Published in final edited form as:

Am J Drug Alcohol Abuse. 2020 May 03; 46(3): 316–324. doi:10.1080/00952990.2019.1660885.

The effect of sensation seeking on alcohol use among middle school students: A latent state-trait analysis

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Abstract

Background.—Sensation seeking has been implicated as a major risk factor for underage alcohol use, however little research into this personality trait has been conducted among children.

Methods.—A latent state-trait (LST) analysis was conducted among 552 individuals (54.3% female; age range 8–13; mean age 9.3) to determine the state or trait-based aspects of sensation seeking, and if this state or trait predicted future alcohol use. Sensation seeking behavior and lifetime alcohol use were assessed at four time points using two previously validated measures.

Results.—Between 49.4% and 95.3% of individual differences in sensation seeking could be attributed to a stable underlying sensation seeking trait. Further, logistic regression of the stable trait of sensation seeking predicted future alcohol use. A one unit increase in the latent trait increased the odds a student would try alcohol by 7.83 times (95% CI = 1.49–41.11, $p = .015$). Standardized regression coefficients revealed that an increase of one standard deviation in the latent trait of sensation seeking increased the odds of experimentation with alcohol by 1.29 times (95% CI = 1.11–1.49, $p = .001$).

Conclusion.—Findings suggest sensation seeking presents as a stable trait during childhood, which can cause children to seek out novel or exciting behaviors such as alcohol use. Future substance use interventions may need to account for the influence of the underlying trait.

1. Introduction

Alcohol use typically begins in middle school and escalates throughout adolescence. By the age of thirteen, 15.5% of youth report trying alcohol at least once in their life. As teenagers

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Disclosure of Interest

The authors report no conflict of interest

transition into high school, alcohol use rates grow to 47.7% by 9th grade and 71.7% by 12th grade (1). Preventing underage alcohol use has thus become an important target for health interventions, as early alcohol use increases the likelihood of developing alcohol use disorders, poor social functioning, and other adverse health effects later in life (2). While research has shown that children may begin experimenting with alcohol as early as age ten by taking a sip of alcohol offered by their parents (3, 4), the majority of research has focused on primarily measuring larger amounts of consumption (e.g. number of full drinks, number of binge events, etc) among older middle and high school aged adolescents (5). Questions that measure these patterns of consumption however, may not be appropriate for children under 12, as there is little evidence they engage in this type of robust alcohol consumption or exhibit problematic levels of involvement with alcohol (6). At younger ages, a single sip of alcohol may constitute a child's first meaningful introduction to the substance (7, 8) thus allowing children to begin forming various psychological and physical associations with alcohol (3). A few investigations into child drinking behavior have found when compared to non-sippers, those who ever sipped alcohol in elementary school were significantly more likely to drink a full drink, get drunk, or drink heavily by high school (9, 10). Consequently, investigating the predictors of alcohol use among younger populations represents a critical gap within the literature (11).

1.1 Sensation Seeking and Alcohol Use

Prior research has focused on certain personality traits, such as sensation seeking, that may distinguish individuals who are at greater risk for underage alcohol use. Sensation seeking is characterized by a need to seek out novel and highly stimulating experiences (12). Individuals high in sensation seeking may be more likely to engage in various risk-taking behaviors, such as alcohol or drug use, in order to satisfy their desire for adventure and excitement (13–16). A long history of investigations have implicated sensation seeking as a significant risk factor for substance use (11). For example, several cross-sectional studies conducted among adolescents have shown that sensation seeking is associated with early alcohol onset and alcohol use frequency (17–20). Further, a number of longitudinal investigations have found sensation seeking predictive of future alcohol use among older adolescents (e.g. binge drinking, full drinks of alcohol) (14, 18, 21, 22). While the number of investigations using child aged populations are limited, a few have found predictive results among high levels of sensation seeking and future substance use behavior. For example, a 9-year longitudinal study by Flory and colleagues found that sensation seeking behavior assessed between the ages 11 to 12 could discriminate early-onset and later-onset alcohol and marijuana use (23). Specifically, early-onset substance use was more likely among those reporting greater sensation seeking at baseline. Another investigation found that early levels of sensation seeking predicted initial alcohol use among middle school students, and that subsequent increases in sensation seeking predicted increases in use throughout high school (24). Finally, in an investigation by Pilatti and colleagues among a similar population of children in Argentina found high levels of extroversion increased the risk for greater alcohol use (25). While a growing body of evidence suggests that sensation seeking may be a critical risk factor for adolescent experimentation with alcohol (26), and increases during early adolescence, (22, 27), to our knowledge no study has yet examined whether this construct operates as a fluctuating latent state or a latent trait during childhood.

