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NORMATIVE DATA AND A SHORT FORM OF THE BARRATT IMPULSIVENESS SCALE

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The Barratt Impulsiveness Scale is one of the most commonly used scales to measure impulsivity. It has demonstrated validity in several neuropsychiatric populations and correlates with objective neuropsychological measures and impulsivity-related behaviors in healthy individuals. Neuroimaging studies show that BIS scores relate to prefrontal structure and function, as well as central serotonergic function. This study reports normative data and demographic influences in a community sample ($n = 700$). A 15-item short form of the BIS (BIS 15) is presented that retains the 3-factor structure (nonplanning, motor impulsivity, and attention impulsivity), and maintained good reliability and validity.

Keywords Barratt Impusiveness Scale, impulsivity, normative data, prefrontal, short form

The Barratt Impulsiveness Scale is one of the most commonly used scales to measure the construct of impulsivity. It has been widely used in a variety of research studies using both normal and clinical populations. Findings with BIS in research using clinical populations, neuropsychological measures, and neuroimaging studies strongly emphasize the validity of this self-rating instrument, making it a very useful research tool.

The BIS has been used in clinical populations of several neuropsychiatric conditions characterized by increased impulsivity, including bulimia, bipolar

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disorder, and borderline personality disorder (Paul et al., 2002; Swann et al., 2001; Dougherty et al., 1999). People with kleptomania also score higher than controls on the BIS (Bayle et al., 2003). Impulsivity is associated with increased risk and severity of several addictive behaviors such as substance abuse. BIS scores correlated with drug craving in women seeking treatment for substance abuse (Zilberman et al., 2003). In pathological gamblers, BIS scores related to illegal activites and risky sexual behaviors (Martins et al., 2004). BIS scores are higher in people with Binge Eating Disorder (BED), and BIS scores correlate with BED criteria an depression prior to binge eating episodes (Nasser et al., 2004).

BIS scores correlate with behavior and personality characteristics in normal community samples. Using Stunkard and Messick's Eating Inventory (1985), eating disinhibition positively correlated with both attention and motor impulsivity, and hunger positively correlated with attention impulsivity (Lyke & Spinella, 2004). BIS scores (nonplanning and attention impulsivity) correlate inversely with aspects of empathy, including perspective taking and empathic concern (Spinella, 2005). Both impulsivity and empathy have been shown to relate to prefrontal functioning, particularly orbitofrontal regions.

The BIS correlates with objective neuropsychological measures of impulsivity (e.g., Carrillo-de-la-Pena et al., 1993). It also correlates with neuropsychological measures that have demonstrated sensitivity to prefrontal, particularly orbitofrontal dysfunction (Spinella, 2004). Errors on go/no-go and antisaccades correlated positively with the BIS motor impulsivity, attention impulsivity, and total score. Correct delayed alternations correlated inversely with motor impulsivity. These were significant despite controlling for age, sex, and education.

Although the afore mentioned studies are indicative of a relationship between BIS scores and the structure and function of prefrontal-subcortical systems, several functional neuroimaging studies provide direct evidence. BIS scores correlate with the structure and function of white matter in right prefrontal cortex in people with schizophrenia (Hoptman et al., 2002). Reduced integrity of the anterior corpus callosum is related to BIS scores in cocaine-dependent individuals (Moeller et al., 2005). Scores also correlate with prefrontal cortex activation during performance of a response inhibition task (Horn et al., 2003). Another study using a response inhibition task (go/no-go) found a correlation between BIS scores (motor impulsiveness) and right dorsolateral prefrontal activation (Asahi et al., 2004). Electrophysiological studies have similarly shown BIS scores to relate to prefrontal activity. BIS scores inversely correlated with activation frontal in both healthy people and

those borderline personality disorder performing a go/no-go task (Ruchsow et al., 2006). People with higher levels of impulsivity as measured by the BIS showed lower frontal delta and theta activity as well as a different topographical pattern of beta activity (Houston & Stanford, 2005). BIS scores also relate to measures of central serotonergic function (Sakado et al., 2003; Preuss et al., 2001; Manuck et al., 1998).

