



Published in final edited form as:

J Affect Disord. 2012 December 20; 143(1-3): 214–222. doi:10.1016/j.jad.2012.05.058.

Sensation Seeking as Risk Factor for Suicidal Ideation and Suicide Attempts in Adolescence

Ana Ortin, Alison M. Lake, Marjorie Kleinman, and Madelyn S. Gould

Division of Child and Adolescent Psychiatry. New York State Psychiatric Institute. Columbia University Medical Center. New York, NY

Abstract

Background—High sensation seeking in adolescence is associated with engagement in risk-taking behaviors, especially substance use. Although depressed adolescents are prone to increased risk-taking, and suicidal behavior can be considered within the spectrum of risk-taking behaviors, the relationships between sensation seeking, depression, and suicidal behavior have not been explored.

Methods—A self-report questionnaire assessing sensation seeking, depression, substance use problems, and suicidal ideation and suicide attempts was completed by 9th- through 12th-grade students (n=2189) in six New York State high-schools from 2002 through 2004. Logistic regression analyses were conducted to examine main and interaction effects between sensation seeking and the four clinical variables.

Results—High sensation seeking was positively associated with depressive symptoms and substance use problems. The main effects of sensation seeking on suicidal ideation and suicide attempts remained significant after controlling for depression and substance use. The association between sensation seeking and suicide attempts was moderated by substance use problems.

Limitations—The schools were suburban and predominantly white, limiting the generalizability of the results. Other mental disorders with potential implications for sensation seeking and for suicidal behavior, such as bipolar disorders, were not assessed.

© 2012 Elsevier B.V. All rights reserved.

Corresponding author: Madelyn S. Gould, Ph.D., M.P.H., Professor, Psychiatry and Public Health (Epidemiology), Deputy Director, Research Training Program in Child Psychiatry.

Contact information: Columbia University/NYS Psychiatric Institute, 1051 Riverside Drive, Unit 72, New York, NY 10032, Phone: 212-543-5329, Fax: 212-543-5966, gouldm@nyspi.columbia.edu

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Conflicts of Interest

None of the authors have conflict of interest/financial disclosures.

Contributors

Author Madelyn S. Gould was the principal investigator of the NIMH funded study (Gould et al. 2005) from which our sample and data came.

Authors Madelyn S. Gould and Ana Ortin designed the current study.

Authors Alison M. Lake and Ana Ortin managed the literature searches.

Author Ana Ortin undertook the statistical analysis under the supervision of Marjorie Kleinman and Madelyn S. Gould.

Author Ana Ortin wrote the first draft of the manuscript.

Authors Alison M. Lake and Ana Ortin wrote the final version of the manuscript.

Author Madelyn S. Gould reviewed each version of the manuscript.

All authors have approved the final manuscript.

Conclusions—The finding that sensation seeking makes an independent contribution to the risk of suicidal ideation and attempts is consistent with findings in literature on novelty seeking and impulsivity. The associations between sensation seeking, depressive symptoms and suicidal behavior may be compatible with the presence of an underlying temperamental dysregulation. Screening for sensation seeking may contribute to the reduction of adolescent suicide risk.

Keywords

Sensation seeking; Adolescence; Suicidal ideation; Suicide attempts; Depression; Substance use

1. Introduction

Heightened levels of sensation seeking in adolescence have been consistently associated with increased participation in risk-taking behaviors ranging from reckless driving to unsafe sex (Arnett, 1990, Arnett, 1996, Roberti, 2004, Wagner, 2001). High levels of sensation seeking have been particularly implicated in earlier onset and greater severity of substance use problems (Bekman et al., 2010, Crawford et al., 2003, MacPherson et al., 2010). While for the most part these studies have not addressed suicidal behavior, some justification has been found for including suicidal behavior within the spectrum of risk-taking behaviors. In a community probability sample of 9 to 17 year olds, suicidal ideation and suicide attempts were associated with risk-taking behaviors such as substance use, early onset of sexual intercourse and physical fighting independent of psychiatric diagnosis (King et al., 2001); moreover, covariation was found between each of the types of risk-taking behaviors, including suicidal ideation and suicide attempts (Flisher et al., 2000). Despite these associations, only one study of which we are aware has explored the potential role of sensation seeking as a risk factor for suicide attempts in adolescence. Bolognini (2002) examined personality differences among 107 drug abusers and 121 controls aged 14–25 years, and found that the Experience Seeking subscale of the Sensation Seeking Scale (SSS; Zuckerman et al., 1964) distinguished suicide attempters from non-attempters in both groups. Within the drug abusing group, sensation seeking was significantly associated with lifetime suicide attempts when controlling for other personality traits, conferring higher risk on girls than on boys.

The association between adolescent depression and suicidal ideation and suicide attempts is well-established (Brent et al., 1993, Shaffer et al., 1996). At the same time, depressive symptoms in this period have also been associated with increased engagement in risk-taking behaviors such as unsafe sex, drunk driving, driving without a seat-belt, and physical fights (Brooks et al., 2002, Spittle et al., 1976, Testa and Steinberg, 2010). Nevertheless, no studies to date have explored the relationship between sensation seeking and depression in adolescence, or examined the potential interactions between sensation seeking, depression, and suicidal behavior.

Sensation seeking is a personality trait defined by “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” (Zuckerman, 1994). High sensation seekers show high reward sensitivity, less reactive anxiety in physically threatening situations, and diminished perception of risk (Blankstein, 1975, Franken et al., 1992, Horvath and Zuckerman, 1993, Steinberg, 2010). As one facet of disinhibited personality, sensation seeking is related to but distinct from novelty seeking and impulsivity (Ferrett et al., 2011, Howard et al., 1996, McCourt et al., 1993), two additional disinhibited personality traits which are measured using different scales (Barratt, 1965, Cloninger, 1987, Zuckerman et al., 1964). Recent research suggests that sensation seeking and impulsivity may reflect distinct dimensions of behavioral disinhibition with different implications for externalizing

behaviors (Handley et al., 2011, Harden and Tucker Drob, 2011, Mackie et al., 2011, Malmberg et al., 2010, Steinberg et al., 2008). For example, Castellanos Ryan (2011, 2011) conceptualizes dual cognitive/motivational pathways of disinhibition, in which sensation seeking is associated with “hot,” reward-motivated disinhibition, more predictive of binge drinking, while impulsivity is associated with “cool” deficits in response inhibition, more predictive of the development of conduct disorder. Romer (2010, 2011) suggests that impulsivity and sensation seeking among adolescents may be attributable to deficits in prefrontal executive function and to rapid maturation of the subcortical motivation system, respectively.

Unlike sensation seeking, novelty seeking and impulsivity have each been more extensively studied in relation to adolescent suicidal behavior. Consistent findings show that novelty seeking (defined as the tendency to respond with intense excitement to novel stimuli or potential reward, and to actively avoid frustration) increases the risk of suicidal behavior in adolescence even after controlling for psychopathology, including depression (Fergusson et al., 2003, Fergusson et al., 2000). For example, Csorba (2010) reported that novelty seeking was the only personality dimension of the Junior Temperament Character Inventory (JTIC; Cloninger) which significantly differentiated between 39 suicidal depressive and 51 non suicidal depressive outpatient adolescents (aged 14–18 years). Studies of the relationship between impulsivity (defined as a tendency to act quickly without reflection or planning, while failing to inhibit behavior that is likely to result in negative consequences) and suicidal behavior in adolescence have produced mixed findings. Whereas a number of studies have demonstrated an association between impulsivity and suicidal behavior in adolescence, this association does not always remain significant after controlling for psychopathology (Horesh et al., 1999, Javdani et al., 2011, Kingsbury et al., 1999, Renaud et al., 2008). In a case-control study, for example, 81 adolescents in short term juvenile detention were matched with 81 adolescent psychiatric inpatients aged 13–16 years. After controlling for depression, impulsivity remained significantly associated with suicide risk in the juvenile detention group, but not in the inpatient group (Sanislow et al., 2003).

