

## Is Sensation Seeking a Stable Trait or Does it Change Over Time?

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### **Abstract:**

The theory of sensation seeking has conceptualized this construct as a stable personality trait associated with a variety of problem behaviors. Reckless behavior theory posits that increases in reckless behavior during adolescence can be attributed, in part, to increases in sensation seeking. This study evaluated patterns of stability and change in sensation seeking among 868 urban, minority youth (53% female), followed longitudinally across middle school (6th–8th grades). Group-based trajectory analysis identified a stable low group (20%), a moderate increasing group (60%), and a stable high group (20%) each of which demonstrated unique associations with changes in problem behaviors. Stable low sensation seekers reported consistently low levels of aggression, delinquency, and substance use across middle school. Moderate increasing sensation seekers reported significant increases in these risk behaviors over time from levels near zero in the 6th grade. Stable high sensation seekers reported high, stable levels of aggression and delinquency upon entry into middle school as well as significant increases in substance use across middle school. These results lend support to both theories and highlight a need for caution when categorizing adolescents as high or low sensation seekers.

**Keywords:** Sensation seeking | Trajectories | Adolescence | Gender | Problem behavior

### **Article:**

A great deal of research on risk behavior during adolescence has shown a consistent connection between high sensation seeking and engagement in risky behaviors, including risky sports, substance use and abuse, delinquent and criminal behavior, as well as precocious sexual activity (Arnett 1992; Zuckerman 2007). Despite this consistency in findings, an important conceptual issue has yet to be fully examined. Specifically, in the theory of sensation seeking, sensation seeking is considered a fairly stable personality trait with a biological/genetic origin (Zuckerman 2007). In theories of the development of risk behavior during adolescence, such as reckless behavior theory, sensation seeking is hypothesized to increase during adolescence and is hence one of two key factors responsible for increases in reckless behavior during this period of

development (Arnett 1992). These two perspectives have distinctly different implications for prevention initiatives.

As defined by Zuckerman (2007), sensation seeking is the need for “varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experiences” (p. 49). Traditionally, sensation seeking is conceptualized as having four distinct components: experience seeking, thrill and adventure seeking, disinhibition, and boredom susceptibility (Zuckerman 2007). Research on the effects of specific components have found stronger associations between risk taking behaviors and the thrill and adventure seeking and disinhibition components of sensation seeking (Newcomb and McGee 1991; Zuckerman 2007). Thrill and adventure seeking refers to a person’s desire to engage in physically risky activities such as risky sports and the enjoyment of frightening experiences (Zuckerman 2007). Disinhibition is similar to impulsivity or a lack of self-control in that it represents a tendency to act without regard for consequences (Acton 2003; Gottfredson and Hirschi 1990). There is little debate among researchers regarding the conceptual similarity among these constructs. For instance, the hierarchical model of personality defines impulsivity as a biologically based personality trait characterized by acting on impulse, nonplanning, liveliness, and risk-taking (Acton 2003). As discussed previously, sensation seeking also represents a biologically based personality trait characterized by a tendency to seek exciting experiences with the disinhibition subscale representing a tendency to act without regard for consequences (Acton 2003). Self-control is considered a behavioral style that is learned early in life and is highly resistant to change. High self-control is characterized by an ability to make decisions about current behavior based on considering the long-term consequences of that behavior. Individuals with low self-control act without consideration of future consequences (Gottfredson and Hirschi 1990). Despite minor theoretical distinctions in the origins and definitions of disinhibition, impulsivity, and self-control, these constructs are all clearly related by a tendency to act on impulse, without planning for or taking into account the future consequences of one’s actions.

Previous research on associations between sensation seeking and risk behaviors have proven informative in identifying which subscales confer risk for particular risk behaviors, yet there are still important limitations that should be addressed. In studies evaluating the association between sensation seeking and substance use, thrill and adventure seeking and disinhibition are continually identified as the subscales most strongly related to drug use (Zuckerman 2007). Individuals with higher levels of thrill and adventure seeking and disinhibition have been identified by numerous studies to be more likely to initiate substance use, as well as have higher levels of use for both specific substances and combined measures of substance use (Zuckerman 2007). A separate literature has elaborated on a similar connection between the thrill and adventure seeking and disinhibition sensation seeking subscales and the development of aggressive and delinquent behaviors (Newcomb and McGee 1991). More recent studies have evaluated drug use, aggression, and delinquency combined representing general deviance in

multiple domains. These studies also find high levels of thrill and adventure seeking and disinhibition to be associated with general deviance (Newcomb and McGee 1991). All of the aforementioned studies categorize individuals as high or low sensation seekers based on somewhat arbitrary cutoffs (e.g., mean split, upper and lower quartile). Other studies that evaluated sensation seeking as a continuous variable found positive correlations between sensation seeking and drug use, aggression and delinquency (Huba et al. 1981; White et al. 1985). However, these studies were limited in that they utilized cross sectional samples of college students. Alternative ways to categorize and evaluate the effects of sensation seeking on risk behaviors across development is warranted.

