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PSYCHOMETRIC PROPERTIES OF URDU VERSION OF BARRATT IMPULSIVENESS SCALE

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Abstract
The Barratt Impulsiveness scale Version 11 (BIS-11; Patton at al., 1995) is considered a gold-standard measure to assess impulsivity and has been translated and validated in many languages, however psychometric research of the structure of BIS-11 Urdu Version is scant. The main purpose of the current study was to assess the psychometric properties of Urdu version of BIS-11 by applying unidimensional model, six correlated first-order factor, three second-order factor and a bifactor model. Confirmatory factor analysis has been applied to the data collected from university students (N= 600). In the current study, attempts are made not only to assess the fit indices, but multilevel bifactor model was also applied to examine the dimensionality. Empirical results revealed that a six-correlated first-order factor model is adequately fit to the data than unidimensional, three second-order factor and a bifactor model.

Keywords: Barratt Impulsive Scale-11 Urdu Version; Confirmatory factor analysis; First-order factor model; Impulsivity; Second-order factor model; Unidimensional model

Introduction

Many studies have been conducted to assess the construct of impulsivity and many self-report scales have been devised to date. The most commonly used scale is Barratt Impulsiveness Scale -11 which is considered gold-standard instrument to assess impulsivity (Čulík & Kalašová, 2021; Kahn et al., 2019; Stanford et al., 2009; Steinberg et al., 2013; Taylor et al., 2018). To explore the individual differences in impulsivity and it social consequences, BIS-11 has been used by many researchers. Over the last 50 years, various versions of BIS have been used in impulsivity related researches and translated into 11 different Languages (Diemen, et al., 2007; Hartmann et al., 2011; Someya et al., 2001; Tsatali et al., 2021; Vasconcelos et al., 2012).

According to the Barratt's theory that there are three subfactors of impulsivity (motor, cognitive and non-paining) and most recent version of BIS-11 was designed as multidimensional scale to assess impulsivity.

Dawe et al. (2004) suggested that impulsivity is not a homogenous construct and proposed two-factor model of impulsivity: reward sensitivity and rash impulsiveness. They further suggested that these two are derived from personality research that is parallel to the development in neurosciences. At the neurobiological level, reward seeking is stimulated by the less efficient inhibition of dopamine at the synaptic sites. In contrast, rash impulsiveness was related to the inability to inhibit a proponent

response to a stimulus or an event. Individual differences in the frontal cortex have been proposed as the driving force for the disinhibited behavior.

Smithet et al. (2007) evaluated the validity and utility of BIS-11 by making discrimination among four impulsive traits: sensation-seeking, lack of paining, lack of persistence and urgency. They found lack of planning and lack of persistence as two distinct facets of one trait whiles sensation seeking and urgency were two separate constructs.

Ireland and Archer (2008) conducted a study on male and female prison inmates. Confirmatory factor analysis was used to analyze the data. They remain unsuccessful in confirming the appropriateness of both unidimensional and proposed three factor model of BIS-11 because they tested three correlated factors model at the item level rather than tested a three-factor second-order model.

Similarly, Haden et al. (2009) tested four alternative models by using a sample consisted of male mentally ill forensic patients. The found two correlated factors model a best fitting model based on 24 items of BIS-11. They underpinned the two-factor model as motor and non-planning impulsivity.

Steinberg and colleagues (2013) used BIS-11 to measure three theoretical traits: attentional, motor, and non-planning impulsiveness. They also apply bifactor model to evaluate the factor structure of BIS-11. They remain unsuccessful to found any evidence to support three-factor model. Therefore, they introduced a unidimensional Barrat Impulsiveness Scale-Brief (BIS-Brief) by utilizing 8 of the original BIS-11 items. They found similar indices of construct validity for BIS- Brief as they demonstrated for BIS-11 total score. They further suggested that BIS-Brief is applicable in clinical setting and due to short items scale it will reduce the burden on respondent without losing their attention.