The relationship between depression and disinhibited personality traits in adolescence remains unexplored. Only one study to date has examined a measure of disinhibited personality in relation specifically to adolescent depression. In a study of 110 Swiss secondary school students, depression as measured by the Reynolds Adolescent Depression Scale (RADS; Reynolds, 1987) was associated with impulsivity as measured by the UPPS Impulsive Behavior Scale (Whiteside and Lynam, 2001). Specifically, depression was associated with the Urgency and Lack of Premeditation subscales. The association with the Sensation Seeking subscale of the UPPS (which includes a shortened adaptation of two of the four subscales of Zuckerman’s SSS) was negligible (d’Acromont and Van der Linden, 2007). More broadly, novelty seeking has been consistently associated with the externalizing dimensions and not with the internalizing dimensions of Achenbach’s Scales, including the anxious/depressed subscale (Asch et al., 2009, Copeland et al., 2004, Kim et al., 2006, Kuo et al., 2004). The replicated finding that high levels of novelty seeking in adolescence are associated with both externalizing disorders and suicide risk has led investigators to speculate that adolescents who attempt suicide “may have a mixed affective-behavioural psychopathology... [and] may occupy a midposition between depressive adolescents and those suffering from conduct disorder pathology with regard to character dimensions” (Csorba et al., 2010).

In sum, most extant research on the role of disinhibited personality traits in adolescent suicide risk has used measures of novelty seeking or impulsivity, while a significant body of research on the role of disinhibited personality traits in substance use problems and other risk-taking behaviors has used a sensation seeking measure. By examining sensation

seeking, substance use and suicidal behavior in an adolescent sample, we hope to bring these bodies of knowledge into closer communication with each other. By also including a measure of depression in our analyses, we seek to clarify the relationship between adolescent depression and a disinhibited personality trait. The specific aims of this study are: (1) to investigate the role of sensation seeking in relation to suicidal ideation and suicide attempts, depressive symptoms, and substance use problems; (2) to explore the extent to which sensation seeking independently contributes to the risk of suicidal ideation and suicide attempts, beyond what is contributed by depression and substance use problems; and (3) to clarify whether sensation seeking interacts with depression and/or substance use problems to increase the risk for suicidal ideation and suicide attempts.

2. Methods

2.1. Participants

Study participants were recruited from five public high-schools and one private school in Nassau, Suffolk, and Westchester counties in New York State from 2002 to 2004. These schools were part of a study examining possible iatrogenic effects of asking about suicide in a school screening program (Gould et al., 2005). A total of 3635 students were eligible for participation; 2342 (64.4%) participated in the study. Reasons for nonparticipation included parental refusals (61.9%), student refusals (14.3%), and absences (23.7%). There were no significant differences in demographics between participants and nonparticipants.

Self-report questionnaires, including the sensation seeking scale, were administered as a part of a 2-day screening procedure. The 2189 participants who completed day 2 of the survey were included in the current study. Of those, 41.6% were female and 81.9% were Caucasian, 4.7% Black, 8.0% Hispanic, 3.2% Asian, and 3.1% other. The mean age of the participants was 14.80 (1.18) with a range of 13 to 18. A total of 153 participants (6.5%) completed only day 1. Reasons for drop out included absences (73.2%) and refusals (26.7%). Those who did not complete the second day were slightly older (by 9 months) and reported significantly more substance use problems. There were no differences between the two groups in any other demographic or clinical variables. For an extensive discussion regarding attrition please see Gould et al. (2005).

Students were recruited with a waiver of parental consent for parents and active written assent for youth. The recruitment procedures were based on those used in our earlier study (Gould et al., 2004). The study procedures were approved by the Institutional Review Board of the New York State Psychiatric Institute/Columbia University Department of Psychiatry.

2.2. Measures

The assessment time frame was the past 4 weeks, with the exception of suicide attempts (lifetime) and sensation seeking (ongoing trait).

Demographic questionnaire—The questionnaire elicited information on age, grade, gender, ethnicity, and household composition.

Sensation seeking—The Brief Sensation Seeking Scale-4 (BSSS-4) contains four items derived from the Brief Sensation Seeking Scale (BSSS) (Hoyle et al., 2002), an eight-item battery tailored for adolescents by adapting items from the Sensation Seeking Scale-V (SSS-V) developed by Zuckerman (1978). Each one of the four items comprising the BSSS-4 pertains to one of the four original SSS-V subscales: “I would like to explore strange places” (Experience Seeking); “I like to do frightening things” (Thrill and Adventure Seeking); “I like new and exciting experiences, even if I have to break the rules” (Disinhibition); and “I

prefer friends who are unpredictable” (Boredom Susceptibility). The BSSS-4 uses a 5-point Likert-type scale, anchored by “Strongly Disagree” to “Strongly Agree.” This four item scale correlates highly ($r=0.89$) with the BSSS, which itself has been found to have strong construct validity (Stephenson et al., 2003). In addition, it has been demonstrated to be both valid and reliable in a national survey of adolescent drug use (Hornik et al., 2002). In the current study, the four item scale came from a telephone survey, The National Annenberg Survey of Youth (NASY), conducted by the Annenberg School of Public Policy’s Institute for Adolescent Risk Communication (Romer, 2003). The only difference between this four item scale and the BSSS-4 was that the items were presented in a 4 point Likert-type scale ranging from 0 (“Strongly Disagree”) to 3 (“Strongly Agree”). The total score ranged from 0 to 12. In our study, the internal reliability coefficient for the sensation seeking scale was high (Cronbach’s $\alpha=0.75$). There is no established cutoff point for the BSSS-4. To allow for the calculation of odds ratios, we dichotomized the sensation seeking scale by classifying as high sensation seeking those students whose scores placed them in the highest quartile (Q_4); and as low sensation seeking those with scores in the lower three quartiles. The same dichotomization has been used in previous epidemiological studies of novelty seeking (Fergusson et al., 2000). The cutoff point of >8 established using this method also coincided with one standard deviation above the mean, based on our sample’s distribution of scores (Mean=5.84; SD=2.95).

Depression—The Beck Depression Inventory (BDI-IA; Beck and Steer, 1993) contains 21 items that assess cognitive, behavioral, affective, and somatic components of depression. Loss of libido was not assessed. The responses for each question range from 0 (symptom is not present) to 3 (symptom is severe). The BDI has been used in >200 studies, and has demonstrated good reliability (Strober et al., 1981, Teri, 1982) and validity (Roberts et al., 1991) for use with an adolescent sample. For the total score, the suicidal ideation question was omitted lowering the maximum score to 57; therefore the cutoff point for depressed versus not depressed was adjusted from 16 to 15, as recommended to detect possible depression in normal populations (Beck and Steer, 1993).

