Why adolescents with ADHD take risks

Biological, cognitive and social mechanisms

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An assessment of the psychometric properties of the Brief Sensation Seeking Scale for Children

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Abstract

Sensation seeking is a trait that predicts a wide range of real-life risk behavior, such as substance abuse and gambling problems. Sensation seeking is often assessed with the Sensation Seeking Scale. Several adaptations of this questionnaire have been made, for example to abbreviate it and to make it suitable for children. However, studies on sensation seeking in children are scarce. The aim of the current study was to investigate sensation seeking in children (N = 158, mean age = 11.4 years). The Brief Sensation Seeking Scale for Children (BSSS-C) was translated into Dutch and psychometric properties were examined. Internal consistency was high, and the factor structure showed large resemblance with previous research. Test-retest and split-half reliability were acceptable, as was convergent validity with self-reported symptoms of psychopathology (attention problems and aggressive behavior). Construct validity was adequate, with more sensation seeking in boys than in girls. No effects of age were found. To sum up, sensation seeking can be measured in children in a valid and reliable way. The correlation of sensation seeking with high-risk behaviors emphasizes the importance of assessment early in development.

Keywords Sensation Seeking; Children; Measurement; Reliability; Validity; BSSS.
**Introduction**

Sensation seeking (SS) is “a 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 experience” (Zuckerman, 1994). SS correlates with personality traits like openness to experience, agreeableness, and impulsivity (McCrae & Costa, 1997; Pfefferbaum & Wood, 1994; Stanford, Greve, Boudreaux, Mathias, & Brumbelow, 1996; Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). Individuals high on SS enjoy unusual art forms (Rawlings, 2003), travel more and to less familiar destinations (Zuckerman, 1994), enjoy high-impact sports (Joireman, Fick, & Anderson, 2002; Zuckerman, 1994) and prefer listening to arousing music (McNamara & Ballard, 1999). However, arousing experiences also include risky, dangerous or violent behavior (Roberti, 2004). Indeed, SS correlates with alcohol abuse (Cohen & Fromme, 2002; Zuckerman, 1994), drug usage (Donohew et al., 1999; Read et al., 2003), risky sexual behavior (Arnold et al., 2010; Wiederman & Hurd, 1999), hazardous driving (Arnett, 1996), gambling (McDaniel, 2002), vandalism, and theft (Arnett, 1996).

Moreover, SS is associated with a wide spectrum of psychopathology. SS is related to externalizing disorders as it predicts risky behavior in ADHD (Graziano et al., 2015) and is found to be one of the most frequent complaints in individuals with ADHD (Kooij, Aeckerlin, & Buitelaar, 2001). SS is also positively related to disruptive behavioral problems, such as aggression and Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) symptoms (Joireman, Anderson, & Strathman, 2003). Furthermore, SS is associated with addiction, as high SS correlates with the usage of cocaine (Ball, Carroll, & Rounsaville, 1994), alcohol (Hittner & Swickert, 2006; Martin et al., 2002), caffeine (Jones & Lejuez, 2005), nicotine (Martin et al., 2002), marijuana (Martin et al., 2002), online gaming (Mehroof & Griffiths, 2010), internet dependence (Lin & Tsai, 2002) and, in ADHD, the abuse of stimulant medication (van Eck, Markle, & Flory, 2012). To summarize, SS is an important personality trait, as it is related to different psychiatric disorders and related risk-taking behavior.

In children, similar patterns are observed. SS correlates with CD (Russo et al., 1993) and children high on SS played more (violent) videogames and scored higher on rule-breaking behavior (Jensen, Weaver, Ivic, & Imboden, 2011). Moreover, early risk-taking behavior was not only associated with SS, it was also predictive of future deviant behavior (Newcomb
& McGee, 1991). SS typically increases between 10 and 15 years old (Steinberg et al., 2008). For these reasons, studying SS in children is important. Identifying children at risk early in development enables prevention or early intervention of risk-taking behavior.