Developmental and demographic trends regarding changes in sensation seeking have traditionally been estimated using variable-centered analyses and would be informed by taking a person-centered approach. Variable-centered analyses find that average levels of sensation seeking tend to increase during childhood, peaking in late adolescence, and declining in adulthood (Zuckerman 2007). A focused longitudinal evaluation of the middle school years is especially warranted given that this time frame captures the transition from childhood to adolescence. It is at this point in time that initial increases in risk behaviors such as aggression, delinquency, and substance use begin to emerge for many youth. Based on variable-centered analyses, males are more likely to be high sensation seekers than females, especially in regards to the thrill and adventure seeking and disinhibition components. There is also evidence that African Americans report slightly lower levels of sensation seeking compared to Caucasians. There is no evidence of racial/ethnic differences in the disinhibition component (Zuckerman 2007). Person-centered longitudinal evaluations of sensation seeking during middle school would determine if developmental and demographic patterns of sensation seeking are consistent among all individuals in the population or if there are different patterns among subgroups of the population. Different patterns of sensation seeking among subgroups of the population during middle school may have implications for associations with changes in risk behaviors during this time frame as well as implications for prevention and intervention.

The utility of targeting a personality trait such as sensation seeking directly as a method of intervention is a topic of debate. Most researchers conceptualize sensation seeking as a stable trait which is unlikely to be reduced via intervention, in line with the theory of sensation seeking (Zuckerman 2007). The reckless behavior perspective (Arnett 1992) states that developmental changes in sensation seeking and egocentrism underlie the rapid increase in reckless behavior seen during the middle school years (ages 11–14). However, neither position implies that sensation seeking should not be incorporated into interventions aimed at reducing risky behavior during adolescence. Arnett (1995) argues that it may be possible to change how sensation seeking is expressed, minimizing unhealthy expressions. Moreover, the expression of sensation seeking is influenced via socialization, and hence, socialization processes could be targeted directly for the prevention of reckless or risky behaviors during adolescence (Arnett 1995). Regardless of whether sensation seeking is stable or changes, preventive interventions can target

how sensation seeking is expressed. Moreover, if sensation seeking changes over time, interventions can be targeted to both attenuate the increase in sensation seeking as well as modify how it is expressed.

In addition to evaluating patterns of stability or change in sensation seeking during middle school, observed changes in risk behaviors such as aggression, delinquency, and substance use have been found to follow different trajectories within subgroups of the population, as hypothesized by Moffitt's theory of adolescent limited versus life-course persistent offending (Moffitt 2006). Specifically, Moffitt's theory predicts a group of individuals who do not engage in the aforementioned risk behaviors, a group of individuals who engage in chronically high levels of risk behaviors throughout childhood, adolescence, and into adulthood, as well as a group of individuals who evince increases in risk behaviors during adolescence that decline upon entry into adulthood. As noted, all previous research on sensation seeking as a predictor of risk behavior is limited in that individuals were classified as either high or low sensation seekers based on cutoffs (e.g. median split, upper and lower quartile). Longitudinal data on sensation seeking allows for the use of person-centered statistical methodology in the estimation of trajectories of sensation seeking over time based on actual data rather than a priori hypotheses. Specifically, group-based trajectory analysis is a recently developed analytic procedure that allows researchers to determine if there are distinct groups within the population that differ in their initial levels of sensation seeking as well as if sensation seeking remains stable or changes across time (Nagin 2005). In the present investigation, we evaluated trajectories of sensation seeking across middle school in order to evaluate the stability or change in sensation seeking and the implications for prediction of risk behaviors.

## **Hypotheses**

The present investigation evaluates trajectories of sensation seeking in a sample of urban girls and boys across middle school. Although we expect higher levels of sensation seeking to predict higher rates of negative outcomes, this is an exploratory investigation to determine whether subgroups of the population follow different trajectories of sensation seeking and, if so, whether these subgroups differentially predict risk behaviors such as aggression, delinquency, and substance use. Gender differences in trajectory group membership are expected with males being more likely to follow trajectories of higher sensation seeking and females more likely to follow trajectories of lower sensation seeking.

## **Method**

### **Design and Participants**

Participants for this longitudinal study were drawn from the control condition of a randomized, school-based substance use and violence prevention trial conducted in a large metropolitan city in the north eastern United States. In 6th, 7th, and 8th grades, participants completed extensive

self-report surveys over 2 days during regular school hours. Multi-ethnic groups of 3–5 data collectors were present to answer participant questions during the survey.

An initial sample of 2,931 individuals provided data during the 6th grade baseline assessment. Sensation seeking was assessed at the end of the survey packet on the second day of testing resulting in a reduced sample at baseline (6th grade) of 1,852. An additional 610 individuals in 7th grade (one school discontinued participation) and 374 individuals in 8th grade did not complete follow-up assessments. The final sample consisted of 868 individuals with complete data from 6th to 8th grade. Study participants were slightly more likely to be female (53%,  $n = 463$ ) in the 6th grade. The average age was 11.6 years old ( $SD = 0.45$ ). Seventy-eight percent of the participants attended public school with 22% in parochial school. Sixty-four percent were from two-parent families. The majority of the sample was African American (47%), with 27% Latino, 8% White/Caucasian, 7% Asian American, 1% American Indian or Alaskan Native, and 10% other or of mixed race or ethnicity. Although a measure of family socioeconomic status (SES) was not available, archival public school records of participating schools showed that the majority (88%) of schools had greater than 65% student eligibility for free or reduced lunch.

