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A confirmatory factor analysis of two models of sensation seeking

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Abstract

The factor structures of Zuckerman's sensation seeking scale Form V (SSSV) [Zuckerman, M., Eysenck, S. & Eysenck, H. J. (1978). Sensation seeking in England and America: cross-cultural, age and sex comparisons. *Journal of Consulting and Clinical Psychology*, 46(1), 139–149 revised, Zuckerman, M. (1994). *Behavioural Expressions and Biosocial Bases of Sensation Seeking*. Cambridge: Cambridge University Press] and Arnett's [Arnett, J. (1994). Sensation seeking: a new scale and a new conceptualisation. *Personality and Individual Differences* 16(2), 289–296.] inventory of sensation seeking (AISS) were analysed using confirmatory factor analysis. 822 participants completed the two measures of sensation seeking and the sample was divided randomly into two subsamples. The factor structures were examined using confirmatory factor analysis with one half of the data. Modification indices (MIs) and standardised expected parameter changes (SEPCs) were used to modify the models as appropriate. The modified models were then re-estimated using the second half of the data set. MIs and SEPCs indicated correlations between the unique variance of some of the SSSV items, suggesting that the subscales may not be unidimensional and in the removal of some items from the AISS due to low factor loadings. A shortened four-factor scale based on the SSSV was tested but did not provide satisfactory results. In light of these and other limitations with the SSSV it is concluded that the modified shortened AISS may provide the more appropriate measure of sensation seeking. © 2000 Elsevier Science Ltd. All rights reserved.

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1. Introduction

The concept of sensation seeking arose out of interest in the optimum level of stimulation and the optimum level of arousal. Zuckerman et al. began work on the first sensation seeking scale during the early 1960's. Since then the sensation seeking scale has undergone a number of stages of development. The first scale, Form I (Zuckerman, Kolin, Price & Zoob, 1964) consisted of 50 items. Items were subsequently selected for Form II (Zuckerman et al., 1964) on the basis of their loadings on the first unrotated factor to emerge from a factor analysis of the 50 items from Form I. This resulted in a scale that was intended to measure a single general trait of sensation seeking. At this time the authors were only interested in a general trait of sensation seeking, however subsequent research suggested that the structure of sensation seeking was more complex, being comprised of more than one dimension (Farley, 1967). Zuckerman and Link (1968) carried out a factor analysis of Form II and identified four subscales for males of which two were also present in female data. These were thrill sensation seeking; social sensation seeking; visual sensation seeking and antisocial sensation seeking. Although four subscales had been identified, the original Form I did not include an adequate number of items to define these four factors clearly.

To overcome this Zuckerman (1971) developed an additional 63 items and factor analysed these together with the original 50 items from Form I. This analysis resulted in the extraction of four factors, thrill and adventure seeking (TAS), experience seeking (ES), disinhibition (Dis) and boredom susceptibility (BS). The general factor was also retained and this general factor and the four subscales constituted the 72 item Form IV. However, a problem emerged as the general scale carried over from Form II did not contain any items from the Dis subscale and as such constituted a poor general representation of sensation seeking. Problems with the general scale were addressed by Zuckerman, Eysenck and Eysenck (1978), with the development of Form V which substituted the general scale from Forms II and IV with a total sensation seeking score derived from the sum of the total scores from the four subscales. The 72 items from Form IV were factor analysed using an oblique rotation and 10 items were selected for each of the four subscales based on primary loadings and the criteria of loadings with absolute values of greater than 0.3. While most items did meet these criteria, it was necessary to include a small number of items with loadings less than 0.3, however, all items had their primary loadings on the relevant factor.

All forms of the sensation seeking scale had used a dichotomous forced choice answer format, however, this was altered in Form VI which uses a 3-point answer scale and provides participants with a little more choice in responses. Items included in form VI represent the TAS and Dis subscales and assesses experience of, and intention to, engage in a variety of sensation seeking behaviours. The Sensation Seeking Scale Form V remains one of the most popular and widely used of the sensation seeking scales and as such merits further attention.

Evidence for the existence of the four factors has been found across both gender and culture. Zuckerman et al. (1978) found evidence for the existence of the four factors in both English and American samples. The four factors showed high resemblance across both English and American males and females with the exception of boredom susceptibility which was not consistent across American males and females. Additional support for the existence of the four factors comes from Ball, Farnill and Wangeman (1983) who found evidence for the four

factors in Australian males and females, with the factors accounting for 31 and 32.7% of the total variance in males and females, respectively. However, the evidence for the four subscales is not as clear as it may seem. In a Canadian sample, Ridgeway and Russell (1980) report moderate reliability for the general trait of sensation seeking and only low reliabilities for the subscales. Furthermore, Ball et al. (1983) identified problems with a number of items including multifactorial items, items failing to load on the correct factor and items with loadings of absolute values of less than 0.3. In addition, a subsequent factor analysis in which the number of factors was not determined revealed 13 factors for males and 12 factors for females, similar to the findings of Stewart and MacGriffith (1975).