The state or trait-based aspects of early sensation seeking could potentially have an impact on intervention strategies, as well as the timeline for attempting to modify this behavior. Interestingly, due to the young age of this population, alcohol use is still relatively new, therefore the variable under study can be assumed to be a predictor, and not a consequence of alcohol use behavior.

1.2 Latent State-Trait Analysis

As children mature into adulthood, certain aspects of their personality may change (states) while others remain constant (traits). The extent to which sensation seeking should be classified as a stable trait or a fluid state during childhood can be determined using latent trait-state (LST) models (28–30). LST models do not assume that the measurement of a construct at one moment in time provides a complete picture of the individual assessed. Rather, the model uses observed variables (e.g. responses on a questionnaire) to estimate a latent state devoid of measurement error. If assessments are administered at multiple points in time, then the latent states can be further decomposed into a person-specific latent trait and occasion-specific residuals that represent the time-specific deviation of the state from the underlying trait (28, 29, 31). In other words, LST models determine if a behavioral outcome is due to a stable individual difference in an underlying characteristic under consideration, or a temporary change in the characteristic due to person/situation interactions at time of assessment (e.g. emotional state, social and physical environment, etc.) (31). Under this framework, it can be assumed observational measurement does not take place in a situational vacuum, and that the interaction between persons and the situations they find themselves in are important sources of outcome variance. The decomposition of trait and state provides an estimate of the degree to which a construct should be construed as stable or fluid. The LST model also allows the stable trait to be utilized in regression models predicting future behavior (32).

The present study evaluated the trait- and state-based aspects of sensation seeking among 4th to 6th grade students. The effect of the underlying trait on experimentation with alcohol was then examined in a logistic regression model. The purpose of this investigation was to explore the role that sensation seeking may play in underage alcohol use, thus no a priori hypothesis was made. The aim of this investigation is to determine if sensation seeking presents as a relatively stable trait or fluctuating state during childhood. If sensation seeking does not increase as children mature, but instead maintains stability throughout childhood, then it may indicate that an even earlier prevention timeline may be needed to mitigate the effects this risk factor has over future behavior. In other words, a focus on modifying sensation seeking behaviors may need to begin in childhood (i.e. decision making, goal-setting, setting alternative behaviors), as opposed to waiting until adolescence.

2. Methods

Data was collected as part of Pathways to Health, a randomized controlled trial designed for the prevention of multiple health risk behaviors, conducted among elementary schools randomly assigned to an intervention or delayed intervention control (33). Participants were assessed at four measurement periods across 30 months, all receiving the same assessments.

At baseline, 1005 4th grade students and their parents signed assent and active consent forms respectively for participation in this study according to procedures approved by the University of Southern California institutional review board. Of the 1005, 296 had missing or incomplete data due to either moving out of the study area ($n=249$, 85%), declining assent at a follow-up assessment ($n=18$, 6%), or being absent on an assessment day ($n=29$, 10%). Missing and non-missing did not differ significantly, and data was representative of the school populations from which sample was drawn (34). At the baseline assessment in grade 4, more than a fifth ($n=157$, 22%) of the students indicated they had tried alcohol at least once in their lifetime. These students were removed from the analytic dataset since the focus of the present investigation was whether sensation seeking predicted experimentation with alcohol. The sample consisted of 552 students (see Table 1).