## **Measures**

### **Demographic Variables**

A series of binary variables captured gender, family structure (% two parent household), and school type (public vs. parochial). Race/ethnicity was captured by two dummy coded dichotomous variables representing African American race/ethnicity and Latino race/ethnicity.

### **Sensation Seeking**

General sensation seeking in this study was a composite measure of self-control (Rosenbaum 1980) and enjoyment of risky activities (Eysenck and Eysenck 1975). These constructs served as proxies for Zuckerman's disinhibition and thrill and adventure seeking subscales of sensation seeking. Enjoyment of risky activities was assessed in the 6th ( $\alpha = .79$ ), 7th ( $\alpha = .82$ ), and 8th grades ( $\alpha = .82$ ) via 4 items (e.g., I would enjoy fast driving; I think life with no danger in it would be dull for me). Self-control was used as a proxy for disinhibition and was assessed in 6th ( $\alpha = .67$ ), 7th ( $\alpha = .71$ ), and 8th grades ( $\alpha = .71$ ) via 13 items (e.g., I find that I like to switch from one thing to another; I am easily distracted from my work). Response options were on a 5 point Likert Scale ranging from strongly disagree to strongly agree (recoded 0–4). Items were averaged to create two subscales of sensation seeking (i.e. self-control and enjoyment of risky activities) where higher values indicated higher self-control and greater enjoyment of risky activities. Correlations between the subscales at each time of assessment were  $-0.29$  in the 6th grade,  $-0.26$  in 7th grade, and  $-0.25$  in 8th grade. These correlations are consistent with observed correlations between subscales of the sensation seeking scale version 5 (Median  $r_s = .14-.41$ ; Zuckerman 2007). Self-control was reverse scored such that higher values

indicated lower self-control and the two subscales were summed to create a general sensation seeking construct ranging from 0 to 8 where higher values indicated greater enjoyment of risky activities and lower self-control in 6th ( $\alpha = .75$ ), 7th ( $\alpha = .76$ ), and 8th grades ( $\alpha = .75$ ).

### **Aggression**

Aggression was assessed via the aggression scale of the Youth Self-Report (YSR, Achenbach 1991). Students were asked how many times in the past month they had engaged in ten incidents of overtly aggressive behavior in the 6th grade ( $\alpha = .93$ ), 7th grade ( $\alpha = .94$ ), and 8th grade ( $\alpha = .94$ ). Examples of items included “Yelled at someone (you were mad at)” and “Told someone off.” Response options included never (1), once (2), 2–3 times (3), 4–5 times (4), and more than 5 times (5). Items were rescored onto a scale of 0–4 and then summed to create a continuous measure where higher scores indicated greater aggression.

### **Delinquency**

Students were also asked how many times in the past year they had engaged in ten incidents of delinquent behavior in the 6th grade ( $\alpha = .86$ ), 7th grade ( $\alpha = .88$ ), and 8th grade ( $\alpha = .90$ ; adapted from Elliott et al. 1989). Examples of items included “Thrown objects such as rocks or bottles at cars or people” and “Hit someone with the idea of seriously hurting them.” Response options included never (1), once (2), 2–3 times (3), 4–5 times (4), and more than 5 times (5). Items were rescored onto a scale of 0–4 and then summed to create a continuous measure where higher scores indicated greater delinquency.

### **Drug Use**

Survey items assessed frequency of cigarette smoking, drinking alcohol, drinking until drunk, smoking marijuana, smoking marijuana until high or stoned, and using inhalants. Frequency of each item was measured with the following response options: never (0), a few times but not in the past year (1), a few times a year (2), once a month (3), a few times a month (4), once a week (5), a few times a week (6), once a day (7), or more than once a day (8). Due to the fact that reports of individual substance use is quite low at the initial assessment but increases, the current study created a composite sum score of drug use across items, such that higher values represented more overall drug use at each grade. Cronbach’s alpha is somewhat low in the 6th grade ( $\alpha = .61$ ) due to the low reported rates of substance use at this age, but increases to appropriate levels in the 7th ( $\alpha = .78$ ) and 8th ( $\alpha = .86$ ) grades.

### *Attrition Analyses*

Attrition analyses were conducted to determine if individuals who were not included in analyses were statistically different at baseline compared with individuals with complete data at all three assessments. There were fewer male participants compared to non-participants  $\chi^2(1, N = 2,915) = 4.19, p = .022$  (47 vs. 51%, respectively), as well as fewer Latino participants

compared to non-participants  $\chi^2(1, N = 2,912) = 6.49, p = .006$  (27 vs. 32%, respectively). Participants were more likely to attend parochial school compared to non-participants  $\chi^2(1, N = 2,931) = 219.91, p < .001$  (22 vs. 5%, respectively), and more likely to come from a two-parent household  $\chi^2(1, N = 2,882) = 27.09, p < .001$  (64 vs. 53%, respectively). In addition, participants reported slightly higher levels of 6th grade self-control  $t(2078) = 5.26, p < .001$ , and lower levels of 6th grade sensation seeking  $t(1850) = -2.10, p = .036$ , compared to non-participants ( $M = 3.51$  vs.  $3.38$  and  $M = 3.20$  vs.  $3.33$ , respectively). There was no difference between participants and non-participants regarding enjoyment of risky activities in the 6th grade. It is important to note that the individuals who provided complete data for this study reported slightly attenuated levels of sensation seeking compared to those who were not included. This is due to the slightly higher reports of self-control among the participants and not because of differences in enjoyment of risky activities.