Further exploration of the factor structure of the Sensation Seeking Scale Form V by Rowland and Franken (1986), revealed similar results to Ball et al. (1983). Preliminary exploratory factor analysis revealed 14 factors for males and 12 for females, however, when the number of factors rotated was restricted to four, only 21 and 20% of the variance was accounted for in males and females, respectively. In accordance with Ball et al. (1983) several items loaded on more than one factor; loaded on the wrong factor or did not significantly load on any factor. Of the 40 items, 25 displayed some of the above characteristics. LISREL IV (Jöreskog & Sörbom, 1978) was used to test the fit of the data to the four-factor model via confirmatory factor analysis. The analysis indicated that the data did fit the model although some items did not load significantly on the correct factor.

These studies have provided evidence for the cross cultural and cross gender reliability of the subscales of the Sensation Seeking Scale Form V, however, they indicated that some refinement to the scale was required. The general factor structure appeared to be substantiated, but problems lay within some of the test items themselves.

Rowland and Franken (1986) suggested that the connotations of the problem items may have changed and that this could be part of the problem with some of the items displaying undesirable psychometric properties. Arnett (1994), elaborated on this by highlighting a number of problems inherent in the Sensation Seeking Scale Form V. Arnett suggested that several of the items were no longer culturally relevant, but reflected the culture at the time when the questionnaire was devised. In addition, Arnett suggested that participants might find the forced choice response format frustrating as they may feel that either both, or neither, choices may correspond to them. A number of confounding items were also identified, namely those requiring physical strength and endurance, which were possibly confounded with age and those which referred directly to behaviours that the Sensation Seeking Scale had been used to investigate such as drinking, smoking and drug taking. Finally, problems were identified with items relating to illegal or norm breaking behaviour. These included questions concerning drug taking, illegal activities and various acts that related to breaking social norms.

While Arnett wanted to devise a new sensation-seeking questionnaire that was free from the limitations of Form V, he also wanted to reconceptualise sensation seeking. While the conceptualisation on which Form V was based viewed sensation seeking as a need for novel and complex stimuli, Arnett proposed that the dimensions of novelty and intensity underpinned sensation seeking. Theoretical differences also emerged between Zuckerman's and Arnett's views concerning the basis of sensation seeking. Zuckerman emphasised the biological basis of sensation seeking, while Arnett placed additional emphasis on socialisation as a basis for sensation seeking. In developing a new scale, Arnett conceived of sensation seeking as

being influenced by biological predispositions which interacted with the social environment and he went on to propose that socialisation was at least as important as biology.

The Arnett Inventory of Sensation Seeking (AISS; Arnett, 1994) attempted to address the limitations of the SSS Form V and use the underlying conceptualisation proposed by Arnett (1994). It did not contain any age related or norm breaking items, it contained items that were culturally relevant in the United States at that time and responses took the format of a 4 point Likert scale. Items included focused on novelty and intensity of stimulation and experience and the two subscales, novelty and intensity each consisting of 10 items, were summed to give a total sensation seeking score. However, one major limitation with the AISS concerns the selection of items. Items were not selected on the basis of any type of psychometric analysis, but simply on the basis of face validity. In addition, while the items may be culturally relevant for a US sample, this may not be the case for other populations. Arnett then went on to compare the AISS and the SSS Form V in their ability to predict a number of risky behaviours and found that the AISS appeared to be more strongly related to risk behaviour than the SSS Form V.

The SSS Form V and the AISS were compared on the basis of scale reliability and ability to predict alcohol consumption in Australian adolescents in a study carried out by Andrew and Cronin (1997). A modified decontaminated version of the SSS Form V was used, in which alcohol related items were removed. However, this resulted in a reduction in the reliability for the total SS score and for the ES and Dis subscales. Low reliabilities were found for the AISS for total score and for each of the subscales. This was not attributable to any one item and heterogeneous items were suggested by the inter-item correlations, which were both positive and negative. The correlation between the two scales was higher than that reported by Arnett (1994), $r = 0.59$ compared with 0.41 from Arnett (1994), but was still relatively low considering the two scales are supposedly measuring different facets of the same construct. In relation to prediction of alcohol consumption, the Intensity scale of the AISS, and the Dis subscale from Form V emerged as the most useful predictors although the limitations of the scales are not adequately accounted for.