Despite the impressive amount of empirical evidence to support the BIS and indicate its usefulness, normative data have not been published in a community sample. This study tested the psychometric properties of the BIS in a non-clinical, community sample. It also sought to empirically derive a shorter, more concise form for use in larger surveys.

STUDY 1

Methods

Participants. Participants were a convenience sample ($n = 700$; 418 female, 279 male, 3 did not specify sex) of individuals recruited by word-of mouth.. Research assistants were instructed to find community-dwelling non-institutionalized adults from the local community. In order to encourage more honest responding, participants filled out the questionnaires in private and sealed them in an envelope before returning them. There was no financial compensation for participating. The study was approved by an institutional review board and all subjects agreed to a consent form in accordance with the Declaration of Helsinki and the ethical principles of the American Psychological Association. Subjects raged in age from 15 to 89 years ($M = 29.3$, $SD = 12.9$), and had completed between 10 and 19 years of education ($M = 14.2$, $SD = 1.9$).

Measure. *Barratt Impulsiveness Scale—version 11* (BIS). The BIS is a 30-item, self-rating scale measuring aspects of impulsivity. The items form three non-overlapping scales that show good reliability: non-planning (BISnp), motor impulsivity (BISm), and attentional impulsivity (BISa) (Patton et al., 1995). Representative items include: "I plan tasks carefully" (BISnp, inverted item), "I act on impulse" (BISm), and "I concentrate easily" (BISa, inverted item). Items are rated on a 4-point Likert-type scale (1 = rarely/never, 4 = almost always). Validity of the scale is indicated by several studies of the instrument using clinical populations, neuroimaging, and neuropsychological measures discussed earlier.

Table 1. Descriptive statistics for the 30-item and 15-item BIS in a normally distributed sample ($n = 700$)

	Range	*M*	*SD*
30 Item Version			
NP	13–56	24.9	5.1
M	12–39	22.1	4.4
A	8–29	17.2	3.9
Total	39–103	64.2	10.7
15 Item Version			
NP	5–20	11.2	3.1
M	5–20	10.5	3.0
A	5–20	10.8	3.0
Total	16–54	32.6	6.9

Results

Normative data. Descriptive statistics for the 30 item BIS are given in Table 1. A linear regression of demographic variables predicting the total score of the BIS was significant, $F(3, 695) = 26.8$, $p < .001$ (Table 2). The model accounted for 10.5% of the variance (Adjusted $R^2 = .101$). Males scored higher than females, and scores tended to decrease with age and education. A one-sample Kolmogorov-Smirnov Test indicated that scores were normally distributed ($Z = 1.02$, $p = .249$, two-tailed significance) (Figure 1). Intrascale reliability (Cronbach's alpha) for this sample was very good (.82) (DeVellis, 1991).

Table 2. Linear regression of demographic variables predicting the 30-item and 15-item BIS total scores

	B	SE	Beta	Partial	Part	*p*
BIS30						
Age	−.25	.03	−.30	−.30	−.30	<.001
Sex	.85	.40	.08	.08	.09	.032
Education	−.70	.21	−.12	−.13	−.12	.001
BIS15						
Age	−.16	.02	−.30	−.30	−.30	.000
Sex	.49	.26	.07	.07	.07	.059
Education	−.48	.13	−.13	−.14	−.13	.000