Reise et al. (2013) identified a multidimensional structure composed of six first-order factors (attention, motor, self-control, cognitive complexity, perseverance, and cognitive instability) which converged into three second-order factors: Motor Impulsiveness (motor and perseverance), Non-planning Impulsiveness (self-control and cognitive complexity) and Attentional Impulsiveness (attention and cognitive instability). They did not find any empirical support for six first-order factor model as well as three-factor model of impulsivity and offered two-factor model as an alternative to the multidimensional structure of the construct.

A study was conducted to assess the psychometric properties of Spanish version of BIS-11-Adults (BIS-11-A) among 1,183 students age ranged between 12 and 14. They found BIS-11-A Spanish Version highly reliable (a = .87) and valid scale to assess the substance use, binge drinking and problem drinking among early adolescents (Martínez-Loredo et al., 2015).

Pechorro and Colleagues (2016) conducted a study among Portuguese male and female adolescents (N = 782) to assess the reliability and dimensionality of BIS-11. They found six first-ordered factors structure as good fit model. However, the three second-ordered factors model did not fit the data well. They stated that BIS-11 is a reliable and validated tool both in male and female Portuguese youth population and useful in the identification of impulsive youth.

Azevedo and colleagues (2018) conducted a study to determine the validity and reliability of the Impulsive/Premeditated Aggression Scale (IPAS) in a sample of Portuguese inmates (N = 240). A principal component factor analysis was performed to assess the construct validity of the IPAS consisted of two subscales: impulsive aggression (IA) and premeditated aggression (PM). Convergent and divergent validity of the subscales were determined by analysing correlations between BIS-11 and the Psychopathic Checklist Revised (PCL-R). Both the IA (a = .89) and PM subscales (a = .88) had a good Cronbach's alpha values. Results revealed that IA subscale was correlated with three dimensions (attentional, motor, and non-planning impulsiveness) whiles the PM subscale was correlated with two dimensions (attentional and motor impulsiveness) of BIS-11 Scale. They found adequate psychometric properties for Portuguese translated version of IPAS.

Recently, Janavičiūtė and Sinkariova, (2020) assessed psychometric properties of BIS-11 among Lithuanian adults (N = 289). Exploratory, confirmatory factor analysis and construct validity indicated that three-factor model of BIS-11 is more appropriate. They found that Lithuanian version of BIS-11 has good psychometric properties and a valid scale to assess impulsivity among Lithuanian adult.

Current investigation

The above literature and scantiness of research in Pakistan in order to explore the latent structure of Urdu Version of BIS-11 item response, the basic purpose of the current study was to investigate the unidimensional, six first- and three second-order factor structure, and a bifactor model to evaluate the degree to which multidimensionality affects the assessment of the BIS-11 scores as reflecting impulsivity as a unidimensional trait.

Method

Participants and Procedure

The sample of the current study was composed of six hundred (N = 600), 16 to 28 years of university students. The sample was recruited from the different universities of Peshawar KP Pakistan. Demographic information revealed that 56.5 % were male and 43.5% were females. Students with physical disabilities, medical and psychological histories were excluded from the study.

Permission for the currents study was taken from the Advanced Study Research Board (ASRB) of the university. Consents of the students were taken on the consent sheet. A demographic sheet consisted of age and gender along with BIS-11 Urdu Version was given to the students. They were requested to complete the questionnaire carefully and avoid missing any question. Students' participation was voluntary and they were assured that their identity will remain confidential and will be used only for the research purpose. They were allowed to quit at any point.

Analytic Plan

Three alternative models of BIS-11 along with the bifactor model were specified and estimated in Amos 21. CFA techniques were used in order to determine the factor structure and factor loading of measured variables, and to assess the fit between the data and the pre-established theoretical model.

