use led to lower suicidal ideation one year later. One possible explanation of this finding is that those individuals with greater illicit drug use (and related suicidal ideation) at Wave I were more likely to receive psychological treatment prior to Wave II. Supporting this notion, those with suicidal ideation at Wave I were in fact more likely to report having received counseling at Wave II. Examination of this unexpected relationship should be the focus of attention in future research.

On the other hand, after considering other risk-taking behaviors in the model, illicit drug use was the only risk-taking behavior to concurrently predict attempted suicide. This supports a strong literature on the association between drug use and suicide attempts and completed suicides (Liu, Case, & Spirit, 2014; Wilcox, Conner, & Caine, 2004). The current findings further suggest that illicit drug use may have a stronger association with suicide attempts than other risk-taking behavior, which is in line with past research proposing that illicit drug use may be more important than tobacco and alcohol use in suicidal behavior (Wong et al., 2013). The current study partially supports this observation. It was found that, when examined independently, tobacco and alcohol use was concurrently related to suicide attempts at Wave I; however, after considering the influence of illicit drug use, tobacco and alcohol use was no longer related to suicide attempts. There are a few possible explanations of these findings. One theory of suicide proposes that suicide is most likely to occur when an individual both desires to commit suicide and has the capability to do so (e.g., increased tolerance of pain and reduced fear of death), often achieved through prior exposure to painful and provocative experiences (Joiner, 2005). Although intravenous drug use may have a more direct relationship to increased pain tolerance and suicidal behavior (Liu et al., 2014) as compared to other illicit drug use, it was not directly assessed in the current study. However, illicit drug use as assessed may still be associated with attenuated fear about death, given its potentially lethal direct and indirect consequences (e.g., overdose, car accidents). If so, it is possible that habituation to fear of death through illicit drug use increases one's acquired capability for suicidal behavior (Riberio et al., 2014). If acquired capability were the driving factor for the observed connection between illicit drug use and suicidal behavior, however, we would also expect that other potentially detrimental / painful risk-taking behaviors, such as violent behavior, would have demonstrated a similar pattern of results. It is possible that the internalizing nature of illicit drug use may be an important characteristic. Both illicit and licit drug use have been implicated in the self-medication hypothesis, suggesting that substance use may be used to self-soothe in the face of distressful psychological states (Khantzian, 2003). There is a long line of research supporting the role of substance use in depression (e.g., Markou, Kosten & Koob, 1998), and it is possible this extends to suicidal behavior. Future research is needed to better understand these potential relationships and to test the aforementioned theoretical frameworks.

When examining risk-taking behaviors independently, all risk-taking behaviors were concurrently associated with suicidal ideation at Wave I and Wave II (excluding risky sexual behavior). In addition to illicit drug use and tobacco and alcohol use, the presence of violent

behavior at Wave I also independently, prospectively predicted suicidal ideation at Wave II. These findings are not surprising. Risk-taking behaviors have been previously found as risk factors for suicidal behaviors (e.g. Pena et al., 2012, Sullivan et al., 2010, Thullen et al., 2015), so it would be expected that the same behaviors would be associated with suicidal ideation. Similarly, all risk-taking behaviors concurrently predicted attempted suicide at Wave I; however, no risk-taking behaviors concurrently or prospectively predicted attempted suicide at Wave II.

As expected, suicidal ideation predicted the presence of suicidal ideation approximately one year later. Unexpectedly, however, neither suicidal ideation nor suicide attempts predicted suicide attempts one year later. These findings, particularly those related to suicide attempts, are inconsistent with previous literature that suggested past (suicidal) behavior is the best predictor of future behavior (e.g., Goldston, Daniel, Reboussin, Reboussin, Frazier, & Kelley, 1999; Lewinsohn, Rohde, & Seely, 1994). It is possible that given the age range of the current sample, and likelihood a caregiver is still involved in their daily living, that these suicide attempts had been brought to the attention of the caregiver. This may have led to the adolescent receiving help for their thoughts and behaviors, thus, potentially mitigating future suicidal behavior. As previously noted, those who reported a suicide attempt at Wave I were more likely to have reported receiving counseling at Wave II. It is also possible that the lack of relationship between suicide attempts at the two time points is due to the short time-span (11 months) between data collections, which may not have allowed enough time to pass for the behavior to re-occur.