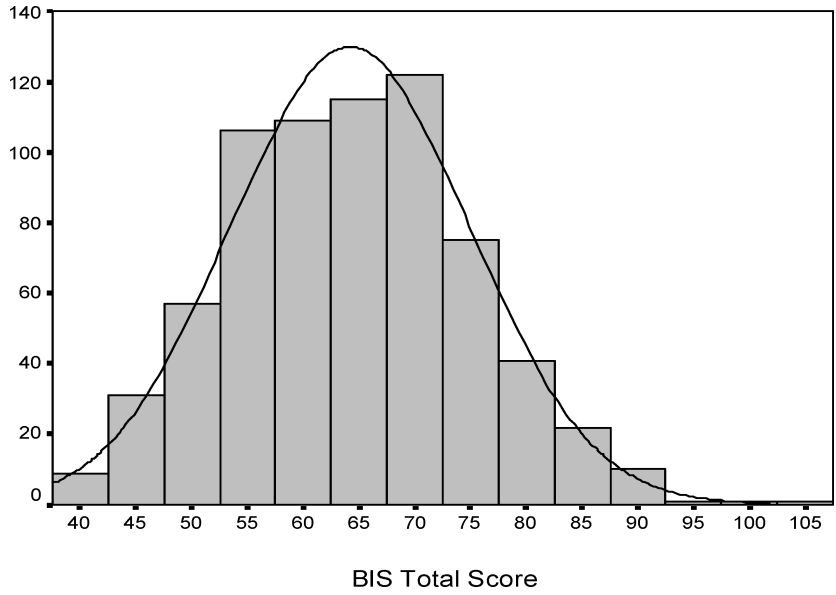

Figure 1. Distribution of the 30-item BIS total scores ($n = 700$).

Development of a short form. The 30 items of the BIS were subjected to a factor analysis by principal components using Varimax rotation. A three factor solution was specified a priori based on previous studies showing a three-factor structure (Patton et al., 1995). Items factored in a manner that was highly consistent with the three established factors: nonplanning, motor impulsivity, and attention impulsivity. Five items with the highest loadings from each of the 3 factors were chosen and the factor analysis was re-run using only these 15 items. Eigenvalues, variance explained and intrascale reliability (Cronbach's alpha) for each item is reported in Table 3. Collectively, these three factors explained 33.4% of the variance. Cronbach's alpha for the total scale was very good (.81). As with the original scale, six of the items are inverted because they relate to lower impulsivity (e.g., "I plan for the future.")

Descriptive statistics for the 15 item BIS (BIS15) are also given in Table 1. A linear regression of demographic variables predicting the total score of the BIS was significant, $F(3, 695) = 26.5, p < .001$ (Table 2). The model accounted for 10.7% of the variance (Adjusted $R^2 = .103$). Scores decreased with age and education. The sex differences (males scoring higher than females) fell to marginal significance ($p = .059$). However, the coefficients for all three demographic variables were equivalent. Scores of the short form were also

Table 3. Factor analysis of a 15-item version of the BIS. Abbreviations: A—Attention impulsivity, M—Motor Impulsivity, NP—Non-planning

1	2	3	Item	BIS30	BIS15
.83	.04	.09	I act on impulse. [inverted]	M	M
.80	.09	.08	I act on the spur of the moment.	M	M
.63	.27	.14	I do things without thinking.	M	M
.63	.12	.22	I say things without thinking.	NP	M
.50	.12	.07	I buy things on impulse	M	M
.14	.71	.02	I plan for job security. [inverted]	NP	NP
.14	.69	−.09	I plan for the future. [inverted]	M	NP
.11	.64	−.05	I save regularly. [inverted]	NP	NP
.16	.63	.15	I plan tasks carefully. [inverted]	NP	NP
.07	.62	.28	I am a careful thinker. [inverted]	NP	NP
.14	−.06	.84	I am restless at lectures or talks.	A	A
.11	−.07	.80	I squirm at plays or lectures.	A	A
.06	.43	.58	I concentrate easily. [inverted]	A	A
.34	.31	.42	I don't pay attention.	A	A
.29	.09	.40	Easily bored solving thought problems.	NP	A

normally distributed, as indicated by a Kolmogorov-Smirnov test ($Z = 1.15$, $p = .14$, two-tailed significance). BIS15 scores correlated with the total scores of the full test (BIS30) ($r = .94$, $p < .001$), and they also correlated with the total of the remainder items not included in the BIS15 ($r = .65$, $p < .001$)

STUDY 2

Methods

Participants. Participants were a convenience sample ($n = 100$; 49 female, 51 male) of community-dwelling individuals recruited by word-of mouth. This was a separate sample from studt 1, but identical procedures were followed. Subjects raged in age from 17 to 57 years ($M = 27.0$, $SD = 11.2$), and had completed between 8 and 18 years of education ($M = 14.0$, $SD = 2.3$).

Measures. Barratt Impulsiveness Scale. The 15-item version of the BIS developed in study 1 was used in this study.