2.1 Measures

2.1.1 Sensation Seeking —Self-reported sensation seeking behaviors were assessed utilizing a three-item measure that asked participants “I like doing things for the excitement of it”, “I like to do things that are a little scary”, and “I like friends who do crazy things or try to get attention” (12, 24). Response options were 1=Never; 2=Sometimes; and 3=Often. Prior investigations have found that the abbreviated measure shows high validity when compared to traditional sensation seeking scales among samples of adolescents and pre-adolescents ($\alpha = 0.81$) (35, 36).

2.1.2 Alcohol Use —Alcohol use was measured using a self-reported lifetime substance use item that was drawn from a national drug survey and used in previous research (5, 37, 38). The item asked youth “Have you ever tried alcohol (beer, wine, liquor that is not for religious purposes)?” Response options were 0=No, not even a sip; 1=Yes, just a sip; 2=Yes, more than a sip (part or all of a glass or can). For the present analyses, self-report of one or more sips of alcohol was used to indicate experimentation with alcohol, as pre-middle school alcohol sipping (i.e. one sip of alcohol) has been shown to be predictive of future more robust alcohol use (i.e. drinking full alcoholic beverage, getting drunk, etc) (9).

2.1.3 Covariates —Gender, ethnicity, and socioeconomic status were included as potential covariates based on previous studies that have shown some differences in substance use risk by gender, ethnicity, and socioeconomic status (39, 40). Dichotomous variables were created for gender (0=Female vs. 1=Male), ethnicity (0=Non-Hispanic vs. 1=Hispanic), and socioeconomic status (0=Did not receive a free lunch at school vs. 1=Received a free lunch at school). Intervention condition assignment (0=Control vs. 1=Intervention) was also included as a covariate.

2.2 Analysis Plan

Intra-class correlations were calculated for levels of sensation seeking. The analysis revealed that between 0.3% and 4.5% of the variance in sensation seeking could be attributed to random effects at the school level. Consequently, cluster robust standard errors were utilized in all statistical models to account for heteroskedasticity across clusters of observations, i.e. similarities between students attending the same school.

A preliminary analysis was performed in SAS using PROC GENMOD. The characteristics of the 157 students who reported experimentation with alcohol prior to the baseline assessment were compared to the 552 students who had never tried alcohol. The dataset was then restricted to the 552 students who had never tried alcohol and a latent state analysis (41) of sensation seeking was conducted in Mplus 8.3 (42) using the M – 1 approach (43, 44) recommended by Geiser and Lockhart (32). Full-information maximum likelihood was employed to account for missing responses (45) that resulted from instances in which students chose not to answer a specific question. Measurement invariance of the latent sensation seeking construct was evaluated by testing an unconstrained model, a model with weak invariance in which unstandardized factor loadings for each point in time were constrained to be equal, and a model with strong invariance in which factor loadings and indicator means were constrained to be equal across time. Measurement invariance is tested to ensure any indicators used to measure a latent variable did not change over time. If key parameters of the measurement model for sensation seeking were to change significantly, comparisons of sensation seeking across time would be uninterpretable (30). The level of measurement invariance present can be determined by imposing equality constraints on these parameters and checking whether additional restrictions lead to a significant decrease in model fit. A weak factorial invariance implies the factor loadings are the same over time for all indicators, while a strong factorial invariance implies both factor loadings and intercepts of indicators are consistent across time. Typically, a minimum level of measurement invariance is desired in longitudinal studies, and the most restrictive model that still shows an acceptable fit is selected (30).

The absolute fit of each model was assessed according to guidelines established by Hu and Bentler (46) who recommend a root mean square error of approximation (RMSEA) less than .08 and a standardized root mean square residual (SRMR) less than .05. The chi-square goodness of fit statistic was also calculated which provides further support for the fit of a model when it is not statistically significant (46), although this test can be affected by sample size (47). The relative fit of each model was determined using the Tucker-Lewis index (TLI) and the comparative fit index (CFI), both of which indicate excellent model fit when they are above .95 (46). Comparisons between the three latent state models were made by calculating changes in the chi-square goodness of fit statistic using the Satorra-Bentler scaling correction (48) and by monitoring the comparative fit index (CFI), Akaike's Information Criterion (AIC; (49)), and sample size adjusted Bayesian Information Criterion (SSA-BIC; (50)).

