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Review

Fifty years of the Barratt Impulsiveness Scale: An update and review

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ABSTRACT

The Barratt Impulsiveness Scale (BIS-11) is a 30 item self-report instrument designed to assess the personality/behavioral construct of impulsiveness. Originally developed as part of a larger attempt to relate anxiety and impulsiveness to psychomotor efficiency, the BIS is arguably the most commonly administered self-report measure for the assessment of impulsiveness in both research and clinical settings. Over the last 50 years the BIS has significantly influenced the way that impulsivity is conceptualized in psychology and psychiatry. On its golden anniversary we thought it important to update the literature in relation to this influential psychometric instrument. The goal of this paper is threefold: (1) describe the history and development of the BIS-11; (2) present new data supporting the psychometric properties of the subscales; and to (3) review the clinical and personality literature that has reported on the BIS-11 subscales.

1. Introduction

Impulsiveness is a construct relevant to explaining both normal individual differences in personality and more extreme personality pathology among clinical populations. Impulsiveness has long been viewed as a complex construct (Barratt & Patton, 1983), which is reflected in one of the more popular definitions of impulsiveness "as a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to the impulsive individuals or to others" (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001).

The question of whether a person is capable of modulating their cognition and behavior to fit the demands of a given environment is imperative in almost any conceivable situation. Because of this there is wide spread interest in understanding the role of impulsiveness among healthy populations in activities ranging from employment behaviors (Everton, Mastrangelo, & Jolton, 2005) to educational performance (Diamantopoulou, Rydell, Thorell, & Bohlin, 2007). Generally though, impulsive behavior is viewed as counterproductive by society, and individual differences in impulsivity have been found to be related to a number of socially deviant behaviors like aggression (Houston, Stanford, Villemarette-Pittman, Conklin, & Helfritz, 2003) and substance abuse (Swann, Dougherty, Pazzaglia, Pham, & Moeller, 2004). Finally, impulsivity is a symptom of several disorders including attention-deficit/hyperactivity disorder, borderline personality disorder, and antisocial personality disorder (American Psychiatric Association, 2000), as well as the basis for a separate section in the DSM-IV-TR entitled *Impulsive Control Disorders not Elsewhere Classified* (which includes intermittent explosive disorder, kleptomania, pyromania, and pathological gambling; American Psychiatric Association, 2000). Given its relevance to both healthy and harmful behaviors, the accurate assessment of impulsiveness has been of wide interest in the scientific literature.

2. Development of the instrument

2.1. History of the Barratt Impulsiveness Scale

This year (2009) will mark the 50th anniversary of the Barratt Impulsiveness Scale (BIS; Barratt, 1959). The BIS, currently in its 11th revision (Patton, Stanford, & Barratt, 1995), is a 30 item self-report instrument designed to assess the personality/behavioral construct of impulsiveness (see Appendix). It is arguably the most commonly administered self-report measure specifically designed for the assessment of impulsiveness in both research and clinical settings. As of March 2009 there have been 551 citations of the BIS-11, building on the large number of publications using the preceding versions of the instrument (ISI, 2009). With its widespread application, the BIS has significantly influenced the way that impulsivity is conceptualized in psychology and psychiatry. The goal of this paper is threefold: (1) describe the history and development of the BIS-11; (2) present new data supporting the

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psychometric properties of the first and second-order subscales; and to (3) review the clinical and personality literature that has reported on the BIS-11 subscales.