The Barrat Impulsiveness Scale (BIS-11; Patton et al., 1995) is a 30 items scale. It was constructed to measure impulsiveness as a unidimensional personality trait but later changed and developed to include several dimensions (Patton et al., 1995). In the present study 25 items of BIS-11-UV were used to collect the responses of the university students. Items of the BIS-11-UV were scored on a 4-point Likert scale (rarely/never = 1, occasionally = 2, often = 3, almost always/always = 4), and the level of impulsiveness is determined by adding up the score for each item (Patton et al., 1995). Unidimensional, six first-order factors, three second-order factors and bifactor model of BIS-11 Urdu Version (BIS-11-UV) were assessed. The subscales used for six first-order factors are: attention (item: 5, 9, 11, 20, 28), cognitive instability (item: 6, 24, 26), motor (item 2,3,4,17,19), perseverance (item: 21, 23, 30), self-control (Item: 1, 7, 8, 12, 4) and cognitive complexity (item: 15, 18,27,29). Items used for second-order factors are follows, attentional impulsiveness: 8, 5, 6, 9, 11, 20, 24, 26, 28; motor impulsiveness: 2, 3, 4, 17, 19, 21, 23, 30; and non- planning impulsiveness: 1, 7, 8, 12, 14, 15, 18, 27, 29.

Item 10 (I save regularly), Item 13 (I plan for job security), Item 16 (I change jobs), item 21 (I change residences), and Item 25 (I spent or charge more than I earn) were removed from the scale because all respondents were not doing any job neither saving any money.

Initially, analysis of response frequencies, item and scale mean, inter item-test correlation and coefficient alpha internal consistency for total and subscales are estimated by using IBM SPSS version 24. Additionally, IBM Amos version 21 was used to examine: (a) unidimensional model; (b) a six correlated first order factor model; (c) and a second-order model; and (d) a bifactor model with single general factor and 3 grouping factors to assess whether Urdu Version of BIS-11 is unidimensional or multidimensional scale of impulsivity.

Model fit was assessed by using robust indices: Comparative Fit Index (CFI) Tucker Lewis Index (TLI), Residual Mean Square Error of Approximation (RMSEA), Standardized Root Mean Residual (SRMR), and Bayesian Information Criterion (BIC). The values of CFI and TLI for best fit model should be $\geq$ 0.95 however, value $\geq$ 0.90 is acceptable. The values of RMSEA and SRMR should be $\leq$ 0.05 for excellent model fit though value $\leq$ 0.08 is acceptable (Hu & Bentler, 1999). The value of

BIC indicates the model fitness in terms of comparison. When comparing different models to each others, the model with smallest BIC values is taken to be the preferred model.

Estimation of Confirmatory Models

The first CFA unidimensional model was estimated by loading all items onto a single factor and variance of the latent variable has been fixed to 1.0. It was important to assess the unidimensional scale of BIS-11 because previous studies have found link between BIS-11 total scale and other criterion variables such as boredom susceptibility, empathy, and fun-seeking behaviour (Stanford et al., 2009). Second, CFA model was estimated with six correlated first-order factors. Each item was loaded onto its factor and all variances were fixed to 1.0.

Third, a second-order model was estimated by loading each item on six uncorrelated factors and: then two factors were loaded on three factors (motor and perseverance loaded on Motor Impulsiveness; self-control and cognitive complexity loaded on Non-planning Impulsiveness; and attention and cognitive instability loaded on Attentional Impulsiveness). (See figure 3).

Finally, a bifactor model was estimated to address the question related to the dimensionality of the scale (Reise et al., 2013). Application of a bifactor model is valuable to evaluate the empirical plausibility of subfactors and the practical impact of dimensionality assumption on test scores. Therefore, all factors of Urdu Version BIS-11 were loaded onto a general factor and six sub-factors. For the identification of the mode all variances were fixed to 1.00 to specify that all factors are orthogonal.

The Bifactor indices Calculator (a Microsoft Excel-based tool) was used to compute various statistical indices relevant to evaluate bifactor models including EVC (Explained Common Variance is the proportion of all common variance explained by the factors); Omega Hierarchical (represents the percentage of systematic variation in the unit weight (raw) total score that can be attributed to individual differences on the general factor; when omega H is high than .80, the total score is basically can be considered non-dimensional); PUC (The Percent of Uncontaminated Correlations: represents the percentage of covariance terms, which only reflect variance from the general dimension). A user guide for the calculator is available on the first worksheet. The copyright holder has granted the permission to everyone to freely use and distribute the calculator for research purpose with the creator's information (Dueber, 2017).