Frontal Systems Behavior Scale (FrSBe). The FrSBe is an instrument that measures neurobehavioral traits associated with prefrontal systems (Grace & Malloy, 2001). It consists of 46 items and has 3 subscales derived by factor

Table 4. Correlations between the BIS15 and Frontal Systems Behavior Scale (FrSBe)

	Bivariate				Partial			
	NP	M	A	Total	NP	M	A	Total
FrSBe-A	.39†	.18	.40†	.43†	.37†	.15	.33†	.39†
FrSBe-D	.37†	.52†	.46†	.60†	.31*	.51†	.36†	.54†
FrSBe-E	.51†	.44†	.62†	.70†	.50†	.44†	.56†	.69†
FrSBe-T	.51†	.46†	.59†	.69†	.49†	.46†	.52†	.67†

($N = 100$; two-tailed significance, $^{*}p <= .01$, $^{\dagger}p <= .001$). Partial correlations are controlling for age, sex, and education. Abbrebiations: FrSBe-A—Apathy, FrSBe-D—Disinhibition, FrSBe-E—Executive dysfunction, NP—Nonplanning, M—Motor impulsivity, A—Attention impulsivity.

analysis: Apathy, Disinhibition, and Executive dysfunction. The scale shows high intrascale reliability in normal and clinical samples (Grace & Malloy, 2001). Validity of the instrument is further supported by studies in neurological populations. FrSBe scores correlated with objective measures of executive functions in people with multiple sclerosis (Chiaravalloti & DeLuca, 2003).

Results

BIS15 scores ranged from 20 to 51 ($M = 32.8, SD = 6.5$), which were consistent with the normative scores in study 1. Cronbach's alpha for the BIS15 in this sample was.79. FrSBe scores ranged from 64 to 154 ($M = 103.5$, $SD = 21.1$), which is consistent with reported normative data in non-clinical samples (Grace & Malloy, 2001; Spinella, 2005).

Bivariate correlations showed moderate to strong relationships between subscales and the total scores of the FrSBe and BIS (Table 4). The only correlation that did not reach significance was between motor impulsivity (BIS15) and apathy (FrSBe-A). Partial correlations showed that these relationships remained significant after controlling for age, sex, and education.

DISCUSSION

This is the first study to report normative data for the BIS in a community sample. Participants were not systematically screened for the presence of psychiatric or neurological illness. Based on the base rates of such illnesses, it is likely that some of the participants suffered from one or more conditions

associated with greater impulsivity (e.g., substance abuse, personality disorder, attention deficit hyperactive disorder). Nonetheless, the scores were normally distributed as would be anticipated from a large community sample. Demographic variables were relevant to impulsivity scores. Age was the strongest predictor, which was moderate in magnitude. Sex and education level were also relevant, but their contribution was relatively small.

The 15-item version of the BIS created here was derived from items that had the highest loadings of on the three factors of the scale. The factor analysis closely replicated the higher order factor structure indicated by Patton and colleages (1995). There are three items that loaded on scales differently. On the 30-item BIS (BIS30), "I say things without thinking." is included in the NP scale, while it loaded significantly on the NP scale in this sample. However, this grouping is logical because it factors with other items that involve a lack of behavioral self-inhibition. "I plan for the future" was included on the M scale of the BIS30, while here it logically loaded on the NP scale. Thirdly, "I am easily bored while sovling thought problems." was part of the NP scale of the BIS30, while here it loaded on the A scale. Other items of the A scale similarly involve sustaining concentration. Thus the minor variations from the original designations involve items that factor logically into the three scales.

Study 2 showed moderate to strong relationships between the BIS15 and FrSBe, which has been validated in clinical populations and against objective neuropsychological measures of prefrontal functions. Thus, these two objectively validated scales self-rating scales of prefrontal system function showed strong intercorrelations.

This short version of the BIS correlated strongly with the full version and with the items non-included in the short version. It also showed good intrascale reliability, which did not decrease (in fact slightly increased) from the total scale. This scale also eliminates items that did not load well into any of the factors. These items (e.g., "I like puzzles," and "I am happy-go-lucky") may relate to impulsivity, but may also relate to other factors or could be interpreted differently by different people. As a shorter, more condensed and homogeneous scale, it can serve as a useful alternative to the longer scale while retaining good psychometric properties.

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