To recap, the limitations of the two scales, the SSS Form V contains confounding items relating to age, smoking, drinking, drug taking and norm breaking behaviour and has a forced choice answer format. It also continues to contain culturally irrelevant items, despite the revisions proposed by Zuckerman (1994, 1996) that attempted to address this particular problem. Zuckerman (1996) goes on to suggest that researchers should consider using the five factor Zuckerman–Kuhlman Personality Questionnaire (ZKPQ; Zuckerman, Kuhlman, Joireman, Teta & Kraft 1993), which contains an impulsive sensation seeking subscale. The AISS has low reliabilities and the subscales are based on face validity alone and were not developed through any type of empirical process. However, the scales continue to be used in research that examines the relationship between Sensation Seeking and various behaviours. For example, Arnett (1994) found a relationship between the AISS and reckless behaviour in adolescents; Andrew and Cronin (1997) found a relationship between both the AISS and the SSS Form V and alcohol consumption in Australian adolescents.

In considering the limitations of the SSS Form V and the AISS, it is clear that further research is required to assess the reliability and dimensionality of the scales and of the underlying construct of sensation seeking.

The present study investigates the factor structures of the SSS form V and the AISS using confirmatory factor analysis. This is a more rigorous approach to the analysis of the dimensionality of a scale, as it allows alternative competing models to be compared and determines which is the most appropriate fit to the data. In addition, as it is a theory driven approach, the resulting factor structure should be theoretically sound, which may not always be the case with data driven exploratory factor analysis.

2. Method

2.1. Participants

Participants consisted of 822 undergraduates, age range 18–72, mean age 24.8 (S.D. 8.3). They comprised of 615 females and 204 males, with 3 participants giving missing data for gender.

2.2. Measures

Participants completed the revised Sensation Seeking Scale Form V (SSSV: Zuckerman 1994, Appendix A) and the Arnett Inventory of Sensation Seeking (AISS: Arnett, 1994, Appendix B). Demographic details were also taken.

3. Results

3.1. Data analysis

Data was analysed using LISREL 8.20 (Jöreskog & Sörbom, 1998). The analysis strategy was to first randomly split the data into two halves, then to use a model generational approach (Jöreskog, 1993) to examine the scales using confirmatory factor analysis with one half of the data (referred to as sample 1). If the initial model to be tested did not provide an adequate representation of the data the modification indices (MIs) and standardised expected parameter changes (SEPCs) were used to modify the model, as recommended by Kaplan (1989). To avoid problems of capitalising on chance this model was then re-estimated incorporating the additional parameters using the second half of the dataset (referred to as sample 2).

3.1.1. Assessing model fit

Determining whether a model can be described as a good fit is a somewhat sticky issue (Bollen & Long, 1993; Shevlin, Miles & Lewis, 2000). A model is assessed in terms of overall fit and in terms of the parameter estimates of the model (component fit; Bollen, 1989). Model fit was originally assessed in confirmatory factor analysis using the likelihood ratio, which follows a χ^2 distribution (and is usually referred to simply as χ^2), however, χ^2 is a powerful test of model fit, which may reject models where the degree of mis-specification is so small as to be inconsequential (Shevlin & Miles, 1998). Additionally the χ^2 value is sensitive to

distortion away from multivariate normality. Because of these problems, we also assess fit using the NNFI (Bentler & Bonett, 1980) and the RMSEA (Steiger, 1990; Steiger & Lind, 1980). The NNFI is calculated by comparing the χ^2 value of the model under test with the value of the χ^2 associated with the null model (the worst possible model, which hypothesis no relationships between the measured variables). The calculation of the RMSEA uses the χ^2 value of the model, in conjunction with the sample size and a correction for the complexity of the model (degrees of freedom) to ensure that these factors do not affect the decision to reject or accept the model. An additional advantage of the RMSEA is that it has a known sampling distribution and, therefore, confidence limits can be calculated. The RMSEA provides “a measure of the *discrepancy per degree of freedom* for the model” (Browne & Cudeck, 1993, p. 144, italics in original). We interpret a value for NNFI of 0.90 or above as showing adequate fit and a value of 0.95 to show excellent fit. Similarly, following Browne and Cudeck (1993) we consider values of RMSEA below 0.08 show adequate fit and values below 0.05 to show good fit. In the present study, while χ^2 is presented in the results, other fit indices, including the RMSEA and the NNFI are presented and considered and the models are not accepted or rejected on the basis of χ^2 , but rather on the basis of the RMSEA and NNFI. This should avoid the possibility of rejecting a model which would be accepted if the restrictive assumptions of χ^2 had been met.

Listwise deletion was used for each questionnaire, which resulted in $N = 389$ for the two samples used to examine the AISS and $N = 374$ for the two samples used to examine the SSSV. Differences in the sample sizes are due to a greater proportion of SSSV questionnaires being returned incomplete than AISS questionnaires.

All models were estimated using a polychoric correlation matrix and weighted least squares (WLS) estimation.