Results

Descriptive Psychometrics

Table 1 show that all items of Urdu Version of BIS-11 have good item-test correlation. Only one item (I am happy go lucky) had item-test correlation .28. Coefficient alpha for total score is .86 and the average item inter-correlation is .24 suggesting the items are well correlated and measure the same construct.

Table 1 *Reliability and Homogeneity of the Urdu Version of the BIS-11 (N=600)*

Items	Scale Mean if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
I plane task carefully	60.58	0.55	0.86
I plane trips well ahead of time	60.66	0.54	0.86
I am self-controlled	60.59	0.52	0.86
I am careful thinker	60.64	0.51	0.86
I say thing without thinking	60.73	0.57	0.86
I like to think about complex thinking	60.69	0.46	0.86
I get bored easily when solving thought problems	60.82	0.54	0.86
I am more interested in the present than the future	60.81	0.42	0.86
I like puzzles	60.76	0.47	0.86
I do thing without thinking	60.77	0.49	0.86
I make up my mind quickly	60.99	0.40	0.86

I am happy go lucky	61.01	0.28	0.86
I act on impulse"	60.94	0.31	0.86
I act on the super of the moment	60.88	0.42	0.86
I buy thing on impulse	61.04	0.41	0.86
I can think only about one problem at a time	60.95	0.40	0.86
I am future oriented	60.51	0.31	0.86
I don't "pay attention"	60.75	0.45	0.86
I have "racing thought"	60.86	0.41	0.86
I concentrate easily	60.61	0.31	0.86
I am "squirm" at play or lecture or training	60.79	0.44	0.86
I am steady thinker	60.62	0.34	0.86
I change hobbies	60.75	0.35	0.86
I often have extraneous thoughts when thinking	60.83	0.39	0.86
I am restless at the theatre, lecture, or training.	60.76	0.30	0.86

Table 2 *Goodness-of-fit Indices for Unidimensional Model, Six First-order Factor Model, Three Second-order Factor Model and Bifactor Model (N=600)*

	Unidimensional Model	**Six First-order Factor Model**	**Three Second-order Factor Model**	**Bifactor Model**
x²/df	4515.4***	**919.6*** **	941.4***	1192.8***
CFI	0.43	**0.91**	0.90	0.87
TLI	0.37	**0.91**	0.89	0.86
RMSEA	0.16	**0.05**	0.06	0.07
SRMR	0.19	**0.04**	0.05	0.09
BIC	4835.3	**1318.8**	1335.4	1531.9
PUC				0.69
ECV				0.30
Omega hierarchical				0.55

Note. CFI = Comparative Fit Index; *TLI* = Tucker Lewis Index; *RMSEA* = Residual Mean Square Error of Approximation; *SRMR* = Standardized Root Mean Residual; *BIS* = Bayes Information Criterion; *PUC* = Percent of Uncontaminated Correlations; *ECV* = Explained Common Variance.

Fit indices in Table 2 shows that First-order factor model (six correlated subscales) is more appropriately fit to the data then unidimensional, bifactor model and ,second-order factor model . Fit indices for first order factor model are CFI = .91, TLI = .91, RSMEA = 0.06, SRMR = 0.04, BIS 1318.8. The ECV is 0.30 whiles PUC is 0.69 which suggested that BIS-11 is not a unidimensional scale. ECV indicates that only 30% variance explained by general factors. It is suggested that "*when ECV is > .70 and PUC > .70, the relative bias will be slight and the common variance can be regarded as essentially unidimensional*" (Rodriguez et al., 2016). When Omega hierarchical is >.80, it indicate that total score of the scale should be considered Unidimensional (Dueber, 2017) whiles, in the current study the Omega hierarchical is 0.55 which suggested that only 55% of the variance of total raw score can be attributed to the individual differences on the general factor. Overall results of Bifactor model suggested that Urdu Version of BIS-11 is multidimensional scale.