Substance use problems—The Drug Use Screening Inventory (DUSI) (Tarter, 1990, Tarter and Hegedus, 1991, Tarter et al., 1992) is designed to screen for alcohol or drug use and problems among teenagers and has demonstrated good reliability, discriminate validity, and sensitivity and has published normative cutoff scores (Kirisci et al., 1995, Kirisci et al., 1994, Tarter et al., 1994, Tarter et al., 1997, Tarter et al., 1992, Tarter et al., 1995). A total score combines all 15 items from the substance use scale (assessing the degree of involvement and severity of consequences from alcohol and drug use), three alcohol or drug items on the school performance adjustment scale, and one additional aggression item assessing the clinically predictive problem of breaking things or getting into fights while under the influence of alcohol or drugs (Shaffer et al., 1996). A cutoff point of 5 was used to dichotomize scores based on the recommended cutoff points, roughly corresponding to 10% of the sample (Kirisci et al., 1995).

Suicidal ideation—Suicidal ideation was assessed by the 15-item Suicidal Ideation Questionnaire (SIQ-JR), and the suicide item on the BDI-IA. The SIQ-JR is designed for large-scale, school based screening of adolescents (Reynolds, 1988). The 15-item questionnaire uses a seven-point Likert-type scale, ranging from 0 (“I never had this thought”) to 6 (“This thought was in my mind almost every day”), assessing the frequency of specific suicidal thoughts during the past month. It assesses a wide range of thoughts related to death and dying, passive and active suicidal ideation, and suicidal intent. The SIQ-JR has demonstrated criterion validity (King et al., 1993, Reynolds, 1990, Reynolds and

Mazza, 1999) construct validity in clinical samples (King et al., 1993, King et al., 1997), and predictive validity (Keane et al., 1996).

Suicidal ideation was considered “serious suicidal ideation” if the adolescent scored 31 or higher on the SIQ-JR, scored 5 or 6 on two or more of the six “critical” SIQ-JR items (Reynolds, 1988), or responded with either of the two most serious response options of the BDI suicide item.

Suicide attempt history—Seven questions asking about lifetime and recent suicide attempts were derived from the depression module of the Diagnostic Interview Schedule for Children (DISC; Shaffer et al., 2000) and an earlier suicide screen (Shaffer et al., 2004). These items have demonstrated good construct validity (Gould et al., 1998, Shaffer et al., 2004). The questions inquired about the occurrence and details of lifetime and recent suicide attempts. The adolescent was considered to have an attempt history if he or she reported any past attempt, regardless of timing, injury, or medical attention, because there is no evidence that injury or need for medical attention is a clear indication of severity of attempts among adolescents.

2.3.Data Analysis

A series of logistic regression analyses was utilized to explore whether sensation seeking was associated with demographic variables (gender, age and grade). Ethnicity was not included because of sampling limitations. Sensation seeking was regressed on each of the demographic variables separately. “Grade” was recoded as dummy variable with “9th grade” as the reference category. “Age” was used as a continuous variable.

A second series of logistic regression analyses was conducted to determine whether sensation seeking was significantly associated with clinical variables: depression, substance use problems, serious suicidal ideation and suicide attempts, adjusting for the demographic variables that were found to be significantly associated with sensation seeking.

Next we assessed whether an interaction between sensation seeking and the significant demographic variables exists for depression, substance use problems, serious suicidal ideation and suicide attempts.

Another series of logistic regression analyses was conducted to find out whether sensation seeking was independently associated with serious suicidal ideation and suicide attempts adjusting separately for depression or substance use problems, in addition to the significant demographic variables.

Lastly, we explored whether depression and substance use problems interacted with sensation seeking in its association with serious suicidal ideation or suicide attempts.

The primary sampling unit was school and the secondary sampling unit was student within school. Thus, we first examined the extent of within-school clustering to determine whether this clustering variable warranted inclusion in the analyses. The sample clusters (school) had little impact on the outcomes (suicide attempt history, serious suicidal ideation, depression symptoms, substance use problems) or the independent variable (sensation seeking), as indicated by the intraclass coefficients, which were all close to zero. Therefore, the use of mixed effects linear models to account for the clustering variable of school was unnecessary. School was included as a covariate in all analyses.

Sixteen students with more than 1 item missing in the BSSS-4 were excluded from the analyses. If only one item was missing, the score was estimated based on the average of the other three items of the scale.

The analyses were conducted with the SPSS software package, version 18. The results were considered significant at $\alpha < 0.05$.

3. Results

3.1. Sensation seeking and demographics

In the logistic regression analyses, a small effect was found for gender when controlling for schools, with boys scoring significantly higher in sensation seeking than girls (Table 1). Sensation seeking was not significantly associated with grade or age. Subsequently, the regression analyses were adjusted only for gender.

3.2. Association of sensation seeking with the clinical variables

A total of 11.9% of the sample met the clinical cutoff on the BDI-IA. There was a significant association between sensation seeking and depressive symptoms (Table 2). Specifically, students in the high sensation seeking group were almost 3 times more likely to be depressed than those in the low sensation seeking group.

A total of 7.0% of the students reported having substance use problems in the past four weeks. There was a significant association between sensation seeking and substance use problems (Table 2). Specifically, students in the high sensation seeking group were 3 times more likely to report substance use problems than those in the low sensation seeking group.

Approximately 3.7% of the students endorsed serious suicidal ideation in the past four weeks. Students in the high sensation seeking group were at significantly higher risk for endorsing serious suicidal ideation (Table 2), such that high sensation seekers were 3.4 times more likely to endorse serious suicidal ideation in the past four weeks than the students in the low sensation seeking group.

Four percent of the participants indicated that they had made least one suicide attempt in their lifetime. Sensation seeking was associated with elevated risk for having engaged in a suicide attempt (Table 2). Students in the high sensation seeking group were almost 3.5 times more likely to have an attempt history than those in the low sensation seeking group.

3.3. Interaction effects between sensation seeking and gender in the clinical variables

With regard to gender, there were no statistically significant interaction effects with sensation seeking in the logistic regression model with any of the outcomes: depressive symptoms ($\beta(\text{s.e.})=0.29(0.30)$, $p>0.05$), substance use problems ($\beta(\text{s.e.})=-0.16(0.36)$, $p>0.05$), serious suicidal ideation ($\beta(\text{s.e.})=-0.29(0.48)$, $p>0.05$), or suicide attempts ($\beta(\text{s.e.})=-0.37(0.49)$, $p>0.05$). Thus, the odds ratios are the same for girls and boys with regard to the suicidal behaviors and psychiatric symptoms.

3.4. Association of sensation seeking with serious suicidal ideation and suicide attempts, adjusting for depression and substance use problems, separately

After controlling for depression, the associations of sensation seeking with both serious suicidal ideation and suicide attempts remained statistically significant (Table 2), such that students in the high sensation seeking group were 1.7 times more likely to endorse current serious suicidal ideation and 2 times more likely to have made a suicide attempt in their lifetimes than those in the low sensation seeking group.

When controlling for substance use problems, the associations of sensation seeking with both suicidal behaviors were statistically significant (Table 2). Students in the high sensation seeking group were nearly 3 times more likely to endorse current serious suicidal ideation and to have made a suicide attempt in their lifetimes than those in the low sensation seeking group.

3.5. Interaction effects between sensation seeking and depression in suicidal behavior

Sensation seeking did not significantly interact with depression in its association with serious suicidal ideation (β (s.e.)= $-0.31(0.66)$, $p>0.05$). In the non-depressed group, the percentage of students who reported serious suicidal ideation was 0.6% and 1.3% for the low and high sensation seeking groups, respectively. In the depressed group, the percentage of students who reported serious suicidal ideation was 22.5% and 31.8% for the low and high sensation seeking groups, respectively.