The best fitting latent state model was developed into a latent state-trait model (30). Experimentation with alcohol during the 30-month assessment period was then regressed on the latent trait of sensation seeking. Age, gender, ethnicity, socioeconomic status, and condition assignment in the Pathways intervention were included in the logistic regression model as time-invariant covariates. A sensitivity analysis was performed using a dataset that combined the 552 students who had never tried alcohol with the 157 students who reported experimentation with alcohol prior to the baseline assessment.

3. Results

The 157 students who had tried alcohol prior to the baseline assessment reported higher levels of sensation seeking (2.11 vs. 1.85, $p < .001$) and were more likely to be male (65.0% vs. 45.7%, $p < .001$) than the 552 students who had never tried alcohol. No statistically significant differences were detected in the age (9.26 vs. 9.27, $p = .842$), ethnicity (19.7% Hispanic vs. 27.4% Hispanic, $p = .065$), or socioeconomic status (21.7% received a free lunch vs. 20.7% received a free lunch, $p = .799$) of the two groups of students.

The unconstrained latent state model of the 552 students who had never tried alcohol fit the data well (Table 2). Constraining the unstandardized factor loadings to be equal at each assessment period improved the model. The CFI increased by .009, the AIC decreased by 16.227, and the SSA-BIC decreased 29.897. A comparison between the unconstrained model and the nested weak invariance model confirmed that the addition of equality constraints did not significantly reduce model fit ($\chi^2 (df = 12) = 6.09$, $p = .911$). In contrast, placing equality constraints on the indicator means did not improve the model. A comparison between the unconstrained model and the strong invariance model ($\chi^2 (df = 18) = 32.60$, $p = .019$) indicated that the overall fit had worsened. This suggests that while the questions posed to the students about sensation seeking had the same meaning at each point in time, there may have been a slight tendency for students to report different levels of sensation seeking as they became older. A decrease in the CFI of .020 and an increase in the AIC by 3.967 provided further support for the use of the weak invariance model in subsequent analyses.

The fit of the latent state-trait model was excellent with a chi-square goodness of fit statistic that was not statistically significant, a RMSEA of .022, a SRMR of .037, a TLI of .979, and a CFI of .983. The R^2 values of the latent state-trait model suggest that between 49.4% and 95.3% of individual differences in sensation seeking could be attributed to an underlying trait. A logistic regression revealed that the latent trait of sensation seeking was a statistically significant predictor of experimentation with alcohol (see Figure 1). A one unit increase in the latent trait of sensation seeking increased the odds that a student would try alcohol by the end of sixth grade by 7.83 times (95% CI = 1.49–41.11, $p = .015$). Age, gender, ethnicity, socioeconomic status, and condition assignment in the Pathways intervention were included in the logistic regression as covariates predicting alcohol use onset, but none of these variables were statistically significant (see Table 3). An examination of the standardized regression coefficients revealed that an increase of one standard deviation in the latent trait of sensation seeking increased the odds of experimentation with alcohol by 1.29 times (95% CI = 1.11–1.49, $p = .001$).

A similar pattern of findings was observed in a sensitivity analysis that combined the 552 students who had never tried alcohol with the 157 students who had tried alcohol prior to the baseline assessment. Age, ethnicity, socioeconomic status, and condition assignment were not statistically significant covariates although students who were male were more likely to experiment with alcohol (OR = 1.10, 95% CI = 1.00–1.21, $p = .043$). A one standard deviation increase in the latent trait of sensation seeking increased the odds of alcohol experimentation by 1.40 times (95% CI = 1.24–1.59, $p < .001$).