Table 3 *Unidimensional, Bifactor Model, First-order Factor, and Second-order Factor Loadings*

	UM	Bifactor Model				Six First-Order Factor						Three Second-Order Factor		
		G	N	M	N	SC	CC	M	P	A	CI	N	M	A
I plane task carefully	.81	.48	.68			.82						.82		
I plane trips well ahead of time	.79	.48	.67			.80						.81		
I am self-controlled	.78	.46	.68			.80						.80		
I am careful thinker	.76	.45	.65			.77						.76		
I say thing without thinking	.76	.47	.60			.75						.76		
I like to think about complex thinking	.72	.45	.63				.76					.75		
I get bored easily when solving thought problems	.73	.47	.57				.75					.75		
I am more interested in the present than the future	.62	.44	.52				.66					66		
I like puzzles	.68	.44	.57				.70					.70		
I do thing without thinking	.26	.56		.33				.73					.72	
I make up my mind quickly	.16	.52		.44				.72					.72	
I am Happy go lucky	.09	.50		.37				.78					.70	
I act on impulse	.15	.39		.47				.60					.59	
I act on the super of the moment	.17	.53		.46				.75					.75	
I buy thing on impulse	.19	.52		.24					.72				.72	
I can think only about one problem at a time	.18	.51		.39					.68				.67	
I am future oriented	.15	.47		.44					.64				.53	
I don't "pay attention"	.24	.49	.49		.59					.89				.87
I am restless at the theatre, lecture, or training.	.14	.45	.45		.60					.60				.60
I concentrate easily	.17	.47	.47		.59					.69				.68
I am "squirm" at play or lecture or training	.23	.44	.44		.56					.75				.77
I am steady thinker	.22	.41	.41		.52					.66				.70
I change hobbies	.15	.48	.48		.59						.72			.70
I often have extraneous thoughts when thinking	.19	.46	.46		.52						.71			.71
I have "racing thought"	.20	.46	.46		.56						.76			.76

Note. *UM* = Unidimensional Model; Bifactor Model; G = General Model; N = Non-Planning; M = Motor Impulsivity; A = Attentional Impulsivity; *SC* = Self Control; *CC* = Cognitive Complexity; *M*= Motor; *P* = Perseverance; *A*= Attentional; *CI* = Cognitive Instability; *NP* = Non-planning; *MI* = Motor Impulsivity; *AI* = Attentional Impulsivity.