It was also surprising that gender differences were not present in relationships between the assessed risk-taking behaviors and suicidal ideation or attempts. Not only does previous research suggest that males are more likely to exhibit specific risk-taking behavior, such as violent behavior (Bjorkqvist, 1994), but the relationship between alcohol use and suicide attempts may be stronger among males (Groves, Stanley, & Sher, 2007; McManama et al., 2014; Wong, Zhou, Goebert, & Hishinuma, 2013). As such, we would have anticipated gender differences to emerge. It is possible that the current study did not find such gender differences due to the consideration of multiple risk-taking behaviors in the model, negating potential differences in any one behavior. Another potential explanation is that differences may emerge in the pattern of results if the frequency or lethality of suicide attempts was examined, especially given that males are more likely to use more lethal methods (Beautrais, 2003). The current findings do suggest, however, the relationship between illicit drug use and suicide attempts is important to consider among both male and female adolescents.

There are a few limitations of note in the current study. First, not all risk-taking behaviors were assessed across the same time period. For example, risky sexual activity was assessed across the lifetime at both time points whereas other behaviors, such as drug use, were assessed in the 12 months prior to the interview. This may have influenced the pattern of findings not only for risky sexual behavior (which may have evidenced stronger associations if examined in 12-month increments), but also in relation to other risk-taking behavior. Although the pattern of findings for the combined models did not differ after removing risky sexual behavior from the model, this limitation should be considered in future research. Further, not all risk-taking behavior was assessed along the same metric; cigarette use was

assessed as daily use whereas other tobacco products were assessed for lifetime use. Future research should better assess for and differentiate among those risk-taking behaviors occurring across the lifetime and those within the time period during which suicidal ideation and attempts are assessed, in addition to using continuous (as opposed to dichotomous) measures of risk-taking behavior. Further, it is possible that individuals may have endorsed engaging in a risk-taking behavior (e.g., illicit drug use) as a means to attempt suicide. Such relationships should be further explored as they may represent a unique risk for suicidal behavior. The current data utilized only single-item self-report measures of suicidal ideation and attempts, and, further, did not consider suicidal ideation severity or multiple suicide attempts, an area necessary for future research. Additionally, there may have been a third variable at play (i.e., depression) influencing the assessed relationships that will be important for future research to consider. Given the long-standing link between depression and suicidal behavior (e.g., Minkoff, Begman, Beck & Beck, 1973) and risk-taking behavior (e.g., Richardson, Radziszewka, Dent, & Flay, 1993), depression may mediate the associations observed here. Finally, it should be noted that the current dataset was collected in the mid-1990's in a community sample; the findings presented should be replicated in an updated sample and further explored in clinical populations.

Despite these limitations, the current study has significant strengths, including the longitudinal design and the use of a nationally representative sample of adolescents. Further, the findings have important implications for suicide risk assessment during this developmental period; for example, it may be important to assess for current illicit drug use, as the findings highlight this risk-taking behavior in current risk for suicidal behavior. However, the unexpected finding between illicit drug use and suicidal ideation should be examined in future research, particularly as it relates to suicide risk. Overall, the findings emphasize the importance of considering all types of risk-taking in the assessment of suicidal thoughts and attempts.

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Figure 1.
Example Latent Auto-regressive Model

Figure 2.

Predicting Suicidal Ideation *Note:* All values presented are standardized; Not all estimated parameters are represented in diagram due to space; ** $p < .001$; * $p < .01$; T1 = Wave I; T2 = Wave II; risky sex = risky sexual behavior; tob&alc = tobacco and alcohol use; drug = illicit drug use; delinquency = delinquent behavior; violence = violent behavior

Figure 3.

Predicting Suicide Attempts *Note:* All values presented are standardized; Not all estimated parameters are represented in diagram due to space; ** $p < .001$; * $p < .01$; T1 = Wave I; T2 = Wave II; risky sex = risky sexual behavior; tob&alc = tobacco and alcohol use; drug = illicit drug use; delinquency = delinquent behavior; violence = violent behavior

Table 1

Item Endorsement for Risk-Taking Behaviors at Wave I and (Wave II)