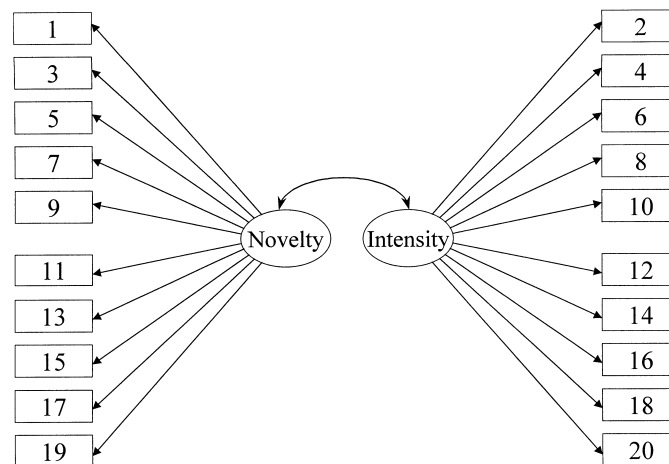


Fig. 1. A path diagram of the AISS showing two latent variables, novelty and intensity, with 10 items loading onto each latent variable. (For clarity, unique variances are not shown.)

3.1.2. Analysis of the AISS

The model proposed by Arnett (1994) is referred to as model A1. This had 2 latent variables, intensity and novelty, with 10 measured variables loading onto each (see Fig. 1).

Analysis of this model resulted in the fit indices shown in Table 1 as model A1. While the RMSEA indicates adequate fit, the NNFI indicates that the model does not satisfactorily account for the data.

Modifications were made to the model to try and provide a more satisfactory account of the data. Non-significant factor loadings suggested that a number of items should be removed. This included items 10, 14 and 16 from the intensity subscale and items 3, 13, 15 and 17 from the novelty subscale (see Appendix B). These items were removed from the subsequent analysis. In addition, modification indices also suggested a correlation between the unique variances of items 8 and 11 and this parameter was added to the model.

The model resulting when these modifications were made is referred to as model A2a (see Table 1). Although χ^2 is significant, the other fit indices indicate that the model seems to provide a reasonable fit to the data. To ensure that the improvements in fit shown by this model were not due to capitalisation on chance, the model was applied to the sample 2 dataset. The fit indices for this are shown in Table 1 as model A2b. This model also provides an adequate representation of the data, cross-validating model A2a.

Table 2 shows the factor loadings for the subscales intensity and novelty from the sample 2 dataset, model A2b. All of the item loadings are significant and all are above 0.3 with the exception of items 2 (intensity) and 7 (novelty).

3.1.3. Analysis of the SSSV

It was not possible to analyse all the subscales in the Zuckerman SSS in one large model, because of the large number of variables, which led to a variable-participant ratio that was too low to calculate the asymptotic covariance matrix. Instead, the sub-scales were initially separately examined for unidimensionality.

Confirmatory factor analysis of the experience seeking (ES) subscale as proposed by Zuckerman et al. (1978), Zuckerman (1994) revealed that the NNFI indicated that the model provided an adequate fit to the data, while the RMSEA indicated poorer fit. This model is referred to as model E1 (see Table 3).

MI and SEPCs suggested correlations between the unique variance of items 9 and 10 and between 6 and 18. The model was modified to incorporate these additional parameters, the fit indices associated with this model are presented in Table 3 as model E2a. Subsequent analysis revealed that the model now provided a better fit to the data as evidenced by the low RMSEA

Table 1
Fit indices from the AISS

	χ^2 (df)	<i>P</i>	RMSEA	NNFI
Model A1	590 (169)	< 0.001	0.080	0.84
Model A2a	138 (63)	< 0.001	0.055	0.95
Model A2b	121 (63)	< 0.001	0.049	0.95

Table 2
Factor loadings for intensity and novelty (model A2b)^a

Item number	Intensity	Novelty
2	0.17	
4	−0.47	
6	0.47	
8	−0.57	
12	−0.33	
18	−0.65	
20	−0.38	
1		0.33
5		0.39
7		0.17
9		0.75
11		0.73
19		0.60

^a All loadings were significant, $p < 0.05$.

and the increased NNFI. When this model was cross-validated on the second dataset, presented in Table 3 as model E2b, the fit indices indicated an adequate fit to the data, although this was not as good as model E2a. Table 4 shows the factor loadings for the items from the confirmed model. All loadings were significant and loaded in the correct direction.

Exploratory analysis of the thrill and adventure seeking subscale, as proposed by Zuckerman et al. (1978), Zuckerman (1994) revealed that the model was close to fitting the data as shown in Table 5, model T1. However modification indices suggested correlations between the unique variances of items 16 and 17, items 16 and 23 and items 3 and 38. Once these correlations were incorporated, the model now fitted the data well (see model T2a, Table 5). Confirmatory factor analysis with sample 2 revealed that the modified model provided a good fit to the data, (Table 5, model T2b). Table 6 shows the factor loadings for the items from the confirmed model. All of the item loadings were significant, were in the correct direction and fell above an absolute value of 0.4.