Figure 1 Unidimensional Model of Urdu Version of BIS-11

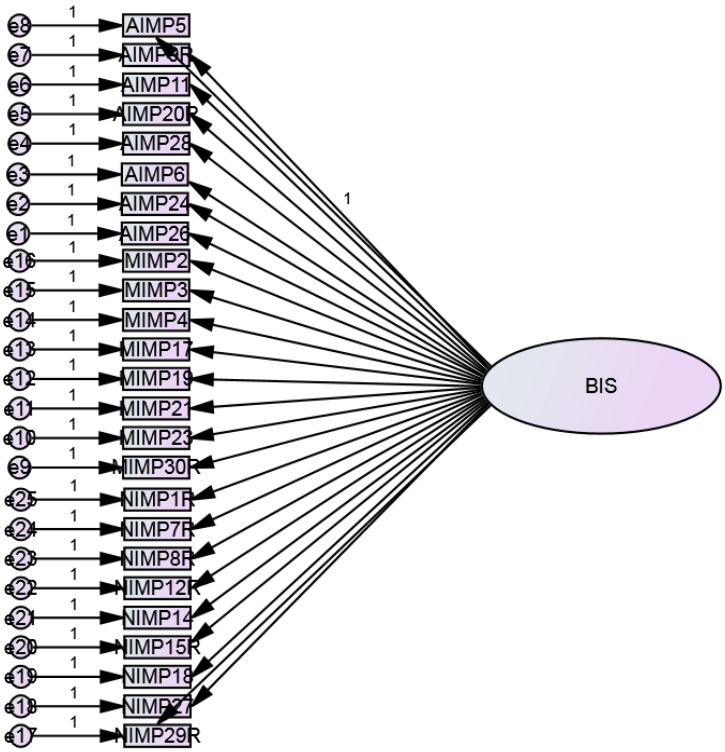

Figure 2 Six First-Order Factor Model

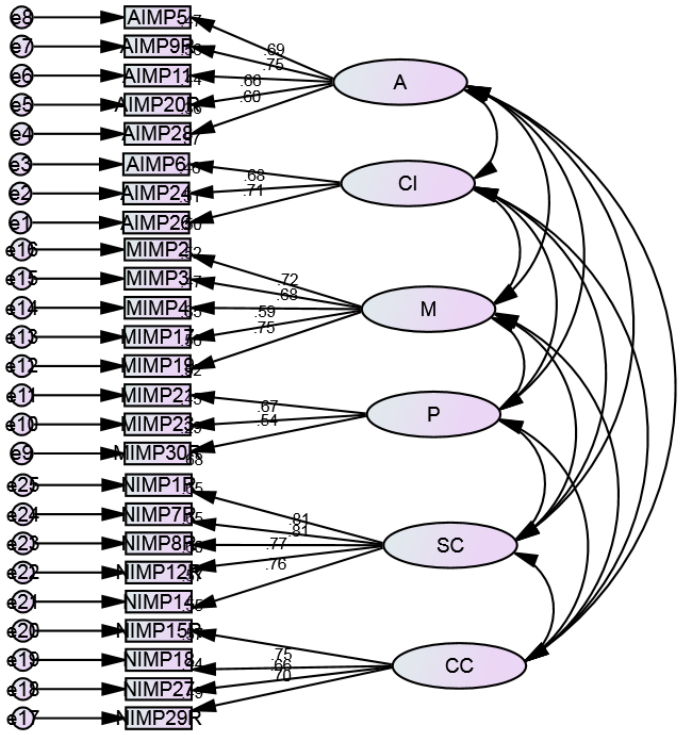

Figure 3 Second-order Factor Model

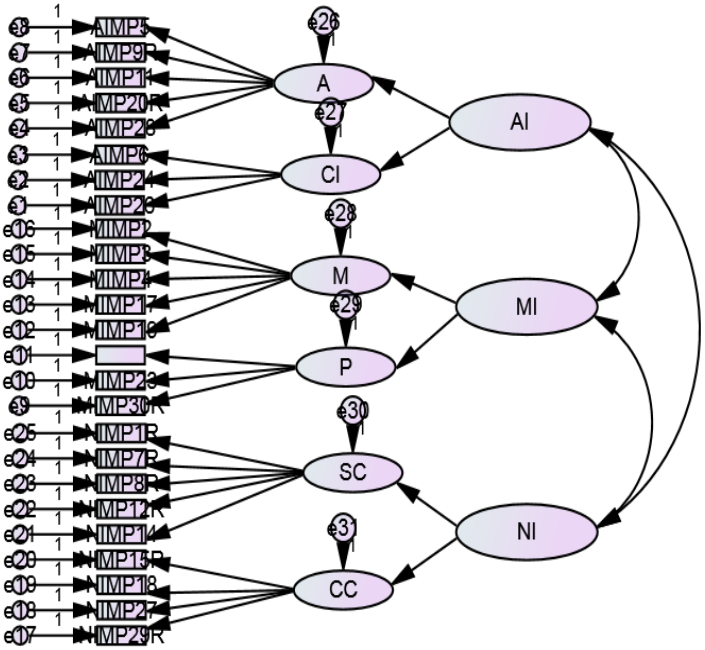

Figure 4 Bifactor Model

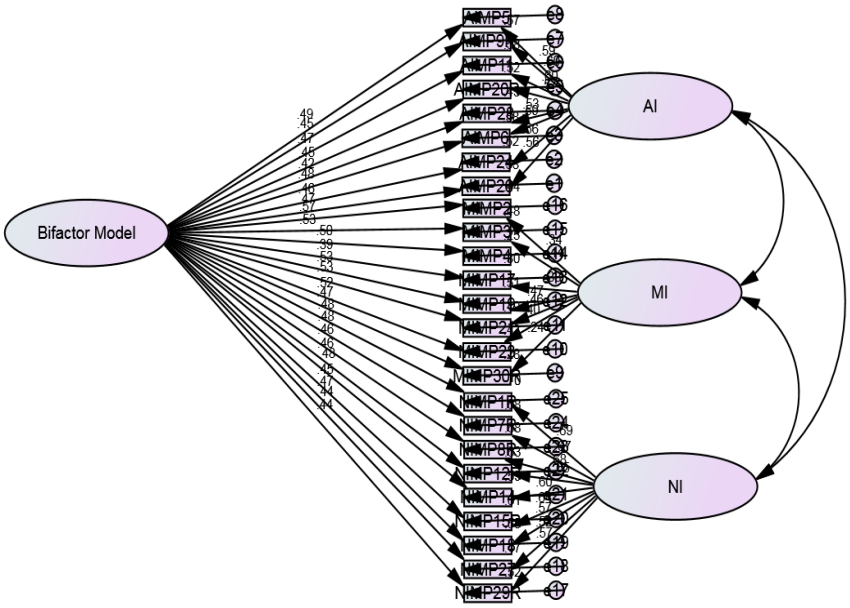

Table 3 indicated that factor loadings on unidimensional model are low then firs-order and second-order factor model. However, the difference between the factor loadings of first-order factor model and second-order factor model are slightly different, therefore a chi-square test of independence was performed to assess the factor structure of Urdu Version of BIS-11.

$$x^2_{diff} = x^2_{second\text{-}order\ factor} - x^2_{first\text{-}order\ factor}$$

$$x^2_{diff} = 941.435\text{-}919.638 = 21.797$$

$$df_{diff} = df_{second\text{-}order\ factor} - df_{first\text{-}order\ factor}$$

$$df_{diff} = 266\text{-}260 = 6$$

Above calculation indicate that the difference between these two models was statistically significant, X^2 (6, N =600) = 21.79, p<.05. Current results revealed that Six First-order factor is statically more significant than Three second-order factor model.

Discussion

The main purpose of the study was to test four theories of the BIS-11 structure, each defined by a different model: (a) a unidimensional model; (b) a bifactor model.

(c) a six correlated first-order factor model, and (d) a three second-order factor model.

Current study attempts to describe the importance of relying not just on model fit indices, but also on bifactor, confirmatory factor analysis to assess the factor structure of the scale presumed to be multidimensional in nature. Three bifactor indices (explained common variance, omega hierarchical, and percentage uncontaminated correlations) were calculated for four models that are described as multidimensional in published research.

It is important to validate the total and subscales derived from the instrument to explore the latent structure of scale to support the theory. The results of assessment and explanation to interpret the total and subscale scores obtained from the BIS-11 have been explained in the following section to support the theories of impulsivity.

Initially, BIS-11 total score were loaded on single scale to assess the unidimensionality of the scale. To assess whether a scale is unidimensional or not it is important to find the distinction between unidimensionality (existence of one and only one common factor) and the ability to scale individuals on a single dimension. If item-response data is strictly unidimensional, scores on the scale can be interpreted unambiguously indicators for a signal, common dimension. However, if item responses are multidimensional, then further analysis required to assess the dimensionality of the scale.

Current results obtained by applying confirmatory factor analyses indicated that BIS-11 responses cannot be explained on the basis of one and only one common factor as evident by factor loadings and fit indices (see Table 3).