Similarly, sensation seeking did not significantly interact with depression in its association with suicide attempt history (β (s.e.)= $-0.70(0.49)$, $p>0.05$). In the non-depressed group, the percentage of students who reported suicide attempts was 1.3% and 3.6% for the low and high sensation seeking groups, respectively. In the depressed group, the percentage of students who reported suicide attempts was 19.2% and 26.1% for the low and high sensation seeking groups, respectively.

3.6. Interaction effects between sensation seeking and substance use problems in suicidal behavior

Sensation seeking did not significantly interact with substance use problems in its association with serious suicidal ideation (β (s.e.)= $-0.72(0.55)$, $p>0.05$). In the group without substance use problems, the percentage of students who reported serious suicidal ideation was 2.2% and 6.6% for the low and high sensation seeking groups, respectively. In the group with substance use problems, the percentage of students who reported serious suicidal ideation was 12.0% and 16.9% in the low and high sensation seeking groups, respectively.

Sensation seeking did significantly interact with substance use problems in its association with suicide attempt history (β (s.e.)= $-1.06(0.52)$, $p<0.05$). In the group without substance use problems, the percentage of students who reported suicide attempts was 2.3% and 7.1% for the low and high sensation seeking groups, respectively. In the group with substance use problems, the percentage of students who reported suicide attempts was 17.2% and 18.6% for the low and high sensation seeking groups, respectively. The association between suicide attempt history and sensation seeking was statistically significant only in the group of students without substance use problems (OR=3.90(95%), CI:2.26–6.71), and not in the group of students with substance use problems (OR=1.16(95%), CI:0.45–2.95).

4. Discussion

The aim of the present study was to clarify the relationship of sensation seeking to depression and suicidal behavior in adolescence, using data gathered from 2189 adolescents from 6 high schools in New York State who participated in a school-based suicide screening program. Three major findings emerged. First, a positive association between sensation seeking and depressive symptoms was found. Second, high levels of sensation seeking significantly increased the risk of current suicidal ideation and lifetime suicide attempts independently of current depressive symptoms and substance use problems. Third, an interaction emerged between high levels of sensation seeking and substance use problems, with a significant association of high sensation seeking with suicide attempts in the group of

students without substance use problems. We found no significant interaction between sensation seeking and depression or between sensation seeking and gender.

A positive association between sensation seeking and depression in adolescents has not been reported elsewhere, and may be unexpected in light of the consistent association between novelty seeking and externalizing rather than internalizing disorders. Depression is known to express itself differently in adolescents compared with adults (Kaufman et al., 2001, Mueller and Orvaschel, 1997). Adolescents tend to report their mood as irritable or bored rather than depressed (Crowe et al., 2006), and adolescent depression manifests with greater comorbidity, especially with anxiety disorders, disruptive behaviors, drug abuse problems, other risk-taking behaviors (Angold and Costello, 1993, Fergusson and Woodward, 2002, Ginicola, 2007, Rohde et al., 1991, Testa and Steinberg, 2010). Moreover, onset of depression during childhood and young adolescence increases the risk of a subsequent transition into the bipolar spectrum (Geller et al., 1994, Geller et al., 2001). Bipolar disorders are associated with high suicide risk (Kelly et al., 2002, Lewinsohn et al., 1995), and with higher levels of novelty seeking and impulsivity in adolescents (Gilbert et al., 2011, Nandagopal et al., 2011, Olvera et al., 2009, Tillman et al., 2003).

In our sample, adolescents with depressive symptoms and high sensation seeking showed the highest rates of suicidal ideation and suicide attempts. The conjunction between sensation seeking, depression and suicidal behavior might be understood as signaling an underlying “temperamental dysregulation,” which usually manifests at a subclinical level and is considered a marker for bipolarity (Akiskal, 1995, Akiskal et al., 2003, Kochman et al., 2005). Further exploration of the role of sensation seeking among depressed adolescents as a potential indicator of emergent bipolarity is warranted.

It is notable that the association of sensation seeking with suicidal ideation and suicide attempts remained significant when controlling for depressive symptoms. This finding is consistent with research linking novelty seeking and impulsivity with higher risk of suicidal behavior after controlling for depression (Fergusson et al., 2000, McGirr et al., 2008). The independent association of sensation seeking with suicide attempts might be understood within the framework of the Interpersonal Psychological Theory of Suicide (Joiner, 2005, Ribeiro and Joiner, 2009, Smith and Cukrowicz, 2010). According to this theory, to attempt suicide a person has to have the “acquired capability for suicide” as well as the desire to die. This capability is a condition involving a heightened degree of fearlessness and pain insensitivity such that the pain and fear entailed by a suicide attempt no longer function as deterrents; it is acquired through “repeated exposure and habituation to painful, fearsome and otherwise provocative events, ...” (Joiner et al., 2009).

High sensation seekers tend to be exposed to variety of intense, provocative, and dangerous situations, and suffer from a high rate of accidental injuries (Arnett, 2002, O’Jile et al., 2004, Osborn et al., 2009). Repeated engagement in high risk activities may result in a progressive habituation to fear and physiological pain, and, over time, “in a higher tolerance for pain and a sense of fearlessness in the face of death” (Joiner et al., 2009). However, this model does not seem able to account for the association we also found between high levels of sensation seeking and increased risk of suicidal ideation.

Our finding regarding substance use extends a previously published finding (Bolognini et al., 2002) that sensation seeking contributes to the risk of suicide attempts over and above the contribution of drug abuse. We similarly found a significant association between sensation seeking and both suicidal ideation and suicide attempts when controlling for substance use problems; however, when we explored the interaction effect, substance use problems moderated the association between sensation seeking and suicide attempts, such

that the association was only significant in the group without substance use problems. This result contradicts the findings of a study of sensation seeking, alcohol/drug use, and risky sexual behavior, in which investigators found that “the personality dimension of sensation seeking increased the positive situational effects of both alcohol and drug use prior to sex on frequency of unprotected sex with partners” (Newcomb et al., 2011). We likewise would have expected to find a cumulatively greater risk of suicidal behavior in the group with both high sensation seeking and substance use problems. We interpret our finding as indicating that in the case of suicidal behavior, substance use problems and high levels of sensation seeking may play parallel roles in promoting behavioral disinhibition; in other words, their contributions to suicide risk may be overlapping rather than additive. Gould (1998) found that substance abuse/dependence independently differentiated suicide attempters from ideators in a sample of 1285 youth ages 9–17. It may be that in adolescents with substance use problems, substance use facilitates the acquisition of the capability for suicide, while in adolescents without substance use problems, high levels of sensation seeking fill the same role, although to a somewhat lesser degree.

4.1.Limitations

The selection of schools was constrained by the design of our earlier study (Gould et al., 2005). The schools were suburban and predominantly white, limiting the generalizability of our findings to urban and more ethnically or socioeconomically diverse populations. The participation rate was low, as is common in suicide-screening protocols (Shaffer et al., 2004). Although there were no significant differences between participants and nonparticipants in demographic factors (e.g., sex, grade level, ethnicity), we were unable to assess differences in clinical factors (e.g., risk status, BDI-IA and SIQ-JR scores). In addition, in our study we only included students who completed both days of the screening program. Those who did not complete the second day were slightly older and reported significantly more substance use problems; no other differences were found. Given the low rates of non-white students, we have not considered differences by ethnicity.