Exploratory analysis of the disinhibition subscale as proposed by Zuckerman et al. (1978), Zuckerman (1994) revealed that the model provided an adequate fit to the data (see Table 7, model D1). However, modification indices suggested correlations between the unique variance of items 13 and 33, and between items 1 and 32. With these modifications, the RMSEA

Table 3
Fit indices from experience seeking, SSSV

	χ^2 (df)	<i>P</i>	RMSEA	NNFI
Model E1	79 (35)	< 0.001	0.058	0.96
Model E2a	45 (33)	< 0.067	0.032	0.98
Model E2b	98 (33)	< 0.001	0.073	0.94

Table 4
Factor loadings of the items onto ES (model E2b)^a

Item number	Factor loading
4	0.20
6	−0.37
9	−0.72
10	0.61
14	−0.34
18	−0.61
19	0.65
22	−0.59
26	0.36
37	0.58

^a All loadings were significant, $p < 0.05$.

demonstrated an improvement in fit, although the NNFI had decreased slightly, it still indicated good fit (see Table 7, model D2a). Confirmatory factor analysis with sample 2 confirmed that the modified model fit the data (Table 7, model D2b). Table 8 shows the factor loadings of the items onto Dis. All loadings are significant and in the correct direction. All fall above 0.6 with the exception of item 33, which has an acceptable loading of −0.36.

Exploratory analysis of the boredom susceptibility subscale as proposed by Zuckerman et al. (1978), Zuckerman (1994) revealed that the model did not adequately fit the data, (see Table 9, model B1) as although the NNFI indicated adequate fit, the RMSEA indicated that the model did not fit. Modification indices suggested correlations between the unique variance of items 8 and 31, 7 and 27, 24 and 27 and between 5 and 24. With these modifications, the model appeared to provide a reasonable fit to the data as the RMSEA had decreased to indicate good fit, although the slight decrease in NNFI indicated a decrease in fit, it was still acceptable (see Table 9, model B2a). Confirmatory factor analysis of the modified model with sample 2 indicated that the model provided adequate fit to the data (see Table 9, model B2b). Table 10 shows the factor loadings for the items from the confirm model. All loadings were significant with the exception of the loading to item 8 which was not significant. Item 2 loaded in the opposite direction to what was expected, and this loading was significant. Examination of loadings from models B1 and B2a revealed that this item had loaded significantly in the correct direction in these models. A number of items also showed low loadings although they were significant.

Table 5
Fit indices from thrill and adventure seeking, SSSV

	χ^2 (df)	p	RMSEA	NNFI
Model T1	93 (35)	< 0.001	0.067	0.98
Model T2a	49 (32)	0.027	0.038	0.98
Model T2b	32 (32)	0.43	0.008	1.00

Table 6
Factor loadings of the items onto TAS (model T2b)^a

Item number	Factor loading
3	0.63
11	−0.58
16	0.79
17	0.73
20	−0.43
21	−0.68
23	0.74
28	0.62
38	−0.47
40	−0.62

^a All loadings were significant, $p < 0.05$.

Table 7
Fit indices from disinhibition, SSSV

	χ^2 (df)	p	RMSEA	NNFI
Model D1	62 (35)	0.003	0.046	0.98
Model D2a	42 (33)	0.14	0.027	0.96
Model D2b	52 (33)	0.017	0.040	0.99

Table 8
Factor loadings of the items onto Dis (model D2b)^a

Item number	Factor loading
1	0.63
12	−0.61
13	−0.85
25	−0.62
29	0.66
30	−0.73
32	0.75
33	−0.36
35	−0.71
36	0.61

^a All loadings were significant, $p < 0.05$.

Table 9
Fit indices from boredom susceptibility, SSSV

	χ^2 (df)	<i>P</i>	RMSEA	NNFI
Model B1	107 (35)	< 0.001	0.075	0.93
Model B2a	48 (31)	0.027	0.038	0.91
Model B2b	91 (31)	< 0.001	0.072	0.93

3.2. Data analysis: development of a revised scale

The entire sample of 822 students was used in the development of the revised scale. Of this sample, 772 participants provided data suitable for inclusion. 50 questionnaires were incomplete and not suitable for inclusion in the analysis.

Data was analysed using LISREL 8.20, (Jöreskog & Sörbom, 1998). Variables included in the analysis were selected based on their suitability for inclusion in a scale that was to be used in subsequent research in relation to alcohol and nicotine consumption. All items that related to drinking or drug taking were excluded from the analysis. This included items 9 and 10 from the ES subscale and items 13, 30 and 36 from the Dis subscale. Items considered to be no longer culturally relevant were also excluded. This included items 12, 32 and 33 from the Dis subscale and items 19 and 22 from the ES subscale.