4. Discussion

To our knowledge, this is the first study to use a LST model to examine the stability of sensation seeking among a population of youth under the age of 14. Sensation seeking is commonly described as a personality trait that drives individuals to engage in various risk-taking behaviors, such as alcohol use, to satisfy a need for adventure and excitement (13, 16). The findings presented here support this characterization of sensation seeking as a primarily stable trait in young childhood, while also indicating that this stable trait increases the risk of experimentation with alcohol. Although the standardized effect size in the current study is small, the results align with a prior meta-analysis indicating a small to moderate effect size in the association between sensation seeking and alcohol use (11). Indeed, substantial evidence collected among adolescents and young adults indicate sensation seeking is an important predictor of several risky behaviors, including alcohol and substance use (13, 51–54).

While many past investigations among adolescents have found sensation seeking to be a fairly stable personality trait with a biological/genetic origin (14, 16, 20), few have conducted this research among younger children. For example, to our knowledge only one study has conducted among a similar population of middle school students, and found sensation seeking to be stable for a large portion of their sample (55). Results presented here extend the evidence gathered from previous adolescent research by suggesting that a stable sensation seeking trait is set far earlier during development, which in turn may have an influence over alcohol use behavior as children enter early adolescence. Recent investigations into early alcohol use behavior have found a young age of initiation leads to increased levels of use, as well as increased alcohol-related problems, later in adolescence (56, 57). This may indicate that future substance use interventions focusing on modifying various cognitive processes may need to begin in early childhood in order to channel the desire to experience novel stimuli into more healthy behaviors (58). By identifying high sensation seekers in elementary school, it may be possible to minimize the risk of adverse health effects occurring later in life, particularly as these individuals mature into adolescence (59). Future research among this age group is warranted to determine the extent to which this trait remains stable, as well as to investigate any other variables that may exert an influence over the development of this trait.

At younger ages, sipping alcohol may be a child's first introduction to drinking (7), which, in turn, begins the process of developing and forming new expectancies and associations with the substance (3). These new associations with alcohol can be especially influential over future behavior (60), as children's experiences are less robust compared to older adolescents or adults (61) and are reinforced through continued use (21, 62, 63). Interestingly, the primary source of alcohol is usually the child's parent, suggesting one of the first alcohol use events will be in the home (64–66). While speculative, it may be possible that higher sensation seeking youth will be more likely to ask their parents to try a sip of alcohol, perhaps as a means of engaging in a new or novel experience. Future research could include sensation seeking scales to determine if youth high in sensation seeking are more likely to ask for, or receive, sips of alcohol from parents compared to lower sensation seeking youths.

4.1 Limitations

Several limitations to the current investigation should be noted. First, an abbreviated measure was used to evaluate sensation seeking. While this same abbreviated measure has been shown to be sufficiently robust demonstrating a significant predictive relationship between growth in sensation seeking to growth in alcohol use during adolescent years (24), it is unknown if the strength of the relationship found in this study would differ if the full sensation seeking scale had been used. Additionally, this scale only measured individual acceptance of novel and/or thrilling experiences, without measuring various cognitive states (i.e. decision making, impulsivity, etc) that may factor into sensation seeking behavior. Future research could use a more robust scale to measure these various aspects of cognition and personality. Second, only four assessments were administered over a period of 30 months, limiting extrapolation of results into adolescent and adult years. Third, the primary analysis involved the removal of 157 students who experimented with alcohol prior to the baseline assessment. These students also reported higher levels of sensation seeking. Consequently, the removal of these students may have attenuated the effect size as evidenced by the larger odds ratio (OR = 1.40 vs. OR = 1.29) detected in the sensitivity analysis performed using both groups of students. Finally, all assessments occurred at school, which may not be representative of all environments that can provoke sensation seeking related behaviors. Assessments of sensation seeking in different environments, such as at home or in social settings, may reveal person-situation interactions that could be key to designing programs that prevent or delay underage alcohol use.