Additionally, there are other constructs which may have implications both for sensation seeking and for suicidal behavior, such as conduct disorder, ADHD, bipolar disorders, and borderline personality disorder, that we did not assess and therefore could not control for. It would be useful in a future study to assess a wider range of psychiatric problems in order to clarify the nature of the association between sensation seeking and depression.

4.2.Clinical implications

Although high levels of sensation seeking contribute to adolescent suicide risk, this contribution is relatively small, with substance use problems and depression remaining the more significant risk factors. However, in light of the independent effect of sensation seeking on the risk of suicide attempts when controlling for depression, and in light of the particular risk conferred by sensation seeking on adolescents without substance use problems, we believe that it would be advisable to include a sensation seeking measure in screens for adolescent suicide risk, to facilitate detection of this additional risk factor. Our findings may also have implications for the development of youth suicide prevention strategies beyond screening. A school-based, personality-targeted intervention incorporating psycho-education, motivational interviewing and cognitive behavioral elements aimed at challenging personality-specific cognitive distortions has been demonstrated effective in reducing adolescent binge drinking and problem drinking (Conrod et al., 2010, Conrod et al., 2006, O’Leary-Barrett et al., 2010), with particularly strong results among students with high sensation seeking compared to those with high impulsivity, negative thinking or anxiety sensitivity (Conrod et al., 2008). In light of our findings, we would recommend that

suicidal ideation and suicide attempts be included as outcomes in future trials of personality targeted interventions.

Acknowledgments

Role of funding source

This research was supported by National Institute of Mental Health (NIMH) grant R01 MH64632. In addition, the first author received support from a research grant from Alicia Koplowitz Foundation (Spain).

The sponsors were not involved in the design and conduct of the study; collection, management, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript.

References

- Akiskal HS. Developmental pathways to bipolarity: are juvenile onset depressions pre bipolar? *J Am Acad Child Adolesc Psychiatry*. 1995; 34:754–763. [PubMed: 7608049]
- Akiskal HS, Hantouche EG, Allilaire JF. Bipolar II with and without cyclothymic temperament: "dark" and "sunny" expressions of soft bipolarity. *J Affect Disord*. 2003; 73:49–57. [PubMed: 12507737]
- Angold A, Costello EJ. Depressive comorbidity in children and adolescents: empirical, theoretical, and methodological issues. *Am J Psychiatry*. 1993; 150:1779–1791. [PubMed: 8238631]
- Arnett J. Drunk Driving, Sensation Seeking, and Egocentrism among Adolescents. *Personality and Individual Differences*. 1990; 11:541–546.
- Arnett JJ. Sensation seeking, aggressiveness, and adolescent reckless behavior. *Personality and Individual Differences*. 1996; 20:693–702.
- Arnett JJ. Developmental sources of crash risk in young drivers. *Inj Prev*. 2002; 8(Suppl 2):ii17–ii21. discussion ii21-3. [PubMed: 12221026]
- Asch M, Cortese S, Perez Diaz F, Pelissolo A, Aubron V, Orejarena S, Acquaviva E, Mouren MC, Michel G, Gorwood P, Purper Ouakil D. Psychometric properties of a French version of the junior temperament and character inventory. *Eur Child Adolesc Psychiatry*. 2009; 18:144–153. [PubMed: 19198924]
- Barratt ES. Factor Analysis of Some Psychometric Measures of Impulsiveness and Anxiety. *Psychol Rep*. 1965; 16:547–554. [PubMed: 14285869]
- Beck, AT.; Steer, RA. *Manual for the Beck Depression Inventory*. San Antonio, TX: The Psychological Corporation; 1993.
- Bekman NM, Cummins K, Brown SA. Affective and personality risk and cognitive mediators of initial adolescent alcohol use. *J Stud Alcohol Drugs*. 2010; 71:570–580. [PubMed: 20553666]
- Blankstein KR. The sensation seeker and anxiety reactivity: relationships between the sensation seeking scales and the activity preference questionnaire. *J Clin Psychol*. 1975; 31:677–681. [PubMed: 1194425]
- Bolognini M, Laget J, Plancherel B, Stephan P, Corcos M, Halfon O. Drug use and suicide attempts: the role of personality factors. *Subst Use Misuse*. 2002; 37:337–356. [PubMed: 11913907]
- Brent DA, Perper JA, Moritz G, Allman C, Friend A, Roth C, Schweers J, Balach L, Baugher M. Psychiatric risk factors for adolescent suicide: a case control study. *J Am Acad Child Adolesc Psychiatry*. 1993; 32:521–529. [PubMed: 8496115]
- Brooks TL, Harris SK, Thrall JS, Woods ER. Association of adolescent risk behaviors with mental health symptoms in high school students. *J Adolesc Health*. 2002; 31:240–246. [PubMed: 12225736]
- Castellanos Ryan N, Conrod PJ. Personality correlates of the common and unique variance across conduct disorder and substance misuse symptoms in adolescence. *J Abnorm Child Psychol*. 2011; 39:563–576. [PubMed: 21181434]
- Castellanos Ryan N, Rubia K, Conrod PJ. Response inhibition and reward response bias mediate the predictive relationships between impulsivity and sensation seeking and common and unique variance in conduct disorder and substance misuse. *Alcohol Clin Exp Res*. 2011; 35:140–155. [PubMed: 21039636]