SS is most often measured with the SSS-V (Sensation Seeking Scale; Zuckerman, Eysenck, & Eysenck, 1978), of which good validity and reliability have been demonstrated repeatedly in adult samples (Brocke, Beauducel, & Tasche, 1999; Cronin, 1995; Zuckerman, 1994; Zuckerman, Bone, Neary, Mangelsdorff, & Brustman, 1972; see Roberti, 2004 for a review). The SSS-V consists of four subscales: Thrill and Adventure Seeking, Experience Seeking, Disinhibition, and Boredom Susceptibility. This factor structure has been found consistently (Ball, Farnill, & Wangeman, 1984; Loas et al., 2001; Roberti, Storch, & Bravata, 2003; Rowland & Franken, 1986; Zuckerman et al., 1978).

To assess SS in children, the Sensation Seeking Scale for Children (SSSC) has been developed (Russo et al., 1991, 1993). The test-retest reliability of this scale was adequate and factor analysis yielded two factors, which resembled the Thrill and Adventure Seeking and Boredom Susceptibility subscales (Russo et al., 1991). In a follow-up study, factor analysis identified three factors: Thrill and Adventure Seeking, Drug and Alcohol Attitudes and Social Disinhibition. Psychometric properties were acceptable and differences in SS according to sex, age and psychopathology were as expected (i.e., higher SS in boys, in older children and in children with CD).

The Brief Sensation Seeking Scale for Children (BSSS-C) was developed as a shorter measurement of sensation seeking in children (Jensen et al., 2011). Factor analysis identified 4 factors, similar to the original factors of the SSS-V (Thrill and Adventure Seeking, Experience Seeking, Disinhibition, and Boredom Susceptibility), and internal consistency was good. There was an effect of sex, with boys scoring higher than girls. No effect of age was found.

The goal of the current study was to investigate the psychometric properties of our Dutch translation of the BSSS-C. Based on previous research, we expected (a) high reliability (evidenced by high internal consistency, split-half reliability, and test-retest reliability) and (b) high validity (evidenced by a similar factor structure as was found by Jensen et al. (2011), positive correlations with attention problems, aggressive behavior and age, and a sex difference). Correlations with internalizing symptoms (i.e., anxiety/depression) were investigated exploratory.
Methods

Participants
Participants were 158 children (90 boys) between 9 and 12 years old, with a mean age of 11.4 (SD = .70). As one school refused to participate in the re-test and some children were absent from class the second time of testing, 108 of the initial 158 children filled out the BSSS-C again (M = 11.6 years, SD = .74; 66 boys). Participants were recruited at three regular elementary schools and one school for special education (grades 7 and 8). Schools were recruited by research assistants, and varied in geographical location (i.e., city and village schools) and socio-economic background. Children attending the school for special education were characterized by behavioral difficulties and a high prevalence of psychiatric disorders. Parents or other legal caretakers gave active or passive informed consent, depending on the preference of the school. The local Ethics Review Board approved the study.

Materials

Brief Sensation Seeking Scale for Children
The Brief Sensation Seeking Scale for Children (BSSS-C; Jensen et al., 2011) was translated into Dutch by three native Dutch speakers, who were also proficient in English. Disagreement between the three translations was solved by a debate between two of the authors (TJD, BRJJ) and a research assistant. The Dutch items were translated back into English by three native English speakers, also fluent in Dutch. Again, disagreement was solved by a debate.

The BSSS-C consisted of 14 items, which were answered on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). An example of an item is “I would like to try sky-diving”. The English version has good psychometric properties. In the original version, internal reliability, $\alpha = .82$, and concurrent validity with externalizing behavior were established (Jensen et al., 2011).

Youth Self Report
Three subscales of the Dutch translation of the Youth Self Report (YSR; Achenbach & Rescorla, 2001; Verhulst, van der Ende, & Koot, 1997) were administered: Attention

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1 Age information of 4 participants was missing at T1, and age information of 1 participant was missing at T2.
Problems, Aggressive Behavior and Anxious/Depressed. On this self-report questionnaire, children indicated whether a given statement (e.g., “I become angry easily”) resembled their behavior or feelings in the last 6 months on a three-point Likert scale (0 = not at all; 1 = a bit/sometimes; 2 = clearly/often). The subscale Attention Problems consisted of 9 items, the subscale Aggressive Behavior consisted of 17 items, and the subscale Anxious/Depressed consisted of 13 items. The reliability of the YSR is good ($\alpha = .79$ for the syndrome subscales; Achenbach et al., 2008). In our sample, the internal consistency was comparable, $\alpha = .73$ for Attention Problems, $\alpha = .83$ for Aggressive Behavior and $\alpha = .80$ for Anxious/Depressed.