5. Conclusion

Personality traits, such as sensation seeking, have been shown to be important predictors of substance use (13, 51). Prior research has documented a significant relationship between sensation seeking and alcohol use frequency in adolescence and adulthood (11). The findings presented here extend this line of evidence by revealing the influence this trait has on alcohol use experimentation in childhood. Investigations into the stability of personality traits and their relationship to alcohol use are an important avenue of research, as behaviors learned during childhood may continue and escalate into later adolescence and adulthood (24). Further research investigating the role of sensation seeking and related personality traits may increase our understanding of the components that lead to the adoption of unhealthy behaviors early in life.

Role of Funding Source

This research was supported by grant T32CA009492 (NCI; Pentz, PI), HD 052107 (NICHD, NIDA; Pentz, P.I.), and is registered at [ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT00787709) (#NCT00787709). The NCI, NICHD, and NIDA had no role in the design of the study, collection, analysis, and interpretation of data, or in the writing of the report.

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Figure 1.

Visual depiction of latent state trait model of sensation seeking predicting experimentation with alcohol

Note: Unstandardized parameter estimates are expressed as odds ratios (OR). Exogenous variables were allowed to freely correlate. Only significant regression paths are shown.

* $p < .0$

Table 1.

Descriptive statistics for 552 students from 29 schools

<u>4th Grade: Initial Assessment</u>	
Age, mean (SD)	9.3 (0.5)
Gender, n (%)	
Male	252 (45.7%)
Female	300 (54.3%)
Ethnicity, n (%)	
Hispanic	151 (27.4%)
Non-Hispanic	401 (72.6%)
Socioeconomic Status, n (%)	
Received a Free Lunch at School	114 (20.7%)
Did Not Receive a Free Lunch at School	438 (79.3%)
Intervention Assignment, n (%)	
Intervention	296 (53.6%)
Control	256 (46.4%)
Experimentation with Alcohol, n (%)	
Yes	0 (0.0%)
No	552 (100.0%)
Sensation Seeking, mean (SD)	1.8 (0.4)
<u>4th Grade: 6-Month Follow-Up Assessment</u>	
Experimentation with Alcohol, n (%)	
Yes	81 (14.7%)
No	470 (85.3%)
Sensation Seeking, mean (SD)	1.9 (0.4)
<u>5th Grade: 18-Month Follow-Up Assessment</u>	
Experimentation with Alcohol, n (%)	
Yes	113 (20.5%)
No	438 (79.5%)
Sensation Seeking, mean (SD)	1.9 (0.4)
<u>6th Grade: 30-Month Follow-Up Assessment</u>	
Experimentation with Alcohol, n (%)	
Yes	141 (25.6%)
No	410 (74.4%)
Sensation Seeking, mean (SD)	1.9 (0.4)

Table 2.

Model fit indices for latent state and latent state trait models

Model	χ^2	RMSEA	SRMR	TLI	CFI	AIC	SSA-BIC
Unconstrained Latent State	52.52	.024	.030	.975	.985	11218.775	11275.731
Latent State with Weak Invariance	56.81	.013	.034	.993	.994	11202.548	11245.834
Latent State with Strong Invariance	86.32 *	.030	.046	.961	.965	11222.742	11259.194
Latent State-Trait	67.03	.022	.037	.979	.983	11211.755	11253.902

Note: χ^2 = Chi-Square Goodness of Fit Statistic, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residual, TLI = Tucker-Lewis Index, CFI = Comparative Fit Index, AIC = Akaike's Information Criterion, SSA-BIC = Sample Size Adjusted Bayesian Information Criterion.

*
 $p < .05$

Table 3.

Unstandardized logistic regression model predicting experimentation with alcohol

Variables	OR	[95% CI]	p
Age	1.35	[0.93, 1.94]	.110
Gender (Male)	1.18	[0.78, 1.79]	.433
Ethnicity (Hispanic)	1.17	[0.83, 1.65]	.365
SES (Free Lunch)	1.02	[0.68, 1.51]	.922
Intervention	0.93	[0.68, 1.29]	.670
Sensation Seeking Trait	7.83	[1.49, 41.11]	.015