The original BIS was developed by Ernest S. Barratt, Ph.D. in his attempt to relate impulsiveness, along with anxiety, to psychomotor efficiency (Barratt, 1959). Recognizing that impulsiveness and anxiety subscales from a number of self-report inventories such as the Thurstone Temperament Schedule (Thurstone, 1953) and the Guilford–Zimmerman Temperament Survey (Guilford & Zimmerman, 1949), usually had non-significant, correlations with each other, Barratt hypothesized that these two constructs were orthogonal. This hypothesis was supported by early studies that showed the Taylor Manifest Anxiety Scale (MAS; Taylor, 1953) and the Institute for Personality and Ability Testing Anxiety Scale (Cattell, 1957) were not significantly correlated with the BIS (Barratt, 1959, 1965, 1967). Barratt theorized that since anxiety, as measured by the MAS, had been related to "habit strength" within the Hull–Spence learning theory (Hull, 1943; Spence, 1956) then impulsiveness might be related to the construct of "oscillation", defined as momentary fluctuations in an organism's propensity to respond to a stimulus, within the same theory. The hypothesized orthogonal nature of impulsiveness and anxiety strongly influenced Barratt's early work on the BIS such that many of the initial item analyses (both published and unpublished) were done not only to arrive at internal consistency within the BIS, but also to eliminate items that correlated with measures of anxiety. A second and equally significant influence on the development of the BIS was Barratt's view that impulsiveness was not a uni-dimensional construct.

2.2. Subtraits of impulsiveness

A review of several factor analytic studies (Barratt, 1965; Eysenck & Eysenck, 1977; Twain, 1957) convinced Barratt that impulsiveness was not uni-dimensional, as he had originally conceptualized. After a long series of analyses (Barratt, 1965, 1972; Barratt & Patton, 1983) aimed at developing not only a scale orthogonal to anxiety but also an item pool that more specifically measured impulsiveness in contrast to other "action-oriented" traits such as sensation seeking, extraversion, and risk taking, Barratt proposed that impulsiveness was composed of three subtraits. Thus, the BIS (version 10) was redesigned to measure the theoretical subtraits of Cognitive Impulsiveness, Motor Impulsiveness, and Non-Planning Impulsiveness (Barratt, 1985). Within this three component conceptualization, Cognitive Impulsiveness involved making quick decisions, Motor Impulsiveness involved acting without thinking, and Non-Planning Impulsiveness involved a lack of "futuring" or forethought (Barratt, 1985). Subsequently, this three subtrait structure of impulsiveness has been consistently demonstrated in the literature (Gerbing, Ahadi, & Patton, 1987; Luengo, Carrillo-de-la-Pena, & Otero, 1991; Miller, Joseph, & Tudway, 2004; Parker, Bagby, & Webster, 1993; Patton et al., 1995).

The BIS-11 came about as Barratt's final attempt to more specifically define the subtraits of impulsiveness. Principal components analysis (PCA) was conducted on BIS-10 data gathered from a sample of 412 university students. The PCA produced six first-order factors; attention, motor, self-control, cognitive complexity, perseverance, and cognitive instability. This was consistent with previous work that had shown impulsiveness to have a broad first-order factor structure (Gerbing et al., 1987). An oblique rotation of the first-order factors showed the expected three second-order factors, with one important difference. While subtraits of Motor Impulsiveness (first-order factors motor and perseverance) and Non-planning Impulsiveness (first-order factors self-control and cognitive complexity) were clearly identified, the third factor had a heavy load of cognitive items and was not exactly the Cognitive Impulsiveness subtrait Barratt had originally conceptualized (Barratt, 1985). Another published study also reported difficulties identifying the Cognitive Impulsiveness subtrait when using the BIS-10 (Luengo et al., 1991). As a result, this third factor was labeled Attentional Impulsiveness (first-order factors attention and cognitive instability) and defined as an inability to focus attention or concentrate. While many researchers agree with Barratt's conclusion that impulsivity is a multi-faceted construct, the majority of studies using the BIS-11 have reported only the total score, ignoring both the first- and second-order subscales. Because impulsiveness is such a complex construct, understanding the relative contribution of each of the subscales is critical for accurately characterizing an individual's general level of impulsiveness. What we have attempted to do in this paper is to summarize in one document the findings from the existing literature on the BIS-11 subscale scores as well as add new psychometric data.

3. New BIS-11 psychometric data

Patton et al. (1995) stated that "the [*BIS-11*] subfactors are of primary value in helping define impulsiveness in general and exploring more subtle relationships between impulsiveness and different clinical syndromes." While interest in the second-order subscales has steadily increased since the publication of the BIS-11; few studies have attempted to look at the reliability and validity of these scores. Further, no study has published psychometric data on the first-order subscales, even though there is continued interest as demonstrated by the number of requests for information by other researchers to the present authors. To remedy this we present new psychometric data on the subscale scores in this section.