**Procedure**

Participants were tested in class by two research assistants, in presence of the teacher. The entire test session lasted approximately 45 minutes. Apart from the measures described above, children also performed a cognitive test and a test on curiosity, which are beyond the scope of the current article. The order of administration was uniform in all classes. Children started with the curiosity test, then the cognitive test, YSR, and BSSS-C. Re-assessment of the BSSS-C, which lasted approximately 10 minutes, took place in class after two to three months (minimum = 76 days later; maximum = 92 days).

**Data-analysis**

Reliability was investigated using tests of internal consistency, split-half reliability and test-retest reliability. The factor structure was investigated with a principal axis factoring analysis, convergent validity by computing correlations between BSSS-C scores and scores on attention problems and aggressive behavior, and construct validity by computing correlations between BSSS-C scores and age and sex.

A-priori power analyses were conducted with G*Power ($\alpha = .05$, Power = .80; Faul, Erdfelder, Lang, & Buchner, 2007). To detect medium effects, a sample size of 82 was sufficient for the correlation analyses and a sample size of 128 (64 participants per group) was sufficient for the independent $t$-test.

Average scores were calculated for the BSSS-C but if more than one question on the BSSS-C was omitted, participants’ data were excluded from the analyses. Average scores were

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2 One item of the Anxious/Depressed subscale (about suicidal thoughts/feelings) was omitted, because of the expected emotional impact in young children.
also calculated for the YSR subscales, with a maximum of 2 out of 17 omitted items on Aggressive Behavior, 1 out of 13 on Anxious/Depressed and 0 out of 9 on Attention Problems.

Results

Descriptives
Higher psychopathology scores were expected in children attending special education. This was confirmed by YSR scores: children attending special education scored higher on aggressive behavior \( U = 1823.50, p < .01 \), attention problems \( U = 1825.50, p = .01 \) and, only at trend level, anxious/depressed \( U = 1637.50, p = .05 \) than children attending regular education.

Reliability
In the first wave, 11 participants skipped 1 item of the questionnaire, resulting in \( N = 147 \). The BSSS-C showed high internal consistency: \( \alpha = .82 \). After dividing questions from the same factors over both halves as much as possible, the split-half reliability of the BSSS-C was good, \( r_{sh} = .86 \) (Spearman-Brown coefficient). Also at re-test, internal consistency was high: \( \alpha = .75 \) (2 participants skipped 1 item, hence \( N = 106 \)), and split-half reliability was good, \( r_{sh} = .81 \). The distribution of the first administration was not normal (Kolmogorov-Smirnov: \( p = .01 \)), and therefore Spearman’s correlation was reported for the test-retest reliability, which was good: \( r_s = .72, p < .001 \).

Validity
A principal axis factoring analysis was conducted to assess the factor structure of the BSSS-C. No multicollinearity was found as there were no correlations above .9 (Field, 2013). An oblique promax rotation was used, as the factors were likely correlated. The sample size was adequate for this analysis, \( KMO = .82 \), and Bartlett’s Test was significant, \( \chi^2(91) = 779.18, p < .001 \), indicating the absence of an identity matrix. Using Kaiser’s criterion of eigenvalues > 1, four factors were identified. Overall, the factor structure showed strong similarities with previous research, see Table 1 (Jensen et al., 2011). The first factor, with high loadings of items 1, 2 and 3, represented Thrill and Adventure Seeking (TAS). The second factor represented Experience Seeking (ES), with high loadings of item 10, 11 and 12. This factor also had high loadings of items 4 and 6, which was different from previous research. The third factor, with loadings of item 13 and 14, represented Boredom Susceptibility (BS). The fourth factor had high loadings of items 7, 8 and 9, representing Disinhibition (D). Item 5, presumed to
tap on Thrill and Adventure Seeking, did not load high on any of the factors. Altogether, the factor structure seemed robust, as only 5% of the residuals were larger than .05.