### *Analysis Plan*

A descriptive analysis of sensation seeking was evaluated via a repeated measures analysis of variance (RM-ANOVA). Sensation seeking was the dependent variable. Gender, race/ethnicity, school type, and family structure were the independent variables. This analysis provided basic descriptive information regarding average changes in sensation seeking across the entire sample during middle school. This technique does not account for the possibility that there may be distinct groups of adolescents whose levels of sensation seeking across middle school differ in terms of onset and change over time.

A group-based approach to analyzing developmental trajectories was used to address the primary objective of this study (Nagin 2005) among individuals with complete data. This approach identifies groups of individuals following approximately the same developmental trajectory over a specified period of time for the outcome of interest, in this case sensation seeking. One of the key benefits of this analytical technique is the ability to identify groups of individuals within the population that would not necessarily have been predicted a priori rather than relying on cut-offs (e.g. median split) to determine groups. Model fit was evaluated using the Bayesian Information Criterion (BIC) where higher values indicated better model fit. In addition to using BIC for model selection, Nagin outlined 3 diagnostic guidelines for evaluating the adequacy of model fit (2005). First, the average posterior probability (AvePP) must be 0.70 or greater for all groups. This indicates that, on average, the individuals assigned to a particular trajectory group had a 70% or greater probability of belonging to that group based on their individual data. The second diagnostic is the odds of correct classification for group  $j$  ( $OCC_j$ ) should be 5 or greater for all groups, indicating high accuracy in individual assignment to trajectory groups. Finally, the correspondence between the model estimation of the proportion of the population that follows a particular trajectory group ( $\pi_j$ ) with the proportion of the sample assigned to a particular trajectory group based on their highest posterior probability ( $P_j$ ) provides a third diagnostic. Closer correspondence between these estimates indicates better model fit.

After model selection, individuals were labeled as belonging to a particular sensation seeking class based on their posterior probability scores. This created an observed variable indicating class membership. A cross-tabulation of sensation seeking trajectory group membership by the demographic variables was conducted to determine whether different developmental trajectories of sensation seeking were associated with gender, family structure, school type, or race/ethnicity. RM-ANCOVAs were conducted to determine if sensation seeking trajectory group membership was associated with changes in aggression, delinquency, and substance use across middle school.

Note that all analyses were replicated on the entire sample accounting for missing values using a Full Information Maximum Likelihood (FIML) algorithm in the group-based trajectory analysis resulting in group membership assignments for the entire sample. The resulting FIML trajectory model and analyses did not differ from the results reported for the reduced sample; these findings are not reported but are available from the first author upon request.

## Results

### *Preliminary Descriptive Analyses*

Average levels of sensation seeking were low to moderate across middle school and were normally distributed with both skewness and kurtosis less than 1 (Table 1 for means and standard deviations). Results of a RM-ANOVA on sensation seeking revealed significant main effects of grade  $F(2, 1720) = 27.95, p < .001, \mu = .03$ , gender  $F(1, 860) = 8.40, p = .004, \mu = .01$ , and race/ethnicity  $F(1, 860) = 6.04, p = .014, \mu = .01$ . Follow-up Bonferoni corrected pairwise comparisons revealed a significant increase in sensation seeking between 6th and 7th grade. The change between 7th and 8th grade was not statistically significant. In addition, Bonferoni corrected pairwise comparisons revealed that males reported significantly higher average levels of sensation seeking compared to females ( $M = 3.61$  vs.  $3.39$ ) and Latinos reported significantly higher average levels of sensation seeking compared to other race/ethnicities ( $M = 3.63$  vs.  $3.38$ ). The effects of family structure and school type on sensation seeking were not significant.

**Table 1.** Sample descriptive statistics

Demographic variables	Test statistic	Sensation seeking trajectory group			
		Low stable (%)	Moderate increasing (%)	High stable (%)	Total sample (%)
% Within trajectory group		20	60	20	100
Gender (% female)	$\chi^2(2, 807) = 8.53^*$	59	54	43	53