To obtain the present sample of adults ($N = 1577$ [m 393, f 1184]; age $M = 21.6$ [5.3], range 17–45; years of education $M = 13.2$ [1.5], range 6–23) data from two separate ongoing, unpublished studies of the BIS-11 were combined. This was done to create a larger and more diverse sample with the goal of obtaining psychometric data reflective of the general population. In the first study, college students ($N = 1178$ [m 266, f 912]; age $M = 19.4$ [1.3], range 17–25; years of education $M = 13.0$ [1.1], range 12–15) were asked to complete an online battery of self-report measures of impulsivity. One month after completion of the initial battery participants were asked to complete the BIS-11 online a second time so that test–retest reliability could be determined. Participants were given extra credit in a course for completion of the online battery which took approximately 2 h.

In the second study, healthy adults ($N = 399$ [m 127, f 272]; age $M = 28.2$ [7.0], range 18–45; years of education $M = 13.7$ [2.2], range 6–23) were recruited between 2001 and 2007 from the community to participate in a study of self-reported impulsivity and behavioral assessment. Participants were recruited via various media outlets and in two settings, one urban (Houston, TX; $n = 151$) and one rural (Winston-Salem, NC; $n = 248$). To be included in the study, participants could not have any DSM-IV-TR Axis I psychiatric disorder or a positive drug urine test, alcohol test, or pregnancy test.

In the combined sample, all participants completed the BIS-11 while subsets of the participants completed other self-report measures of impulsivity and risk-taking that included the Eysenck Impulsiveness Questionnaire (I_7; Eysenck, Pearson, Easting, & Allsopp, 1985), Zuckerman Sensation-Seeking Scale (SSS-V; Zuckerman, Eysenck, & Eysenck, 1978) and the Behavioral Inhibition/Activation Scales (BIS/BAS; Carver & White, 1994). In addition, a subset of the participants also completed a battery of laboratory behavioral measures of impulsivity (Dougherty, Marsh, & Mathias, 2002; Dougherty, Mathias, Marsh, & Jagar, 2005) that included, a

continuous performance test (Immediate and Delayed Memory Tasks [IMT/DMT]), a stop task (GoStop Impulsivity Paradigm), delay-discounting measure (Two Choice Impulsivity Paradigm [TCIP]), and a delay-of-gratification type procedure (Single Key Impulsivity Paradigm [SKIP]).

Table 1 presents descriptive statistics for the BIS-11 arranged by gender. Consistent with Patton et al. (1995), analysis of variance showed no significant gender differences for either the total score or the second-order subscales. A significant gender difference was found for the first-order subscale perseverance ($F(1, 1575) = 12.5$, $p < 0.01$). Table 2 presents measures of internal consistency (Cronbach's α) and test–retest reliability at one month for the BIS-11. Intercorrelations between the BIS-11 total score and subscales are presented in Table 3. Correlations between the BIS-11 and other behavioral and self-report measures of impulsivity are shown in Table 4. Consistent with previous research, the BIS-11 is highly correlated with similar self-report measures (convergent validity) but not significantly correlated with behavioral measures of impulsiveness (Barratt & Patton, 1983; Lane, Cherek, Rhoades, Pietras, & Tcheremissine, 2003). This is a common finding since self-report measures like the BIS-11 assess personality traits occurring over extended periods of time and reflect an individual's subjective experience, while behavioral procedures assess more state-dependent aspects of impulsivity (Dougherty, Mathias, & Marsh, 2003).