Failure to meet the criteria does not necessarily rule out the possibility of interpreting the total score as it reflects the dimensions of a general sequence. It has been argued that in order to estimate the interpretation of a comprehensive score in the presence of a multidimensional response to an item, one must estimate the data indexes based on the bifactor structural model(e.g., Gignac et al., 2016; Gustafsson & Aberg-Bengtsson, 2010; Reise et al., 2013). There was a specific recommendation (McDonald, 1978) that could be interpreted as an indicator of general factor saturation, or as an estimate of the percentage of total score variation due to a common hidden factor.

The bifactor model assumes a general factor, on which all items were loaded on general factor and a series of specific unrelated grouping factors. The bifactor model is especially valuable for estimating the practical effect of dimensional assumptions on the empirical capabilities of sub-scales and test scores.

In the current study, bifactor model was estimated by loading all 25 items on to the general factor and also loaded onto the three grouping factors (Attentional Impulsivity, Motor impulsivity and Non-planning impulsivity). In this fourth model the grouping factors are restricted to being uncorrelated with each other and uncorrelated with the general factors. The variance of each factor is set to 1.0 for the purpose of model identification. Tables 4 shows that factor loadings of some items are below .40 which is not acceptable (Tanaka, 1987).

The empirical findings showed those BIS-11 items are clearly multidimensional, as demonstrated by the confirmatory factor analysis that supports both the proposed six first order and three second order multidimensional structures. A previous study found the result from the CFA that a three factors model of Japanese version of BIS-11 is acceptable fit of the data based on the goodness-of-fit indices (GFI = 0.85; AGFI = 0.82). However, the values of fit indices which they found are very low. In the current study, the value of TLI for three factor model is low (TLI, .89) than the six first-order factor model (TLI, .91). Furthermore, to find more accurate results a Chi Square formula was applied to find the best fitting model. Thus, present results provided support for scoring the BIS-11 tool through the six correlated first-order factor model, and indicated that the sub-scale scores were significantly indicative of a basic latent variable or psychological construction.

Conclusion

The BIS-11 was originally developed as three-factor model (attention, motor, non-planning). In the current study, a unidimensional model, first-order six factors, second-order three factor model, and a bifactor model were empirically proposed to assess the multidimensional structure of the Urdu Version of BIS-11.

The results of the present study, as well as those of Steinberg et al. (2013) provided no support for the theory that BIS-11 can be partitioned meaningfully into three subscales that reflect the three constructs proposed by Barratt. Six correlated first order factor solution is not consistent with the previous study Contrary to the previous study of Raise et al. (2013) who used confirmatory factor analysis to assess the factor structure of the BIS-11. They applied one-dimensional model; a six related first order factor model; a three second order factor model; and bifactor model. They found that the use of the total score of BIS-11 reflects the challenges in interpreting individual differences on a common dimension. Furthermore, the theory that BIS-11 measures the three sub-domains of impulsivity (attention, motor, and unplanned) has not been empirically supported. However, they found a two-factor model is presented as an alternative multidimensional structural representation.

Current results are contradictory to the study of Raise et al. (2013) who applied four models: unidimensional, Bifactor, First-order, and Second-order factor model however, could not found any empirical support for all fours models. They suggested two factor model of BIS-11 is more appropriate than above mentioned four different models to support the theory.

Psychometric analyses in current study address the structure of data derived from a particular instrument and evaluate the theory of the true nature of a psychological based construct. Finally, for researchers who like to study the broader framework of conceptual understanding of impulsivity should consider BIS-11 as six correlated factors rather than three sub-scales. An Urdu version of BIS-11 has undergone a more rigorous psychological assessment and well maintained to assess the true construct of impulsivity.

Limitation and Future Suggestions

Current study has few limitations. Only university students were included in the study therefore information from the sample cannot be generalized back to the students 'population. Self-report method has been used to collect the data. Reponses can be over or under estimated by the respondent. Future study should be warranted by using more diverse sample to assess the psychometric properties of Urdu version of BIS-11 such as clinical, criminal, and general population.

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