	Risky Sexual Behavior	Tobacco/Alcohol Use	Illicit Drug Use	Delinquent Behavior	Violent Behavior
Unprotected Sex RP	.05 (.14)				
Number NRP	.23 (.17)				
Unprotected Sex NRP	.01 (.04)				
Solicited Sex	.01 (.03)				
Reg. Cigarette Use		.18 (.21)			
Tobacco Use		.06 (.07)			
Drink W/o Parent		.37 (.37)			
Drink 5+		.24 (.28)			
Drive Drunk		.05 (.05)			
Marijuana Use			.23 (.25)		
Cocaine Use			.03 (.03)		
Inhalant Use			.06 (.02)		
Other Drug Use			.08 (.06)		
Drive High			.06 (.06)		
Graffiti				.09 (.07)	
Steal worth \$50+				.05 (.05)	
Damage Property				.19 (.14)	
Physical Fight					.32 (.21)
Injure Someone					.18 (.08)
Injure Self					.09 (.04)
Pull Knife/Gun					.05 (.05)

Note: Item endorsement represents the percentage of participants who endorsed each item at each Wave; Wave II item endorsement is presented in parentheses; RP = romantic partner; NRP = nonrelationship and/or nonromantic partner; Reg. = regular; W/o = without; 5+ = five or more drinks

Table 2

Standardized Factor Loadings for Risk Behaviors at Wave I(and Wave II)

	Risky Sexual Behavior	Tobacco/Alcohol Use	Illicit Drug Use	Delinquent Behavior	Violent Behavior
Unprotected Sex RP	.56 (.58)				
Number NRP	.74 (.94)				
Unprotected Sex NRP	.59 (.73)				
Solicited Sex	.61 (.33)				
Reg. Cigarette Use		.82 (.84)			
Tobacco Use		.44 (.36)			
Drink W/o Parent		.85 (.81)			
Drink 5+		.89 (.93)			
Drive Drunk		.78 (.82)			
Marijuana Use			.88 (.92)		
Cocaine Use			.82 (.86)		
Inhalant Use			.60 (.51)		
Other Drug Use			.83 (.86)		
Drive High			.87 (.93)		
Graffiti				.80 (.84)	
Steal worth \$50+				.83 (.78)	
Damage Property				.73 (.86)	
Physical Fight					.72 (.76)
Injure Someone					.75 (.84)
Injure Self					.49 (.63)
Pull Knife/Gun					.77 (.88)

Note: Wave II factor loadings presented in parentheses; RP = romantic partner; NRP = nonrelationship and/or nonromantic partner; Reg. = regular; W/o = without; 5+ = five or more drinks

Table 3

Correlations for Latent Variables

	Risky Sex 1	Tob/Alc 1	Drug 1	Delinquent 1
Risky Sex 1	--			
Tob/Alc Use 1	.64 *	--		
Drug Use 1	.66 *	.83 *	--	
Delinquent 1	.36 *	.48 *	.60 *	--
Violent 1	.49 *	.41 *	.46 *	.63 *
	Risky Sex 2	Tob / Alc 2	Drug 2	Delinquent 2
Risky Sex 2	--			
Tob/Alc Use 2	.44 *	--		
Drug Use 2	.44 *	.81 *	--	
Delinquent 2	.18 *	.37 *	.48 *	--
Violent 2	.44 *	.46 *	.50 *	.66 *

Note:

* $p < .001$; risky sex = risky sexual behavior; tob/alc use = tobacco and alcohol use; drug use = illicit drug use; delinquent = delinquent behavior; violent = violent behavior

Table 4

Predictive Relationships Between Study Variables

Regression Relationship	<i>b</i> (<i>SE</i>)	<i>p</i> -value
Risky Sex T1 → Risky Sex T2	.77 (.03)	<.001
Tob/Alc Use T1 → Tob/Alc Use T2	.89 (.01)	<.001
Drug Use T1 → Drug Use T2	.90 (.01)	<.001
Delinquent T1 → Delinquent T2	.78 (.03)	<.001
Violent T1 → Violent T2	.95 (.03)	<.001
S. Ideation T1 → S. Ideation T2	.36 (.06)	<.001
S. IdeationT1 → S. Attempt T2	.003 (.17)	.93
S. Attempt T1 → S. Attempt T2	.04 (.10)	.25
S. Attempt T1 → S. Ideation T2	-.01 (.22)	.96

Note: Risky sex = risky sexual behavior; tob/alc use = tobacco and alcohol use; drug use = illicit drug use; delinquent = delinquent behavior; violent = violent behavior