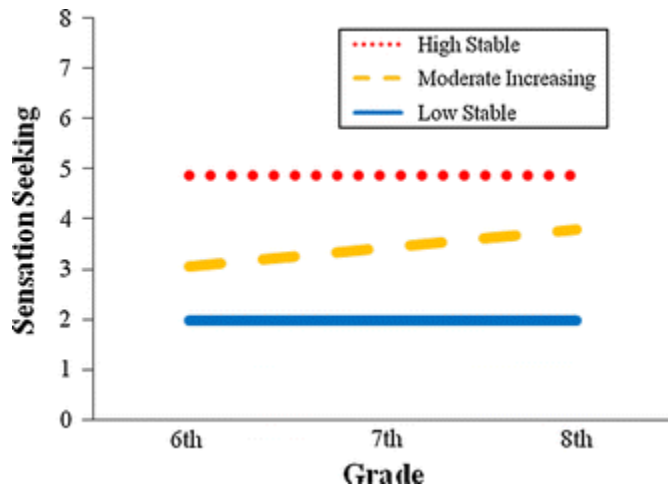


% African American	$\chi^2(2, 807) = 5.73$	56	45	48	47
% Latino	$\chi^2(2, 807) = 10.67^{**}$	17	30	29	27
Family structure (% two-parent)	$\chi^2(2, 805) = 1.52$	62	63	68	64
School type (% public)	$\chi^2(2, 807) = 0.38$	79	79	77	78
			<b><i>M(SD)</i></b>	<b><i>M(SD)</i></b>	<b><i>M(SD)</i></b>
Sensation seeking variables					
Sensation seeking 6th grade	$F(2, 804) = 448.18^{***}$	1.85 (.99)	3.01 (.98)	4.99 (.91)	3.20 (1.39)
Sensation seeking 7th grade	$F(2, 804) = 537.07^{***}$	1.81 (.86)	3.50 (.96)	5.09 (.79)	3.47 (1.37)
Sensation seeking 8th grade	$F(2, 804) = 576.44^{***}$	1.85 (.77)	3.81 (.90)	5.07 (.87)	3.65 (1.34)
Sensation seeking subscales					
Risk enjoyment 6th grade	$F(2, 804) = 356.86^{***}$	1.75 (.73)	2.55 (.83)	4.04 (.75)	2.71 (1.08)
Risk enjoyment 7th grade	$F(2, 804) = 364.81^{***}$	1.75 (.71)	2.85 (.81)	4.07 (.75)	2.87 (1.07)
Risk enjoyment 8th grade	$F(2, 804) = 376.81^{***}$	1.77 (.69)	3.12 (.80)	4.09 (.75)	3.03 (1.06)
Self-control 6th grade	$F(2, 804) = 103.73^{***}$	3.90 (.58)	3.54 (.53)	3.05 (.52)	3.51 (.59)
Self-control 7th grade	$F(2, 804) = 148.26^{***}$	3.94 (.58)	3.35 (.51)	2.97 (.44)	3.40 (.59)
Self-control 8th grade	$F(2, 804) = 145.15^{***}$	3.92 (.56)	3.32 (.48)	3.03 (.45)	3.38 (.57)

Note: Asterisks mark significant differences between trajectory groups; \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ ; demographic variables were binary with 1 representing the group labeled in the table and 0 representing all others

*Primary Trajectory Analysis of Sensation Seeking*

Given that sensation seeking was normally distributed, a censored normal group based trajectory analysis was estimated, identifying three distinct developmental trajectories of sensation seeking (Fig. 1). Linear growth models ranging from 1 group to 6 groups were evaluated to determine how many groups best represented the data. The 3 group model had a 90–98% probability of being the correct model based on BIC comparisons. In addition, the diagnostics of model fit all indicated that individuals were assigned to groups with acceptable accuracy (Table 2). At either high or low levels, sensation seeking was relatively stable across middle school. However, sensation seeking increased across 6th, 7th, and 8th grade among individuals with more moderate levels of sensation seeking ( $slope = 3.58, p < .001$ ).



**Fig. 1** Final 3 group trajectory model of sensation seeking

**Table 2.** Diagnostics of assignment accuracy

Assigned group	$\pi_j$ (%)	$P_j$	Ave. PP	OCC
Low	21	164 (20%)	0.87	25.2
Moderate increasing	57	479 (59%)	0.88	5.5
High	22	164 (20%)	0.89	28.7