- Cloninger CR. A systematic method for clinical description and classification of personality variants. A proposal. *Arch Gen Psychiatry*. 1987; 44:573–588. [PubMed: 3579504]
- Conrod PJ, Castellanos Ryan N, Strang J. Brief, personality targeted coping skills interventions and survival as a non drug user over a 2 year period during adolescence. *Arch Gen Psychiatry*. 2010; 67:85–93. [PubMed: 20048226]
- Conrod PJ, Castellanos N, Mackie C. Personality targeted interventions delay the growth of adolescent drinking and binge drinking. *J Child Psychol Psychiatry*. 2008; 49:181–190. [PubMed: 18211277]
- Conrod PJ, Stewart SH, Comeau N, Maclean AM. Efficacy of cognitive behavioral interventions targeting personality risk factors for youth alcohol misuse. *J Clin Child Adolesc Psychol*. 2006; 35:550–563. [PubMed: 17007600]
- Copeland W, Landry K, Stanger C, Hudziak JJ. Multi informant assessment of temperament in children with externalizing behavior problems. *J Clin Child Adolesc Psychol*. 2004; 33:547–556. [PubMed: 15271612]
- Crawford AM, Pentz MA, Chou CP, Li C, Dwyer JH. Parallel developmental trajectories of sensation seeking and regular substance use in adolescents. *Psychol Addict Behav*. 2003; 17:179–192. [PubMed: 14498812]
- Crowe M, Ward N, Dunnachie B, Roberts M. Characteristics of adolescent depression. *Int J Ment Health Nurs*. 2006; 15:10–18. [PubMed: 16499786]
- Csorba J, Dinya E, Ferencz E, Steiner P, Bertalan G, Zsardon A. Novelty seeking: difference between suicidal and non suicidal Hungarian adolescent outpatients suffering from depression. *J Affect Disord*. 2010; 120:217–220. [PubMed: 19386368]
- D'acremont M, Van Der Linden M. How is impulsivity related to depression in adolescence? Evidence from a French validation of the cognitive emotion regulation questionnaire. *J Adolesc*. 2007; 30:271–282. [PubMed: 16600359]
- Fergusson DM, Beautrais AL, Horwood LJ. Vulnerability and resiliency to suicidal behaviours in young people. *Psychol Med*. 2003; 33:61–73. [PubMed: 12537037]
- Fergusson DM, Woodward LJ. Mental health, educational, and social role outcomes of adolescents with depression. *Arch Gen Psychiatry*. 2002; 59:225–231. [PubMed: 11879160]
- Fergusson DM, Woodward LJ, Horwood LJ. Risk factors and life processes associated with the onset of suicidal behaviour during adolescence and early adulthood. *Psychol Med*. 2000; 30:23–39. [PubMed: 10722173]
- Ferrett HL, Cuzen NL, Thomas KG, Carey PD, Stein DJ, Finn PR, Tapert SF, Fein G. Characterization of South African Adolescents With Alcohol Use Disorders but Without Psychiatric or Polysubstance Comorbidity. *Alcohol Clin Exp Res*. 2011; 35:1705–1715. [PubMed: 21535026]
- Flisher AJ, Kramer RA, Hoven CW, King RA, Bird HR, Davies M, Gould MS, Greenwald S, Lahey BB, Regier DA, Schwab Stone M, Shaffer D. Risk behavior in a community sample of children and adolescents. *J Am Acad Child Adolesc Psychiatry*. 2000; 39:881–887. [PubMed: 10892230]
- Franken RE, Gibson KJ, Rowland GL. Sensation Seeking and the Tendency to View the World as Threatening. *Personality and Individual Differences*. 1992; 13:31–38.
- Geller B, Fox LW, Clark KA. Rate and predictors of prepubertal bipolarity during follow up of 6 to 12 year old depressed children. *J Am Acad Child Adolesc Psychiatry*. 1994; 33:461–468. [PubMed: 8005898]
- Geller B, Zimerman B, Williams M, Bolhofner K, Craney JL. Bipolar disorder at prospective follow up of adults who had prepubertal major depressive disorder. *Am J Psychiatry*. 2001; 158:125–127. [PubMed: 11136645]
- Gilbert KE, Kalmar JH, Womer FY, Markovich PJ, Pittman B, Nolen Hoeksema S, Blumberg HP. Impulsivity in Adolescent Bipolar Disorder. *Acta Neuropsychiatr*. 2011; 23:57–61. [PubMed: 21483649]
- Ginicola MM. Children's unique experience of depression: using a developmental approach to predict variation in symptomatology. *Child Adolesc Psychiatry Ment Health*. 2007; 1:9. [PubMed: 17714590]
- Gould MS, King R, Greenwald S, Fisher P, Schwab Stone M, Kramer R, Flisher AJ, Goodman S, Canino G, Shaffer D. Psychopathology associated with suicidal ideation and attempts among

- children and adolescents. *J Am Acad Child Adolesc Psychiatry*. 1998; 37:915–923. [PubMed: 9735611]
- Gould MS, Marrocco FA, Kleinman M, Thomas JG, Mostkoff K, Cote J, Davies M. Evaluating iatrogenic risk of youth suicide screening programs: a randomized controlled trial. *JAMA*. 2005; 293:1635–1643. [PubMed: 15811983]
- Gould MS, Velting D, Kleinman M, Lucas C, Thomas JG, Chung M. Teenagers' attitudes about coping strategies and help seeking behavior for suicidality. *J Am Acad Child Adolesc Psychiatry*. 2004; 43:1124–1133. [PubMed: 15322416]
- Handley ED, Chassin L, Haller MM, Bountress KE, Dandreaux D, Beltran I. Do executive and reactive disinhibition mediate the effects of familial substance use disorders on adolescent externalizing outcomes? *J Abnorm Psychol*. 2011; 120:528–542. [PubMed: 21668077]
- Harden KP, Tucker Drob EM. Individual differences in the development of sensation seeking and impulsivity during adolescence: further evidence for a dual systems model. *Dev Psychol*. 2011; 47:739–746. [PubMed: 21534657]
- Horesh N, Gothelf D, Ofek H, Weizman T, Apter A. Impulsivity as a correlate of suicidal behavior in adolescent psychiatric inpatients. *Crisis*. 1999; 20:8–14. [PubMed: 10365500]
- Hornik, R.; Maklan, D.; Cadell, D.; Barmada, CB.; Jacobsohn, L.; Prado, A. Evaluation of the national youth anti drug media campaign: Fifth semi annual report of findings. Rockville, MD: Westat; 2002.
- Horvath P, Zuckerman M. Sensation Seeking, Risk Appraisal, and Risky Behavior. *Personality and Individual Differences*. 1993; 14:41–52.
- Howard MO, Cowley DS, Roy Byrne PP, Hopfenbeck JR. Tridimensional personality traits in sons of alcoholic and nonalcoholic fathers. *Alcohol Clin Exp Res*. 1996; 20:445–448. [PubMed: 8727235]
- Hoyle RH, Stephenson MT, Palmgreen P, Lorch EP, Donohew RL. Reliability and validity of a brief measure of sensation seeking. *Personality and Individual Differences*. 2002; 32:401–414.
- Javdani S, Sadeh N, Verona E. Suicidality as a function of impulsivity, callous unemotional traits, and depressive symptoms in youth. *J Abnorm Psychol*. 2011; 120:400–413. [PubMed: 21280931]
- Joiner, T. *Why people die by suicide*. Cambridge, MA: Harvard University Press; 2005.
- Joiner TE Jr, Van Orden KA, Witte TK, Selby EA, Ribeiro JD, Lewis R, Rudd MD. Main predictions of the interpersonal psychological theory of suicidal behavior: empirical tests in two samples of young adults. *J Abnorm Psychol*. 2009; 118:634–646. [PubMed: 19685959]
- Kaufman J, Martin A, King RA, Charney D. Are child , adolescent , and adult onset depression one and the same disorder? *Biol Psychiatry*. 2001; 49:980–1001. [PubMed: 11430841]
- Keane EM, Dick RW, Bechtold DW, Manson SM. Predictive and concurrent validity of the Suicidal Ideation Questionnaire among American Indian adolescents. *J Abnorm Child Psychol*. 1996; 24:735–747. [PubMed: 8970907]
- Kelly TM, Cornelius JR, Lynch KG. Psychiatric and substance use disorders as risk factors for attempted suicide among adolescents: a case control study. *Suicide Life Threat Behav*. 2002; 32:301–312. [PubMed: 12374475]
- Kim SJ, Lee SJ, Yune SK, Sung YH, Bae SC, Chung A, Kim J, Lyoo IK. The relationship between the biogenetic temperament and character and psychopathology in adolescents. *Psychopathology*. 2006; 39:80–86. [PubMed: 16391509]
- King CA, Hill EM, Naylor M, Evans T, Shain B. Alcohol consumption in relation to other predictors of suicidality among adolescent inpatient girls. *J Am Acad Child Adolesc Psychiatry*. 1993; 32:82–88. [PubMed: 8428889]
- King CA, Katz SH, Ghaziuddin N, Brand E, Hill E, McGovern L. Diagnosis and assessment of depression and suicidality using the NIMH Diagnostic Interview Schedule for Children (DISC 2.3). *J Abnorm Child Psychol*. 1997; 25:173–181. [PubMed: 9212370]
- King RA, Schwab Stone M, Flisher AJ, Greenwald S, Kramer RA, Goodman SH, Lahey BB, Shaffer D, Gould MS. Psychosocial and risk behavior correlates of youth suicide attempts and suicidal ideation. *J Am Acad Child Adolesc Psychiatry*. 2001; 40:837–846. [PubMed: 11437023]
- Kingsbury S, Hawton K, Steinhardt K, James A. Do adolescents who take overdoses have specific psychological characteristics? A comparative study with psychiatric and community controls. *J Am Acad Child Adolesc Psychiatry*. 1999; 38:1125–1131. [PubMed: 10504811]