A shortened four factor model was proposed, with 4 items drawn from each of the four subscales. Items were selected on the basis of factor loadings from the modified, confirmed models and absence of correlations with other selected items. Table 11 shows the factor loadings of the items selected based on the confirmed models for each subscale. All items on the TAS and Dis subscales had factor loadings of above 0.6, while some items selected for the BS and ES subscales showed lower loadings, although all were above 0.35. All items loaded in the correct direction. Serious convergence problems were experienced with the new 16 item

Table 10
Factor loadings of the items onto BS (model B2b)^a

Item number	Factor loading
2	0.35*
5	0.43*
7	-0.65*
8	0.03
15	-0.24*
24	0.46*
27	-0.23*
31	-0.77*
34	0.58*
39	0.24*

^a **p* < 0.05.

four factor model. Despite modification, the model still failed to converge, suggesting that a 16 item short scale was not appropriate.

4. Discussion

The present study examined the factor structures of the SSS Form V and the AISS using confirmatory factor analysis. The sample was divided in half and on the first sample the factor structure was tested as proposed by the authors of the two scales. Fit indices indicated that the theoretical structure of the AISS did not provide an adequate account of the data, while fit indices for the SSSV subscales did indicate adequate fit. The size and significance of factor loadings, along with MIs and SEPCs were used to modify the models and the modified models were then re-estimated using the second sample. Following modification of the AISS which involved removing 3 intensity items, 4 novelty items and allowing the unique variance of two items to correlate, the AISS provided a good representation of the data. Separate analyses were conducted for the subscales of the SSS Form V. Modifications of all SSS Form V subscales involved allowing the unique variance of specific items to correlate. When the modified models were tested using the second sample while there was slight variation in fit improvements all subscales provided adequate representation of the data.

The modifications to the AISS involved removing 7 items from the overall scale in total and this did result in a model which fit the data. It is possible that these items did not load adequately on the respective factors because Arnett did not use factor analysis in the

Table 11
Factor loadings of items included in the 4 factor shortened model^a

Item number	TAS	Dis	BS	ES
3	0.63			
16	0.79			
17	0.73			
21	-0.68			
1		0.63		
25		-0.62		
29		0.66		
35		-0.71		
7			-0.65	
24			0.46	
31			-0.77	
34			0.58	
14				-0.34
18				-0.61
26				0.36
37				0.58

^a All loadings were significant, $p < 0.05$.

development of the model. This could also help to explain the low reliabilities found for the AISS total score and the individual subscales by Andrew and Cronin (1997).

Modifications suggested for the SSS Form V subscales all involved allowing correlations between the unique variance of specific items. These correlations are of greater magnitude than is desirable and this indicates that the subscales are not unidimensional, but are possibly measuring another trait in addition to the individual sensation seeking subscales. It is also difficult to explain the presence of the significant loading in the opposite direction to that expected of item 2 from the BS subscale.

Out of 822 returned questionnaires, 778 were suitable for use in the analysis of the AISS, compared with 748 for the SSS Form V. This was due to participants failing to complete all the questions. This appears to demonstrate that participants preferred to complete the AISS. Arnett (1994) had suggested that participants may find the forced choice response format of the SSS Form V frustrating and it does appear that some participants felt unable to answer all of the questions.

This study has demonstrated that neither of the models is wholly adequate as proposed by the authors. The subscales of the AISS may be more unidimensional than those of the SSS form V, as evidenced by the low correlated errors in the AISS, however, a number of items were removed from this scale in order to attain good model fit. While it is quite possible that the subscales of the SSS Form V are not unidimensional, the items do all load adequately onto the respective subscales, although item 2 from the BS subscale loaded in the wrong direction, providing some support for the factor structure proposed by Zuckerman et al. (1978). The limitations of the SSS Form V identified by Arnett (1994) and acknowledged by Zuckerman (1996) should restrict use of the scale, however the scale continues to be employed in current research (e.g. Andrew & Cronin, 1997; Kokuti & Short, 1998) possibly due to the lack of a validated suitable alternative. The AISS provides a more culturally relevant scale, with a preferable response format, but some items do not load adequately on their respective factors as highlighted by the current study. One final alternative measure, the Zuckerman–Kuhlman Personality Questionnaire (ZKPQ III) provides a general measure of sensation seeking, which may be useful for some research, but this lacks the detail available from the subscales of the SSS Form V and the AISS.

Appendix A. Sensation Seeking Scale Form V revised (Zuckerman, 1994)

1. I like 'wild' uninhibited parties.
I prefer quiet parties with good conversation.
2. There are some movies I enjoy seeing a second or even third time.
I can't stand watching a movie that I've seen before.
3. I often wish I could be a mountain climber.
I can't understand people who risk their necks climbing mountains.
4. I dislike all body odours.
I like some of the earthy body smells.
5. I get bored seeing the same old faces.
I like the comfortable familiarity of everyday friends.