<table>
<thead>
<tr>
<th>Factors</th>
<th>TAS</th>
<th>ES</th>
<th>BS</th>
<th>D</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would like to try sky-diving \textsuperscript{TAS}</td>
<td>.988</td>
<td></td>
<td></td>
<td>3.8</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>I would like to try using a parachute \textsuperscript{TAS}</td>
<td>.879</td>
<td></td>
<td></td>
<td>3.7</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>I would like to try bungee jumping \textsuperscript{TAS}</td>
<td>.858</td>
<td></td>
<td></td>
<td>3.6</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>I would like to explore strange places \textsuperscript{TAS}</td>
<td>.421</td>
<td></td>
<td></td>
<td>4.0</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>I’m the first one in my group of friends to try new things \textsuperscript{TAS}</td>
<td></td>
<td>3.1</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If somebody dares me to do something, I do it \textsuperscript{D}</td>
<td>.574</td>
<td></td>
<td></td>
<td>3.0</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>I like hanging out with older kids \textsuperscript{D}</td>
<td></td>
<td>.609</td>
<td>2.9</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like new and exciting experiences, even if I have to break the rules \textsuperscript{D}</td>
<td></td>
<td>.461</td>
<td>3.0</td>
<td>1.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I prefer friends who are exciting and unpredictable \textsuperscript{D}</td>
<td></td>
<td>.525</td>
<td>3.2</td>
<td>1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like telling jokes \textsuperscript{ES}</td>
<td>.321</td>
<td></td>
<td>3.2</td>
<td>1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I think bugs and snakes are pretty cool \textsuperscript{ES}</td>
<td>.522</td>
<td></td>
<td>3.0</td>
<td>1.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to do things that scare me a little bit \textsuperscript{ES/TAS}</td>
<td>.932</td>
<td></td>
<td>3.3</td>
<td>1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I get bored quickly \textsuperscript{BS}</td>
<td></td>
<td>.598</td>
<td>3.2</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I get restless when I spend too much time at home \textsuperscript{BS}</td>
<td></td>
<td>.629</td>
<td>2.8</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Principal Axis Analysis of the Brief Sensation Seeking Scale for Children, using promax rotation and Kaiser’s criterion of eigenvalues > 1. Values of the pattern matrix are reported. TAS=Thrill and Adventure Seeking; ES=Experience Seeking; BS=Boredom Susceptibility; D=Disinhibition; SD=Standard Deviation. Superscripts represent factors identified by Jensen et al. (2011).

To assess convergent validity, correlations between the BSSS-C and different indicators of psychopathology (i.e., YSR subscales) were estimated. Scores on none of the YSR subscales were normally distributed (Kolmogorov-Smirnov: \(p\)'s < .001). Therefore, Spearman’s correlations were reported. As expected, the total score on the BSSS-C correlated significantly with both Attention Problems and Aggressive Behavior, \(r_s = .25, p = .002\) and \(r_s = .35, p < .001\) respectively. There was no significant correlation between sensation seeking and the Anxious/Depressed subscale, \(r_s = -.04, p = .60\).³

In line with expectations, higher sensation seeking was observed in boys than in girls at the first⁴, \(U = 2103.00, p < .001\) and at the second administration, \(t(106) = 2.12, p = .04\) No effect of age was observed at the first, \(r_s = -.02, p = .85\) and at the second administration, \(r_s = -.08, p = .42\).

3 Note that these correlations were not only driven by the children attending special education. For children attending regular education, the correlation with Attention Problems and Aggressive Behavior was similar as in the entire sample (\(r_s = .22, p = .013\) and \(r_s = .31, p < .001\) respectively). Correlations were higher for children attending special education (\(r_s = .46, p = .043\) and \(r_s = .55, p = .012\) for Attention Problems and Aggressive Behavior respectively).