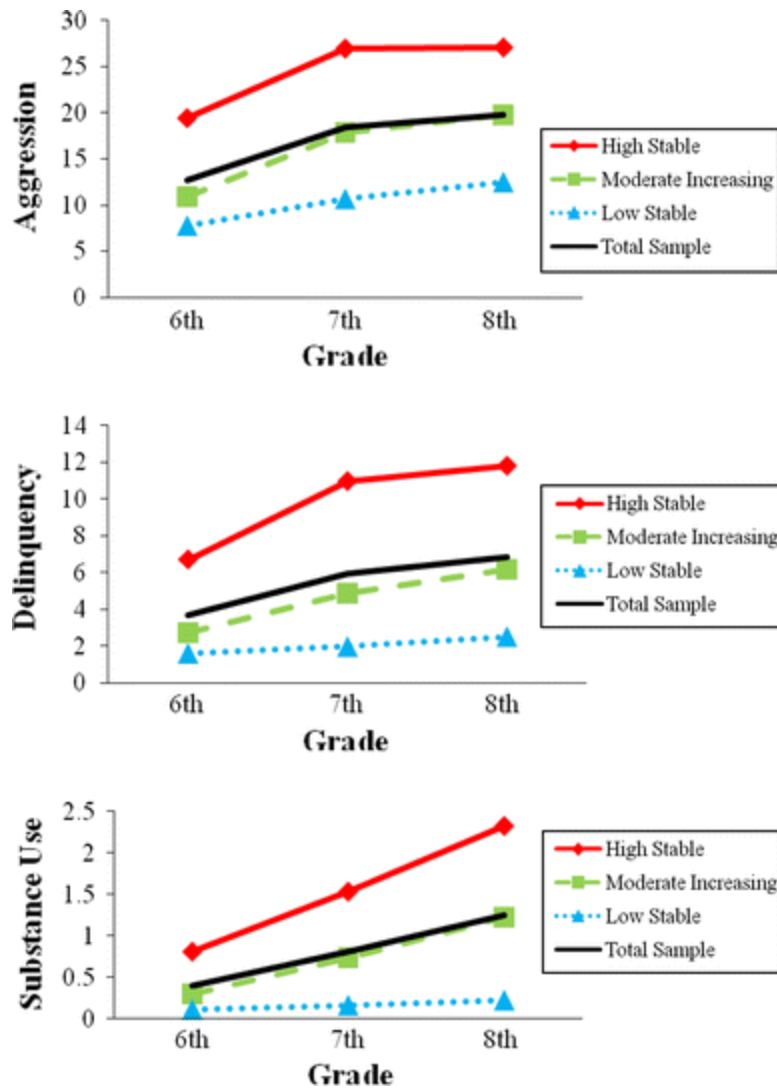
Note:  $\pi_j$  = group membership probability,  $P_j$  = proportion of sample classified in group based on posterior probability, Ave. PP = average posterior probability, OCC = odds correct classification

As can be seen in Fig. 1, the 3 groups of sensation seeking were: stable low (21%), moderate increasing (57%), and stable high (22%). The preceding percentages refer to the proportion of the population expected to fall within each trajectory group ( $\pi_j$ ). Individual posterior probabilities of membership in each trajectory group were estimated based on participant's own data. Participants were labeled as belonging to a trajectory group if their posterior probability was greater than 60% for a particular group. Average posterior probability was 0.87 for the stable low group, 0.88 for the moderate increasing group, and 0.89 for the stable high group.

The high within group values for the posterior probabilities provide evidence that the participants assigned to each group are closely representative of that group's pattern of sensation seeking. In addition, descriptive statistics and levels of sensation seeking were evaluated within the sensation seeking trajectory group (Table 1). Clear patterns of sensation seeking were evident among individuals assigned to each of the three trajectory groups, lending validation to the trajectory model and the posterior assignment of individual participants to groups. Note that there are significantly more males within the stable high sensation seeking trajectory group and significantly more females in the stable low sensation seeking trajectory group. There are also significantly fewer Latinos in the stable low sensation seeking trajectory group compared with the moderate increasing or stable high sensation seeking trajectory groups. These findings complement and expand upon the findings for the overall sample regarding gender and race/ethnic differences in sensation seeking.

#### *Sensation Seeking Trajectory Group Predicting Risk Behaviors*

Results of a RM-ANCOVA, controlling for gender, race/ethnicity, school type, and household structure, found significant interactions between grade and sensation seeking trajectory group for aggression  $F(4, 1522) = 6.12, p < .001, \mu = .02$ , delinquency  $F(4, 1522) = 10.43, p < .001, \mu = .03$ , and substance use  $F(4, 1522) = 8.74, p < .001, \mu = .02$ . Bonferroni corrected pairwise comparisons were used to aid in interpretation of these significant interactions. Figure 2 illustrates average trends in the risk behaviors for each trajectory group.



**Fig. 2** Average trends in risk behaviors within trajectory group

Stable low sensation seekers reported consistently low levels of risk behaviors which did not increase significantly across middle school, with the exception of a slight increase in aggression between 6th and 7th grades (Table 3). Moderate increasing sensation seekers began 6th grade with low levels of all risk behaviors which subsequently increased significantly across middle school. Stable high sensation seekers reported high levels of aggression and delinquency upon entry into middle school which increased significantly between 6th and 7th grade and remained stable and high between 7th and 8th grade. Stable high sensation seekers also reported significant increases in substance use across middle school.