- Kirisci L, Mezzich A, Tarter R. Norms and sensitivity of the adolescent version of the drug use screening inventory. *Addict Behav.* 1995; 20:149–157. [PubMed: 7484309]
- Kirisci L, Tarter RE, Hsu TC. Fitting a two parameter logistic item response model to clarify the psychometric properties of the Drug Use Screening Inventory for adolescent alcohol and drug abusers. *Alcohol Clin Exp Res.* 1994; 18:1335–1341. [PubMed: 7695027]
- Kochman FJ, Hantouche EG, Ferrari P, Lancrenon S, Bayart D, Akiskal HS. Cyclothymic temperament as a prospective predictor of bipolarity and suicidality in children and adolescents with major depressive disorder. *J Affect Disord.* 2005; 85:181–189. [PubMed: 15780688]
- Kuo PH, Chih YC, Soong WT, Yang HJ, Chen WJ. Assessing personality features and their relations with behavioral problems in adolescents: Tridimensional Personality Questionnaire and Junior Eysenck Personality Questionnaire. *Compr Psychiatry.* 2004; 45:20–28. [PubMed: 14671733]
- Lewinsohn PM, Klein DN, Seeley JR. Bipolar disorders in a community sample of older adolescents: prevalence, phenomenology, comorbidity, and course. *J Am Acad Child Adolesc Psychiatry.* 1995; 34:454–463. [PubMed: 7751259]
- Mackie CJ, Castellanos Ryan N, Conrod PJ. Personality moderates the longitudinal relationship between psychological symptoms and alcohol use in adolescents. *Alcohol Clin Exp Res.* 2011; 35:703–716. [PubMed: 21223307]
- Macpherson L, Magidson JF, Reynolds EK, Kahler CW, Lejuez CW. Changes in sensation seeking and risk taking propensity predict increases in alcohol use among early adolescents. *Alcohol Clin Exp Res.* 2010; 34:1400–1408. [PubMed: 20491737]
- Malmberg M, Overbeek G, Monshouwer K, Lammers J, Vollebergh WA, Engels RC. Substance use risk profiles and associations with early substance use in adolescence. *J Behav Med.* 2010; 33:474–485. [PubMed: 20625809]
- Mccourt WF, Gurrera RJ, Cutter HS. Sensation seeking and novelty seeking. Are they the same? *J Nerv Ment Dis.* 1993; 181:309–312. [PubMed: 8501447]
- Mcgirr A, Renaud J, Bureau A, Seguin M, Lesage A, Turecki G. Impulsive aggressive behaviours and completed suicide across the life cycle: a predisposition for younger age of suicide. *Psychol Med.* 2008; 38:407–417. [PubMed: 17803833]
- Mueller C, Orvaschel H. The failure of 'adult' interventions with adolescent depression: what does it mean for theory, research and practice? *J Affect Disord.* 1997; 44:203–215. [PubMed: 9241581]
- Nandagopal JJ, Fleck DE, Adler CM, Mills NP, Strakowski SM, Delbello MP. Impulsivity in adolescents with bipolar disorder and/or attention deficit/hyperactivity disorder and healthy controls as measured by the Barratt Impulsiveness Scale. *J Child Adolesc Psychopharmacol.* 2011; 21:465–468. [PubMed: 22040191]
- Newcomb ME, Clerkin EM, Mustanski B. Sensation seeking moderates the effects of alcohol and drug use prior to sex on sexual risk in young men who have sex with men. *AIDS Behav.* 2011; 15:565–575. [PubMed: 20960048]
- O'jile JR, Ryan LM, Parks Levy J, Betz B, Gouvier WD. Sensation seeking and risk behaviors in young adults with and without a history of head injury. *Appl Neuropsychol.* 2004; 11:107–112. [PubMed: 15477182]
- O'leary Barrett M, Mackie CJ, Castellanos Ryan N, Al Khudhairy N, Conrod PJ. Personality targeted interventions delay uptake of drinking and decrease risk of alcohol related problems when delivered by teachers. *J Am Acad Child Adolesc Psychiatry.* 2010; 49:954–996. e1. [PubMed: 20732631]
- Olvera RL, Fonseca M, Caetano SC, Hatch JP, Hunter K, Nicoletti M, Pliszka SR, Cloninger CR, Soares JC. Assessment of personality dimensions in children and adolescents with bipolar disorder using the Junior Temperament and Character Inventory. *J Child Adolesc Psychopharmacol.* 2009; 19:13–21. [PubMed: 19232019]
- Osborn ZH, Blanton PD, Schwebel DC. Personality and injury risk among professional hockey players. *J Inj Violence Res.* 2009; 1:15–19. [PubMed: 21483186]
- Renaud J, Berlim MT, Mcgirr A, Tousignant M, Turecki G. Current psychiatric morbidity, aggression/impulsivity, and personality dimensions in child and adolescent suicide: a case control study. *J Affect Disord.* 2008; 105:221–228. [PubMed: 17568682]
- Reynolds, W. *SIQ Professional Manual.* Odessa, FL: Psychological Assessment Resources Inc; 1988.