A common question asked concerning the BIS-11 is what score can be used to designate an individual as highly impulsive? Several previous studies have used a BIS-11 total score of 74, one standard deviation above the mean reported in Patton et al. (1995), to designate high impulsiveness. Individuals with this level of impulsiveness show more aggression, a greater variability of performance, faster cognitive tempo (Lawrence & Stanford, 1999) and physiological differences suggestive of low baseline arousal (Houston & Stanford, 2005; Mathias & Stanford, 2003). Review of the present data suggests that a total score of 72 or above should be used to classify an individual as highly impulsive. In the college sample reported here individuals scoring 72 or higher were more than twice as likely to have shoplifted an item over $10 (2.54 odds ratio, 95% CI 1.33–4.86) and more than twice as likely to have been involved in self-mutilation (2.23 odds ratio, 95% CI 1.25–3.97). This result suggests that the scale has good concurrent validity. BIS-11 total scores between 52 and 71 should be thought of as within normal limits for impulsiveness. Scores lower than 52 usually are representative of an individual that is either extremely over-controlled (Knyazev & Slobodskaya, 2006) or who has not honestly completed the questionnaire (Helfritz et al., 2006).

Table 1
Descriptive statistics for the BIS-11 by gender.

Scale	Male *M* (*SD*)	Female *M* (*SD*)	Total *M* (*SD*)
Total score	62.8 (9.2)	62.1 (10.6)	62.3 (10.3)
Second-order subscales			
Attentional	16.8 (3.9)	16.7 (4.1)	16.7 (4.1)
Motor	22.4 (3.4)	21.8 (4.1)	22.0 (4.0)
Non-planning	23.6 (4.5)	23.6 (5.0)	23.6 (4.9)
First-order subscales			
Attention	10.3 (2.8)	10.4 (2.9)	10.4 (2.9)
Motor	15.2 (2.8)	15.0 (3.4)	15.0 (3.2)
Self-control	12.4 (3.1)	12.0 (3.3)	12.1 (3.3)
Cognitive complexity	11.3 (2.4)	11.6 (2.6)	11.5 (2.6)
Perseverance	7.2 (1.8)	6.8 (1.7)**	6.9 (1.8)
Cognitive instability	6.4 (1.8)	6.3 (1.9)	6.4 (1.9)

Note: Adult sample ($N = 1577$; m 393, f 1184); differs significantly from males.
** $p < 0.01$.

Table 2
Internal consistency and test–retest reliability at one month for the BIS-11.

Scale	No. of items	Cronbach's α	Spearman's Rho
Total score	30	0.83	0.83
Second-order subscales			
Attentional	8	0.74	0.61
Motor	11	0.59	0.67
Non-planning	11	0.72	0.72
First-order subscales			
Attention	5	0.72	0.74
Motor	7	0.64	0.67
Self-control	6	0.72	0.73
Cognitive complexity	5	0.48	0.50
Perseverance	4	0.27	0.35
Cognitive instability	3	0.55	0.23

Note: Cronbach's α calculated using adult sample ($N = 1577$; m 393, f 1184); test–retest reliability at one month calculated using $N = 153$ (m 33, f 120), all correlation coefficients statistically significant at $p < 0.01$.

4. Review of the literature utilizing the BIS-11 subscales

4.1. Clinical populations

While the BIS-11 has been used in a diverse set of clinical samples, the predominance of studies have tended to focus on Substance Use Disorders, Axis I disorders other than substance abuse/dependence specifically: Depression, Bipolar Disorder, and Attention-Deficit/Hyperactivity Disorder (AD/HD), as well as suicide attempters and criminal offenders. In this section we will briefly review BIS-11 results from studies in these four clinical populations that have reported meaningful differences in the BIS-11 subscale scores. Table 5 presents descriptive statistics for the BIS-11 total score and second-order subscales in a variety of adult clinical samples. The studies reported here were obtained using the ISI Web of Science citation search.