6. I like to explore a strange city or section of town by myself, even if it means getting lost.
I prefer a guide when I am in a place I don't know well.
7. I dislike people who do or say things just to shock or upset others.
When you can predict almost everything a person will do or say he or she must be a bore.
8. I usually don't enjoy a movie or play where I can predict what will happen in advance.
I don't mind watching a movie or play where I can predict what will happen in advance.
9. I have tried marijuana or would like to.
I would never smoke marijuana.
10. I would not like to try any drug which might produce strange and dangerous effects on me.
I would like to try some of the new drugs that produce hallucinations.
11. A sensible person avoids activities that are dangerous.
I sometimes like to do things that are a little frightening.
12. I dislike 'swingers' (people who are uninhibited and free about sex).
I enjoy the company of real 'swingers'.
13. I find that stimulants make me uncomfortable.
I often like to get high (drinking liquor or smoking marijuana).
14. I like to try new foods that I have never tasted before.
I order the dishes with which I am familiar, so as to avoid disappointment and unpleasantness.
15. I enjoy looking at home movies or travel slides.
Looking at someone's home movies or travel slides bores me tremendously.
16. I would like to take up the sport of water skiing.
I would not like to take up the sport of water skiing.
17. I would like to try surf board riding.
I would not like to try surf board riding.
18. I would like to take off on a trip with no preplanned or definite routes, or timetable.
When I go on a trip I like to plan my route and timetable fairly carefully.
19. I prefer the 'down to earth' kinds of people as friends.
I would like to make friends in some of the 'far out' groups like artists or 'punks'.
20. I would not like to learn to fly an aeroplane.
I would like to learn to fly an aeroplane.
21. I prefer the surface of the water to the depths.
I would like to go scuba diving.
22. I would like to meet some persons who are homosexual (men or women).
I stay away from anyone I suspect of being 'gay or lesbian'.
23. I would like to try parachute jumping.
I would never want to try jumping out of a plane with or without a parachute.
24. I prefer friends who are excitingly unpredictable.
I prefer friends who are reliable and predictable.
25. I am not interested in experience for its own sake.
I like to have new and exciting experiences and sensations even if they are a little frightening, unconventional or illegal.
26. The essence of good art is in its clarity, symmetry of form and harmony of colours.
I often find beauty in the 'clashing' of colours and irregular forms of modern paintings.

27. I enjoy spending time in the familiar surroundings of home.
I get restless if I have to stay around home for any length of time.
28. I like to dive off the high board.
I don't like the feeling I get standing on the high board (or I don't go near it at all).
29. I like to date members of the opposite sex who are physically exciting.
I like to date members of the opposite sex who share my values.
30. Heavy drinking usually ruins a party because some people get loud and boisterous.
Keeping the drinks full is the key to a good party.
31. The worst social sin is to be rude.
The worst social sin is to be a bore.
32. A person should have considerable sexual experience before marriage.
It's better if two married persons begin their sexual experience with each other.
33. Even if I had the money I would not care to associate with flighty rich persons like those in the 'jet set'.
I could conceive of myself seeking pleasures around the world with the 'jet set'.
34. I like people who are sharp and witty even if they do sometimes insult others.
I dislike people who have their fun at the expense of hurting the feelings of others.
35. There is altogether too much portrayal of sex in movies.
I enjoy watching many of the 'sexy' scenes in movies.
36. I feel best after taking a couple of drinks.
Something is wrong with people who need liquor to feel good.
37. People should dress according to some standard of taste, neatness and style.
People should dress in individual ways even if the effects are sometimes strange.
38. Sailing long distances in small sailing crafts is foolhardy.
I would like to sail a long distance in a small but seaworthy sailing craft.
39. I have no patience with dull or boring persons.
I find something interesting in almost every person I talk to.
40. Skiing down a high mountain slope is a good way to end up on crutches.
I think I would enjoy the sensations of skiing very fast down a high mountain slope.

Appendix B. Arnett Inventory of Sensation Seeking (Arnett, 1994)

1. I can see how it would be interesting to marry someone from a foreign country.
2. When the water is very cold, I prefer not to swim even if it is a hot day.
3. If I have to wait a long time, I'm usually patient about it.
4. When I listen to music, I like it to be loud.
5. When taking a trip, I think it is best to make as few plans as possible and just take it as it comes.
6. I stay away from movies that are said to be frightening or highly suspenseful.
7. I think it's fun and exciting to perform or speak before a group.
8. If I were to go to an amusement park, I would prefer to ride the rollercoaster or other fast rides.