- Reynolds W. Development of a semi structured clinical interview for suicidal behaviors in adolescents. *Psychol Assess J Consult Clin Psychol*. 1990; 2
- Reynolds, WM. *Reynolds Adolescent Depression Scale: Professional manual*. Odessa, FL: Psychological Assessment Resources; 1987.
- Reynolds WM, Mazza JJ. Assessment of suicidal ideation in inner city children and young adolescents: Reliability and validity of the suicidal ideation questionnaire JR. *School Psychology Review*. 1999; 28:17–30.
- Ribeiro JD, Joiner TE. The interpersonal psychological theory of suicidal behavior: current status and future directions. *J Clin Psychol*. 2009; 65:1291–1299. [PubMed: 19827114]
- Roberti JW. A review of behavioral and biological correlates of sensation seeking. *Journal of Research in Personality*. 2004; 38:256–279.
- Roberts RE, Lewinsohn PM, Seeley JR. Screening for adolescent depression: a comparison of depression scales. *J Am Acad Child Adolesc Psychiatry*. 1991; 30:58–66. [PubMed: 2005065]
- Rohde P, Lewinsohn PM, Seeley JR. Comorbidity of unipolar depression: II. Comorbidity with other mental disorders in adolescents and adults. *J Abnorm Psychol*. 1991; 100:214–222. [PubMed: 2040773]
- Romer, D. *Reducing adolescent risk: toward an integrated approach*. Thousand Oaks, CA: Sage; 2003.
- Romer D. Adolescent risk taking, impulsivity, and brain development: implications for prevention. *Dev Psychobiol*. 2010; 52:263–276. [PubMed: 20175097]
- Romer D, Betancourt LM, Brodsky NL, Giannetta JM, Yang W, Hurt H. Does adolescent risk taking imply weak executive function? A prospective study of relations between working memory performance, impulsivity, and risk taking in early adolescence. *Dev Sci*. 2011; 14:1119–1133. [PubMed: 21884327]
- Sanislow CA, Grilo CM, Fehon DC, Axelrod SR, Mcglashan TH. Correlates of suicide risk in juvenile detainees and adolescent inpatients. *J Am Acad Child Adolesc Psychiatry*. 2003; 42:234–240. [PubMed: 12544184]
- Shaffer D, Fisher P, Lucas CP, Dulcan MK, Schwab Stone ME. NIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC IV): description, differences from previous versions, and reliability of some common diagnoses. *J Am Acad Child Adolesc Psychiatry*. 2000; 39:28–38. [PubMed: 10638065]
- Shaffer D, Gould MS, Fisher P, Trautman P, Moreau D, Kleinman M, Flory M. Psychiatric diagnosis in child and adolescent suicide. *Arch Gen Psychiatry*. 1996; 53:339–348. [PubMed: 8634012]
- Shaffer D, Scott M, Wilcox H, Maslow C, Hicks R, Lucas CP, Garfinkel R, Greenwald S. The Columbia Suicide Screen: validity and reliability of a screen for youth suicide and depression. *J Am Acad Child Adolesc Psychiatry*. 2004; 43:71–79. [PubMed: 14691362]
- Smith PN, Cukrowicz KC. Capable of suicide: a functional model of the acquired capability component of the Interpersonal Psychological Theory of Suicide. *Suicide Life Threat Behav*. 2010; 40:266–275. [PubMed: 20560748]
- Spittle B, Bragan K, James B. Risk taking propensity, depression and parasuicide. *Aust N Z J Psychiatry*. 1976; 10:269–273. [PubMed: 1071006]
- Steinberg L. A dual systems model of adolescent risk taking. *Dev Psychobiol*. 2010; 52:216–224. [PubMed: 20213754]
- Steinberg L, Albert D, Cauffman E, Banich M, Graham S, Woolard J. Age differences in sensation seeking and impulsivity as indexed by behavior and self report: evidence for a dual systems model. *Dev Psychol*. 2008; 44:1764–1778. [PubMed: 18999337]
- Stephenson MT, Hoyle RH, Palmgreen P, Slater MD. Brief measures of sensation seeking for screening and large scale surveys. *Drug Alcohol Depend*. 2003; 72:279–286. [PubMed: 14643945]
- Strober M, Green J, Carlson G. Utility of the Beck Depression Inventory with psychiatrically hospitalized adolescents. *J Consult Clin Psychol*. 1981; 49:482–483. [PubMed: 7276342]
- Tarter R, Mezzich A, Kirisci L, Kaczynski N. Reliability of Drug Use Screening Inventory among adolescent alcoholics. *J Child Adolesc Subst Abuse*. 1994; 3
- Tarter RE. Evaluation and treatment of adolescent substance abuse: a decision tree method. *Am J Drug Alcohol Abuse*. 1990; 16:1–46. [PubMed: 2330931]

- Tarter RE, Hegedus AM. The Drug Use Screening Inventory: its applications in the evaluation and treatment of alcohol and other drug abuse. *Alcohol Health Res World*. 1991; 15:65–75.
- Tarter RE, Kirisci L, Mezzich A. Multivariate typology of adolescents with alcohol use disorder. *Am J Addict*. 1997; 6:150–158. [PubMed: 9134077]
- Tarter RE, Laird SB, Bukstein O, Kaminer Y. Validation of the Adolescent Drug Use Screening Inventory: preliminary findings. *Psychol Addict Behav*. 1992; 6
- Tarter RE, Mezzich AC, Hsieh YC, Parks SM. Cognitive capacity in female adolescent substance abusers. *Drug Alcohol Depend*. 1995; 39:15–21. [PubMed: 7587969]
- Teri L. The use of the Beck Depression Inventory with adolescents. *J Abnorm Child Psychol*. 1982; 10:277–284. [PubMed: 7108067]
- Testa CR, Steinberg L. Depressive symptoms and health related risk taking in adolescence. *Suicide Life Threat Behav*. 2010; 40:298–305. [PubMed: 20560751]
- Tillman R, Geller B, Craney JL, Bolhofner K, Williams M, Zimmerman B, Frazier J, Beringer L. Temperament and character factors in a prepubertal and early adolescent bipolar disorder phenotype compared to attention deficit hyperactive and normal controls. *J Child Adolesc Psychopharmacol*. 2003; 13:531–543. [PubMed: 14977466]
- Wagner MK. Behavioral characteristics related to substance abuse and risk taking, sensation seeking, anxiety sensitivity, and self reinforcement. *Addict Behav*. 2001; 26:115–120. [PubMed: 11196285]
- Whiteside SP, Lynam DR. The Five Factor Model and impulsivity: using a structural model of personality to understand impulsivity. *Personality and Individual Differences*. 2001; 30:669–689.
- Zuckerman, M. Behavioral expressions and biosocial bases of sensation seeking. New York, NY: Cambridge University Press; 1994.
- Zuckerman M, Eysenck S, Eysenck HJ. Sensation seeking in England and America: cross-cultural, age, and sex comparisons. *J Consult Clin Psychol*. 1978; 46:139–149. [PubMed: 627648]
- Zuckerman M, Kolin I, Price L, Zoob I. Development of a Sensation Seeking Scale. *J Consult Psychol*. 1964; 28

Table 1

Association of Sensation Seeking with Demographic Variables

		Adjusted Odds Ratio			
		Low SS group (n= 1778)	High SS group (n= 395)	OR ^a	(95% CI)
Gender	n				
Boys	1266	% (n) 80.6 (1021)	19.4 (245)	1.27*	(1.002–1.61)
Girls	907	% (n) 83.5 (757)	16.5 (150)		
Grade	n				
9 ^b	1126	% (n) 81.8 (921)	18.2 (205)		
10	549	% (n) 82.9 (455)	17.1 (94)	0.90	(0.67–1.21)
11	312	% (n) 80.8 (252)	19.2 (60)	0.93	(0.65–1.34)
12	186	% (n) 80.6 (150)	19.4 (36)	0.89	(0.57–1.38)
		Mean (SD)	Mean (SD)	β (s.e.)	p
Age		14.78 (1.18)	14.87 (1.18)	0.04 (0.05)	0.398

Note: In the table are given the row percentages.

^a Adjusted for school.

^b Reference category for grade.

OR: Odds Ratio. CI: Confidence Interval. SS: Sensation Seeking.

* p < .05;

** p < .01;

*** p < .001

\$watermark-text

\$watermark-text

\$watermark-text

Table 2
 Association of Sensation Seeking with Depressive Symptoms, Substance Use Problems, Serious Suicidal ideation, and Suicide Attempts

	Adjusted Odds Ratio				
	Low SS group (n= 1778)	High SS group (n= 395)	OR ^a (95% CI)	OR ^b (95% CI)	OR ^c (95% CI)
	% (n)	% (n)			
Depressive symptoms	9.7 (172)	22.4 (88)	2.90 *** (2.16–3.89)		
Substance use problems	5.2 (93)	14.9 (59)	3.25 *** (2.27–4.64)		
Serious suicidal ideation	2.7 (48)	8.1 (32)	3.43 *** (2.15–5.49)	1.73* (1.01–2.94)	2.81 *** (1.73–4.57)
Suicide attempts	3.0 (54)	8.9 (35)	3.47 *** (2.20–5.46)	2.08** (1.26–3.41)	2.79 *** (1.74–4.47)

Note:

^a Adjusted for gender and school.

^b Adjusted for depressive symptoms, gender, and school.

^c Adjusted for substance use problems, gender, and school.

OR: Odds Ratio. CI: Confidence Interval.

* p < .05;

** p < .01;

*** p < .001