**Table 3.** Middle school aggression, delinquency, and substance use within trajectory group

	<b>Sensation seeking trajectory group</b>			
	<b>Low stable</b>	<b>Moderate increasing</b>	<b>High stable</b>	<b>Total sample</b>
	<i>M</i> (SE)	<i>M</i> (SE)	<i>M</i> (SE)	<i>M</i> (SE)
<b>Aggression</b>				
6th grade	7.77 <sup>a</sup> (0.71)	10.92 <sup>a</sup> (0.42)	19.46 <sup>a</sup> (0.74)	12.71 <sup>a</sup> (0.37)
7th grade	10.66 <sup>b</sup> (0.82)	17.84 <sup>b</sup> (0.48)	26.96 <sup>b</sup> (0.85)	18.49 <sup>b</sup> (0.42)
8th grade	12.50 <sup>b</sup> (0.88)	19.78 <sup>c</sup> (0.52)	27.08 <sup>b</sup> (0.91)	19.79 <sup>c</sup> (0.45)
<b>Delinquency</b>				
6th grade	1.60 <sup>a</sup> (0.34)	2.72 <sup>a</sup> (0.20)	6.69 <sup>a</sup> (0.35)	3.67 <sup>a</sup> (0.17)
7th grade	1.98 <sup>a</sup> (0.47)	4.89 <sup>b</sup> (0.28)	10.96 <sup>b</sup> (0.49)	5.94 <sup>b</sup> (0.24)
8th grade	2.52 <sup>a</sup> (0.56)	6.18 <sup>c</sup> (0.33)	11.80 <sup>b</sup> (0.58)	6.84 <sup>c</sup> (0.29)
<b>Substance use</b>				
6th grade	0.11 <sup>a</sup> (0.08)	0.30 <sup>a</sup> (0.05)	0.81 <sup>a</sup> (0.08)	0.40 <sup>a</sup> (0.04)
7th grade	0.16 <sup>a</sup> (0.14)	0.74 <sup>b</sup> (0.08)	1.53 <sup>b</sup> (0.14)	0.81 <sup>b</sup> (0.07)
8th grade	0.22 <sup>a</sup> (0.19)	1.22 <sup>c</sup> (0.11)	2.32 <sup>c</sup> (0.20)	1.25 <sup>c</sup> (0.10)

*Note:* Different superscript letters within columns indicate statistically significant differences in means for each outcome across middle school

## **Discussion**

Sensation seeking is a clearly established predictor of risk behavior and as such should be included in prevention and intervention strategies aimed at reducing risk behavior. Less clear is the most appropriate method of incorporating sensation seeking into prevention strategies. The results of this study indicate that, for about 40% of youth during early adolescence, sensation seeking is relatively stable whereas for the majority of the sample (60%) levels of sensation seeking are moderate and show increases during the middle school years. This provides a richer picture of changes in sensation seeking that occur during early adolescence in line with both the reckless behavior theory and the theory of sensation seeking (Arnett 1992; Zuckerman 2007). In addition, the trajectories of sensation seeking identified in this study mirror changes in risk behaviors that occur during middle school with low stable sensation seekers reported consistently

low levels of risk behaviors, increasing sensation seekers reported increases in risk behavior, and stable high sensation seekers reported relatively stable high levels of risk behaviors.

Recent advances in statistical methodology have enabled researchers to identify patterns in the data that may not necessarily be predicted a priori. The findings for sensation seeking are a perfect example of the strengths of using group-based trajectory analysis. Through the use of group-based trajectory analysis, this study was able to verify patterns of change in sensation seeking predicted by two conceptualizations of the construct, a stable trait (Zuckerman 2007) and a construct that increases during early adolescence (Arnett 1992). The stability of sensation seeking at the upper and lower ends, in combination with the moderate increasing group that comprised the majority of the sample, highlights the need for a two pronged approach to the incorporation of sensation seeking into preventive interventions. The stability of the high sensation seeking group, along with its association to the highest levels of risk behaviors, emphasizes a need for interventions aimed at altering how sensation seeking is expressed as suggested by Arnett (1995). Minimizing unhealthy expressions of sensation seeking would be beneficial for both high and moderate increasing sensation seekers; however, it also would be beneficial to further evaluate factors associated with the observed increase in sensation seeking among the majority of the sample (e.g., socialization processes; Arnett 1995). These factors can be directly targeted via preventive interventions to attenuate the observed increase in sensation seeking, thereby attenuating engagement in risk behaviors.

In addition, this study grouped individuals based on their data and was able to expand upon our current understanding of observed gender differences in sensation seeking. The moderate increasing group is of particular interest regarding interventions for risk behavior given that there are equal proportions of males and females within this trajectory group. That is, previously observed gender differences in studies of sensation seeking based on cutoffs may be attributed to the higher proportion of males in the high sensation seeking trajectory and the higher proportion of females in the low sensation seeking trajectory. However, these two groups account for a minority of the sample overall. For the majority of adolescents during middle school, there are slight increases in sensation seeking and this does not differ by gender. Furthermore, the moderate increasing sensation seekers reported increases in aggression, delinquency, and substance use across middle school, highlighting sensation seeking as an important risk factor for both males and females.

Moreover, the identification of the moderate increasing sensation seeking group is particularly noteworthy given that all previous research on sensation seeking that used somewhat arbitrary cutoffs to create high and low sensation seekers (e.g. median split, upper and low quartile) would have completely missed this trajectory group. It may be that moderate increasing sensation seekers are a substantively interesting group of individuals to evaluate. Future research on sensation seeking as a predictor of negative adjustment outcomes (e.g., substance use, aggression, delinquency, sexual risk taking) may benefit substantially from evaluating this group of moderate increasers separately from individuals who are either stable high or stable low

sensation seekers. However, it may not always be feasible to evaluate sensation seeking using a person-centered trajectory group methodology. In future research of sensation seeking in which cutoff scores are used, the results of this study suggest that the most appropriate group comparisons would be between the upper quartile, lower quartile, and the middle 50%. These groups would roughly map onto the high, low, and moderate increasing trajectory groups respectively; however, they will still result in group misspecification. This study clearly establishes for the first time that cutoffs based on mean or median split are inappropriate for the study of sensation seeking as they miss a large percentage of individuals incorrectly classified as low sensation seekers.