4.1.1. Substance use disorders

Substance users are known to be highly impulsive and this is reflected in their BIS-11 scores. For instance, higher BIS-11 scores are found for cocaine dependent adults (Lane, Moeller, Steinberg, Buzby, & Kosten, 2007) and Ecstasy users (Bond, Verheyden, Wingrove, & Curran, 2004) relative to controls. While it is not completely surprising that substance abusers would score higher on the BIS-11, the instrument's sensitivity to distinctions within substance use disorder is impressive. Early-onset alcoholics score higher on the BIS-11 than late-onset alcoholics, which are generally thought to be less severe cases (Dom, D'haene, Hulstijn, & Sabbe, 2006a). Also, among alcohol-dependent subjects, the number of daily cigarettes smoked correlates with the Non-planning subscale (Dom, Hulstijn, & Sabbe, 2006c; Skinner, Aubin, & Berlin, 2004). Finally, BIS-11 scores are predictive of the level of an individual's crack/cocaine use (Lejuez, Bornovalova, Reynolds, Daughters, & Curtin, 2007).

4.1.2. Other Axis I disorders

A number of studies have shown that the presence of a mood disorder is correlated with a significantly high level of impulsiveness (Peluso et al., 2007; Swann, Steinberg, Lijffijt, & Moeller, 2008; Swann et al., 2004; van den Eynde et al., 2008). In comparison to patients with unipolar depression, bipolar disordered patients tend to show higher levels of impulsiveness (Peluso et al., 2007; Swann et al., 2008; van den Eynde et al., 2008). In bipolar disorder, the three subtraits of impulsiveness are differentially related to the affective states of the disorder with Motor Impulsiveness related to the manic episodes, Non-planning Impulsiveness related to the depressive episodes, and Attentional Impulsiveness related to both manic and depressive episodes (Swann et al., 2008). Consistent with these findings Peluso and colleagues (2007) have hypothesized that Non-planning Impulsiveness is a state-dependent symptom of unipolar depression.

Table 3
Intercorrelations among BIS-11 subscales.

	ATT	MOT	NP	att	mot	sc	cc	per	ci	TOT
Second-order subscales										
Attentional	–									
Motor	0.39	–								
Non-planning	0.45	0.50	–							
First-order subscales										
Attention	0.91	0.38	0.53	–						
Motor	0.37	0.90	0.42	0.34	–					
Self-control	0.47	0.47	0.88	0.51	0.41	–				
Cognitive complexity	0.27	0.35	0.79	0.36	0.27	0.39	–			
Perseverance	0.21	0.60	0.36	0.25	0.19	0.31	0.30	–		
Cognitive instability	0.76	0.26	0.16	0.41	0.27	0.22	0.02[a]	0.08	–	
Total score	0.76	0.78	0.85	0.76	0.69	0.78	0.61	0.49	0.47	–

Note: Adult sample $N = 1577$ (m 393, f 1184).
[a] All correlation coefficients statistically significant at $p < 0.01$ except.

Table 4
Correlations of BIS-11 with other self-report and behavioral measures of impulsiveness.

	ATT	MOT	NP	att	mot	sc	cc	per	ci	TOT
Zuckerman Sensation-Seeking Scale (SSS-V)[a]										
Thrill-adventure seeking	0.06	0.17**	0.05	0.07	0.16**	0.12	-0.05	0.09	0.02	0.11
Experience seeking	0.19**	0.29**	0.13	0.13	0.30**	0.26**	−0.07	0.11	0.21**	0.24**
Disinhibition	0.25**	0.39**	0.31**	0.30**	0.37**	0.30**	0.22**	0.20**	0.07	0.39**
Boredom susceptibility	0.34**	0.31**	0.26**	0.32**	0.27**	0.30**	0.11	0.23**	0.21**	0.36**
Eysenck Impulsiveness Scale (I_7)[b]										
Impulsiveness	0.44**	0.57**	0.50**	0.40**	0.59**	0.53**	0.28**	0.22**	0.33**	0.63**
Venturesomeness	0.11**	0.19**	0.04	0.08	0.19**	0.10**	−0.06	0.10**	0.12**	0.14**
Empathy	0.22**	−0.01	0.06	0.16**	0.03	0.06	0.03	−0.07	0.23**	0.11**
Behavioral Inhibition/Activation Scales (BIS/BAS)[c]										
Inhibition	0.07	0.16**	0.13**	0.08	0.17**	0.16**	0.05	0.06	0.15	0.15**
Reward responsiveness	−0.14**	−0.05	0.07	−0.08	−0.16**	0.09	0.02	0.17**	−0.17**	−0.04
Drive	−0.15**	−0.21**	0.01	−0.13**	−0.27**	0.02	−0.01	0.01	−0.11	−0.13**
Fun-seeking	−0.30**	−0.29**	−0.18**	−0.27**	−0.33**	−0.19**	−0.11	−0.05	0.23**	−0.31**
Behavioral Measures of Impulsiveness[d]										
IMT ratio	0.06	0.07	0.14	0.08	0.03	0.10	0.14	0.09	0.00	0.12
DMT ratio	0.07	0.05	0.09	0.10	0.03	0.07	0.09	0.05	−0.02	0.09
GoStop 150 ms ratio	0.00	0.08	0.05	0.03	0.12	0.02	0.06	−0.02	−0.06	0.06
TCIP-% short	−0.02	−0.06	−0.06	−0.08	−0.06	−0.02	−0.07	−0.03	0.08	−0.05
SKIP response interval	0.04	0.10	−0.01	0.01	0.04	0.06	−0.10	0.14	0.07	0.05