4 As BSSS-C was not distributed normally at the first administration, this was tested non-parametrically.
Discussion

The goal of the current study was to establish the psychometric properties of the Dutch translation of the Brief Sensation Seeking Scale for Children (BSSS-C; Jensen et al., 2011). Overall, the psychometric properties of the questionnaire were good. The internal consistency and split-half reliability were high and the four-factor structure of the translation largely resembled the original version (Jensen et al., 2011). Test-retest reliability, which was never investigated for the BSSS-C before, was good after two to three months. Validity was supported by the positive significant correlation between the total score on the BSSS-C and self-reported attention problems and aggressive behavior. These correlations are in line with previously observed correlations between BSSS-C and aggressive gaming and rule breaking (Jensen et al., 2011). In older samples, the BSSS has also been found to correlate with risky behaviors such as drug usage and risky sexual behavior (Donohew et al., 1999; Hoyle et al., 2002; Stephenson et al., 1999). Furthermore, the observed correlation with attention problems was expected as well, as sensation seeking has been linked to ADHD before (Kooij et al., 2001; Zuckerman, 2002). According to the vigilance regulation model, sensation-seeking behavior in ADHD serves as an autoregulatory attempt to create a stimulating environment to stabilize vigilance, as unstable vigilance is a basic dysfunction in ADHD (Geissler, Romanos, Hegerl, & Hensch, 2014).

In line with previous studies (Jensen et al., 2011; Martin et al., 2002; Russo et al., 1991, 1993), we found that boys scored higher on sensation seeking than girls. However, discordant to some previous findings on sensation seeking, no effect of age was found. Earlier studies show that the presence of age effects on sensation seeking are dependent of the particular age range. SS seems to peak around the age of 15 (Steinberg et al., 2008). The current non-significant correlation may be explained by the fact that we used a pre-adolescent sample with a limited age range (9-12). A previous study on SS in the same age group also reported no effects of age (Jensen et al., 2011). The relation between age and SS thus far has been established by cross-sectional research (Steinberg et al., 2008). Previous longitudinal research focuses primarily on adolescent samples (Collado, Felton, MacPherson, & Lejuez, 2014; Harden & Tucker-Drob, 2011). We suggest future research could benefit from longitudinal designs, starting in young children, to identify which personality profiles are at risk for harmful development and, ultimately, to prevent this development.
A limitation of the current study is that only self-report measures were used. Self-report measures have limited validity in children, as informant discrepancies are often detected (Achenbach, McConaughy, & Howell, 1987; Waters, Stewart-Brown, & Fitzpatrick, 2003). However, many studies claim that schoolchildren are capable of self-reporting (De Reyes & Kazdin, 2005; Riley, 2004; Varni, Limbers, & Burwinkle, 2007). Furthermore, average YSR scores on all subscales were higher for the children attending special education as compared to children attending regular education, which indicates that this self-report was valid at least at group level.

A related limitation is that the YSR is validated from 11 years old, but a minority of our sample was younger than 11. However, it was ensured that all children understood the questionnaires, as the teacher and two research assistants were in the classroom whilst filling out the questionnaires, providing the children with ample opportunity to ask for clarification if necessary. Furthermore, one question of the Anxious/Depressed subscale was omitted, because of the expected emotional impact in young children.

It is important to note that the current study was performed in the Netherlands. The resemblance of the results with previous studies on sensation seeking in children (e.g., Jensen et al., 2011) suggest that the current findings can be generalized to Western populations. Future research is needed to identify potential differences with non-Western populations.

To sum up, the current study showed that sensation seeking can be measured in children in a reliable way. Moreover, sensation seeking correlates with symptoms of psychopathology like attention problems and aggressive behavior. As sensation seeking is predictive for a wide range of risk behaviors, such as risky sexual behaviors, rule breaking, internet-dependence, gambling, and substance abuse (Newcomb & McGee, 1991), it is important to assess SS early in development. Application of instruments like the BSSS-C can aid this assessment, ultimately aiming to identify those children with high-risk personality profiles, in order to prevent potential harmful development.

Conflicts of interest & Funding
All authors declare no conflicts of interest and none of the authors received funding for performing this study.
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