There is already a substantial literature evaluating the role of self-control/disinhibition in regards to engagement in risky behaviors during adolescence (Dishion and Patterson 2006; Gottfredson and Hirschi 1990). This study added to this literature by combining self-control with enjoyment of risky activities into a composite indicator of sensation seeking. Individuals within the high stable sensation seeking group represent those adolescents with persistent problems due to poor inhibition compounded by a high enjoyment of risk.

It is of note that individuals in the low stable sensation seeking group did not report increases in delinquency or substance use across middle school. However, there were slightly significant increases in aggression among individuals in the stable low group between 6th and 7th grade. This highlights the importance of considering other risk factors for risk behaviors beyond sensation seeking, such as peer deviancy. Likewise, the stable high sensation seekers reported the highest levels of risk behaviors across middle school with increases in substance use across 6th, 7th, and 8th grades and increases in aggression and delinquency between the 6th and 7th grades. The moderate increasing sensation seekers reported low levels of risk behaviors in 6th grade followed by significant increases across middle school. These trends in risk behaviors do differ between sensation seeking trajectory groups, lending validation to the trajectory model. However, it is important for future research to not only identify risk based on sensation seeking but also to evaluate what other risk factors may lead to the unhealthy expression of sensation seeking as risk behaviors.

### *Strengths and Limitations*

This study is limited by the loss of participants due to survey characteristics and follow-up. The individuals who were maintained in this study did report lower levels of sensation seeking compared with those lost due to missing data. This limitation is important to acknowledge and does encourage replication of these results. However, it does not negate the importance of these findings. As indicated, when missing data were accounted for using FIML, findings did not differ. Also, the sample maintained for this study was still large ( $n = 868$ ) which makes it feasible to conduct the complex analyses which were a strength of this investigation. The utilization of group-based trajectory analysis allowed for the estimation of the number of groups and patterns of change in sensation seeking for each group based on the actual data. As such, this

study was able to move beyond theory to determine how the construct of sensation seeking manifested and changed during the middle school years, the results of which will inform future theory as well as evaluations of sensation seeking as an indicator of adjustment. However, it would be advantageous to evaluate trajectories of sensation seeking across a wider age range. It is possible that different patterns of change in sensation seeking may emerge given more information about sensation seeking in childhood as well as late adolescence and adulthood.

Notably, a debate regarding the application and interpretation of group-based trajectory modeling, as well as other complex longitudinal statistical methods, has arisen in response to the recent increase in the use of these analytic techniques (Nagin and Tremblay 2005a, b; Sampson and Laub 2005). In brief, caution must be used when applying these complex methodologies so as not to misinterpret the results obtained. For example, regarding group-based trajectory analysis, it is important to emphasize that individuals do not actually belong to trajectory groups, the number of groups is not immutable, and even individuals with a high probability of belonging to a particular group do not follow that group trajectory exactly (Nagin and Tremblay 2005a). Given these features of group-based trajectory modeling, it has been argued that results provided by this type of technique are potentially flawed due to ambiguity in groups and group membership, an inability to accurately predict individual outcomes based on group membership, and a tendency to rely on results of statistical analyses to draw conclusions and inform future analyses as opposed to relying strictly on theory (Sampson and Laub 2005). This study included strong theoretical justification for the use of group based trajectory analysis in evaluating changes in sensation seeking across middle school. In addition, numerous diagnostic checks of the accuracy of group assignment indicated good model fit and the groups did differentially predict risk behaviors, lending further validation to group assignment.

Another limitation of the study is in regards to the assessment of sensation seeking. This study used self-reports of the enjoyment of risky activities and self-control to create the construct of sensation seeking. Past research has also evaluated two other aspects of sensation seeking: boredom susceptibility and novelty seeking (Zuckerman 2007). The current study only assessed enjoyment of risky activities and self-control because these were the two aspects of sensation seeking most strongly associated with substance use and violence in adolescence (Zuckerman 2007) and the data for this project came from the control group of a substance use and violence prevention intervention. However, it would be beneficial to replicate these findings using alternative measures of sensation seeking. In addition, the sensation seeking measure and the outcomes of interest were self-reported resulting in shared method variance. Future research would benefit from the use of multiple reporters or alternative methods of assessment. Finally, the sample was a largely minority, urban sample of adolescents. While the sample demographics are a limitation in terms of generalizability, they are also a strength of the study given the dearth of information on sensation seeking among urban, minority adolescents.

### *Implications*



The aim of this study was to evaluate trajectories of sensation seeking for patterns of stability and change during middle school. For youth in the stable groups (low and high), sensation seeking seems to be a more stable trait-like construct. However, over half of the adolescents in this study demonstrated increases in sensation seeking over time. Of most interest for future research is the examination of the large group of adolescents who follow a trajectory of increasing sensation seeking during the middle school year. Fully understanding the contextual and individual factors that differentiate this group from the more stable sensation seeking groups could prove beneficial for understanding the role of sensation seeking regarding developmental increases in other problem behavior during adolescence.

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