[a] $n = 336$ (m 88, f 248; college students only).
[b] $n = 712$ (m 212, f 500; 336 college students, 376 healthy adults [233 Winston-Salem sample, 143 Houston sample]).
[c] $n = 442$ (m 88, f 354; 336 college students, 106 healthy adults [Houston sample only]).
[d] $n = 315$ (m 126, f 189; healthy adults only [227 Winston-Salem sample, 88 Houston sample]).
** $p < 0.01$.

Similar to mood disordered patients, adults diagnosed with AD/HD also show significantly higher levels of impulsivity when compared to healthy controls. Malloy-Diniz and colleagues (Malloy-Diniz, Fuentes, Leite, Correa, & Bechara, 2007) in discussing these results theorized that due to the uniformly higher subtrait scores among adults diagnosed with AD/HD, deficits must exist in the underlying mechanisms of all the subtraits of impulsiveness (Motor, Non-planning, and Attentional) in this population. Rodriguez-Jimenez et al. (2006) found similar results in pathological gamblers with a childhood history of AD/HD using the Spanish version of the BIS-11 (Oquendo et al., 2001). In this study pathological gamblers with a history of AD/HD had significantly higher BIS-11 total scores and less capacity to delay gratification on a stop signal task than pathological gamblers without a history of AD/HD or controls.

4.1.3. Suicide attempters

Impulsiveness is often a problem for individuals who exhibit suicidal behaviors. Adults with a past history of suicide attempt(s) tend to score higher on the BIS-11 Motor (Dougherty et al., 2004) or Attentional subscales (Quednow et al., 2006) than those without attempts. Among psychiatric patients with a recent suicide attempt, all BIS-11 subscale scores were higher than orthopedic patients, and these differences were stable from hospitalization to 1-week after discharge (Jallade, Sarfati, & Hardy-Bayle, 2005).

4.1.4. Forensic populations

Impulsivity and aggression are associated constructs and as a result, the BIS-11 has been utilized a great deal in criminal populations. The BIS-11 is sensitive to differences in levels of aggression; for instance, violent offenders score higher on the BIS-11 than those convicted of non-violent offenses (Smith, Waterman, & Ward, 2006). Among female prisoners, those who met criteria for Antisocial Personality Disorder (ASPD) demonstrated significantly higher scores on all BIS-11 subscales compared to those who met criteria for psychopathy or control subjects (Warren & South, 2006). This finding has been extended to male prisoners as well (Dolan & Fullam, 2004).

4.2. Normal populations

There have been over 60 published studies that have reported the BIS-11 subscales in normal populations. Topics have ranged

Table 5
BIS-11 descriptive statistics for published adult clinical samples.