9. I would like to travel to places that are strange and far away.
10. I would never like to gamble with money, even if I could afford it.
11. I would have enjoyed being one of the first explorers of an unknown land.
12. I like a movie where there are a lot of explosions and car chases.
13. I don't like extremely hot and spicy food.
14. In general, I work better when I'm under pressure.
15. I often like to have the T.V. on while I'm doing something else, such as reading or cleaning up.
16. It would be interesting to see a car accident happen.
17. I think it's best to order something familiar when eating in a restaurant.
18. I like the feeling of standing next to the edge on a high place and looking down.
19. If it were possible to visit another planet or the moon for free, I would be among the first to sign up.
20. I can see how it must be exciting to be in a battle during a war.

References

- Andrew, M., & Cronin, C. (1997). Two measures of sensation seeking as predictors of alcohol use among high school males. *Personality and Individual Differences*, 22(3), 393–401.
- Arnett, J. (1994). Sensation seeking: a new scale and a new conceptualisation. *Personality and Individual Differences*, 16(2), 289–296.
- Ball, I. L., Farnill, D., & Wangeman, J. (1983). Factorial invariance across sex of the form V of the sensation seeking scale. *Journal of Personality and Social Psychology*, 45(5), 1156–1159.
- Bentler, P. M., & Bonett (1980). Significance tests and the analysis of goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88, 588–606.
- Bollen, K. A. (1989). *Structural equations with latent variables*. New York: Wiley.
- Bollen, K. A., & Long, J. S. (1993). *Testing structural equation models*. London: Sage.
- Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Long, *Testing structural equation models*. Newbury Park, CA: Sage.
- Farley, F. H. (1967). Social desirability and dimensionality in the sensation seeking scale. *Acta Psychologica*, 26, 89–96.
- Jöreskog, K. (1993). Testing structural equation models. In K. A. Bollen, & J. S. Long, *Testing structural equation models*. Newbury Park, CA: Sage.
- Jöreskog, K., & Sörbom, D. (1978). *LISREL IV (computer program)*. Chicago: Scientific Software International.
- Jöreskog, K., & Sörbom, D. (1998). *LISREL 8.20 (computer program)*. Chicago: Scientific Software International.
- Kaplan, D. (1989). A study of the sampling variability and z-values of parameter estimates from misspecified structural equation models. *Multivariate Behavioural Research*, 24(1), 41–57.
- Kokuti, A., & Short, E. (1998). The effects of activity/sensation seeking on mood. *Proceedings of the British Psychological Society*, 7(1), 32.
- Ridgeway, D., & Russell, J. A. (1980). Reliability and validity of the sensation seeking scale: psychometric problems in form V. *Journal of Consulting and Clinical Psychology*, 48(5), 662–664.
- Rowland, G. L., & Franken, R. E. (1986). The four dimensions of sensation seeking: a confirmatory factor analysis. *Personality and Individual Differences*, 7, 237–240.
- Shevlin, M., & Miles, J. N. V. (1998). Effects of sample size, model specification and factor loadings on the GFI in confirmatory factor analysis. *Personality and Individual Differences*, 25(1), 85–90.

- Shevlin, M. E., Miles, J. N. V. & Lewis, C.A. (2000). Reassessing the fit of the confirmatory factor analysis of the multidimensional students life satisfaction scale. *Personality and Individual Differences*, 28(1), 181–185.
- Steiger, J. H. (1990). Structural model evaluation and modification: an interval estimation approach. *Multivariate Behavioural Research*, 25, 173–180.
- Steiger, J. H. & Lind, J. M. (1980). *Statistically based tests for the number of factors*. Paper presented at the Annual Meeting of the Psychometric Society, Iowa City, IA.
- Stewart, D. W., & MacGriffith, G. (1975). Factor analysis of Zuckerman's sensation seeking scale. *Psychological Reports*, 37, 849–850.
- Zuckerman, M. (1971). Dimensions of sensation seeking. *Journal of Consulting and Clinical Psychology*, 36, 45–52.
- Zuckerman, M. (1994). *Behavioural Expressions and Biosocial Bases of Sensation Seeking*. Cambridge: Cambridge University Press.
- Zuckerman, M. (1996). Item revisions in the Sensation Seeking Scale Form V (SSS-V). *Personality and Individual Differences*, 20, 515.
- Zuckerman, M., & Link, K. (1968). Construct validity for the sensation seeking scale. *Journal of Consulting and Clinical Psychology*, 32(4), 420–426.
- Zuckerman, M., Eysenck, S., & Eysenck, H. J. (1978). Sensation seeking in England and America: cross-cultural, age and sex comparisons. *Journal of Consulting and Clinical Psychology*, 46(1), 139–149.
- Zuckerman, M., Kolin, E. A., Price, L., & Zoob, I. (1964). Development of a sensation seeking scale. *Journal of Consulting and Clinical Psychology*, 28, 477–482.
- Zuckerman, M., Kuhlman, D. M., Joireman, J., Teta, P., & Kraft, M. (1993). A comparison of three structural models for personality: the big three, the big five and the alternative five. *Journal of Personality and Social Psychology*, 65(4), 757–768.