Sample	*n*	*M* Age	F/M	ATT *M* (*SD*)	MOT *M* (*SD*)	NP *M* (*SD*)	TOT *M* (*SD*)	Source
Substance use disorders								
Substance abusers	35			17.4 (5.0)	25.8 (4.9)	24.7 (5.4)	?	Swann et al. (2004)
Substance users								Bond et al. (2004)
Current users	32	25.2		13.9 (5.0)*	19.2 (5.1)	26.8 (5.6)	59.8 (13.8)	
Former users	32	27.8		15.7 (5.3)*	19.1 (5.9)	22.9 (7.5)	57.6 (14.5)	
Mixed Sub. dependence	18	38.9	0/18	18.4 (3.4)	26.7 (5.3)	28.7 (6.3)	73.8 (11.8)	Conklin & Stanford (2008)
Substance dependent								Lejuez et al. (2007)
Females	56	41.9	56/0	31.3 (4.6)	23.4 (4.6)	27.4 (5.3)	79.9 (11.4)	
Males	96	41.9	0/96	29.6 (5.4)	20.7 (5.1)	26.0 (5.0)	74.2 (12.6)	
Alcoholic								Dom et al. (2006c)
Early onset	62	37.5	14/48	18.0 (5.5)*	19.3 (7.8)	23.8 (7.3)	61.1 (15.4)	
Late onset	68	45.5	26/42	14.8 (5.9)*	13.2 (5.8)	17.9 (8.1)	45.9 (14.7)	
Alcoholic								Dom et al. (2006a)
Early onset	42	38.1		18.0 (5.5)*	18.6 (7.5)	24.4 (7.2)	60.9 (15.7)	
Late onset	46	45.6		14.1 (6.0)*	13.2 (5.7)	19.2 (7.9)	47.2 (14.3)	
Alcohol dependent	130	39.8	96/34	17.7 (3.7)	25.7 (4.5)	27.2 (5.0)	70.6 (11.7)	Bjork, Hommer, Grant, & Danube (2004)
Cocaine dependent	17	37.3	5/12	17.0 (3.8)	25.9 (4.8)	27.4 (6.5)	68.6 (13.1)	Moeller et al. (2004)
Cocaine dependent	18	33.1	4/14	16.1 (4.4)	24.7 (4.2)	25.4 (4.7)	65.9 (10.6)	Moeller et al. (2005)
Cocaine dependent	18	39.2	5/13	14.9 (.86)	23.2 (1.3)	27.5 (1.1)	65.6 (2.68)	Lane et al. (2007)
Cocaine dependent	50	39.3	11/39	17.6 (4.2)	21.5 (5.2)	30.6 (5.1)	69.7 (12.4)	Moeller, Dougherty et al. (2001)
MDMA (Ecstasy) users	32	25.2	0/32	13.9 (5.0)	19.2 (5.1)	26.8 (6.6)	59.8 (13.8)	Bond et al. (2004)
Stimulant dependent	15	42.3	0/15	17.9	28.6	28.4	?	Wittmann, Leland, Churan, & Paulus (2007)
Stimulant users	19	18.4	14/5	17.6 (3.7)	23.2 (3.5)	27.4 (3.1)	68.2 (7.7)	Leland & Paulus, 2005
Substance users								Clark, Robbins, Ersche, & Sahakian (2006)
Amphetamine User	24	37.3	11/13	18.5 (3.8)	26.4 (5.7)	27.9 (6.1)	72.7 (13.6)	
Opiate user	40	34.0	8/32	14.9 (3.0)	24.6 (3.0)	27.9 (4.2)	67.4 (7.1)	
Exdrug users	24	38.5	11/13	17.9 (3.8)	25.3 (4.2)	27.1 (4.8)	70.3 (11.2)	
Other Axis I disorders								
Conduct disorder	5	28.5	0/5	21.6 (2.2)	26.8 (2.9)	28.0 (0.8)	76.4 (5.2)	Cherek & Lane (2000)
Obese binge eaters	11	29.0	11/0	17.3 (3.5)	26.2 (6.8)	27.4 (4.2)	70.9 (12.0)	Nasser, Gluck, & Geliebter (2004)
AD/HD	50	33.7	22/28	22.2 (3.7)	26.9 (5.6)	28.2 (5.8)	77.3 (10.8)	Malloy-Diniz et al. (2007)
AD/HD	30	33.8	10/20	21.5 (3.8)	23.9 (3.5)	29.5 (4.7)	74.9 (8.9)	Muller et al. (2007)
Pathological gamblers								Rodriguez-Jimenez et al. (2006)
–AD/HD	39		0/39	20.9 (5.6)*	15.4 (6.2)	23.9 (5.1)	60.2 (15.5)	
+AD/HD	16		0/16	25.1 (5.2)*	26.9 (8.8)	27.0 (3.8)	79.1 (14.2)	
Depression	15	45.1	0/15	15.4 (3.0)	20.3 (4.6)	25.7 (4.4)	62.1 (9.7)	Westheide et al. (2007)
Depression								Peluso et al. (2007)
Unipolar	24	37.0	15/9	21.1 (3.4)	23.0 (6.3)	30.3 (5.5)	74.5 (11.7)	
Bipolar	24	36.2	18/6	21.5 (3.5)	25.5 (5.9)	30.7 (4.3)	77.7 (11.3)	
Euthymic								
Unipolar	10	46.0	7/3	17.8 (4.8)	23.8 (3.7)	22.8 (5.6)	64.4 (12.5)	
Bipolar	12	36.8	8/4	19.6 (4.7)	24.3 (6.7)	31.2 (6.8)	75.0 (15.1)	
Bipolar disorder	32	28.4	25/7	23.9 (3.0)	29.6 (4.8)	30.4 (5.5)	84.0 (11.0)	van den Eynde et al. (2008)
Bipolar disorder								Swann et al. (2004)
Without sub. abuse	15			18.5 (4.3)	23.5 (3.9)	26.8 (5.8)	?	
With sub. abuse	12			20.5 (4.9)	26.5 (5.2)	27.5 (5.6)	?	
Bipolar disorder		33.0	20/19					Swann, Pazzaglia, Nicholls, Dougherty, & Moeller (2003)
Euthymic	22			20.7 (4.7)	27.7 (4.8)	29.0 (6.2)	77.1 (13.8)	
Manic	12			20.5 (4.6)	28.5 (3.7)	28.1 (7.0)	77.6 (11.6)	
Bipolar disorder + SUD	74							Swann et al. (2008)
Interepisode	24			20.0 (4.3)	27.7 (4.3)	27.0 (6.6)	74.5 (15.2)	
Depressed	17			21.6 (3.7)	27.5 (5.2)	31.0 (4.1)	80.1 (10.1)	
Manic	16			21.6 (4.6)	30.9 (6.5)	29.2 (6.5)	82.4 (14.5)	
Mixed	17			24.8 (4.0)	31.3 (5.3)	32.6 (4.8)	88.7 (13.0)	
Suicide attempters								
Bipolar + suicide attempts								Swann et al. (2005)
No attempts	20	35.0	15/9	19.6 (5.3)	27.1 (6.7)	27.6 (7.1)	73.9 (17.5)	
Not severe attempt	13	35.1	11/5	22.8 (5.3)	28.9 (7.0)	29.6 (7.2)	81.4 (18.3)	
Medically severe	8	34.3	5/3	22.3 (6.9)	28.5 (6.4)	31.4 (6.2)	82.1 (18.6)	
Suicide attempters								Dougherty et al. (2004)
Single	20	31.2	14/6	17.1 (3.1)	24.8 (3.5)	26.4 (4.2)	68.3 (9.3)	
Multiple	10	28.0	7/3	18.0 (4.9)	28.7 (5.6)	25.2 (6.2)	71.9 (20.6)	
Attempt + depression	20	35.7	8/12	18.0 (3.5)	22.7 (6.6)	26.1 (5.8)	66.7 (13.5)	Quednow et al. (2006)
Single suicide attempt	26	30.6	17/9	19.3 (4.6)*	26.4 (8.3)	27.4 (5.2)	71.6 (13.2)	Jallade et al. (2005)
Forensic populations								
Violent offenders								Enticott, Ogloff, Bradshaw, & Fitzgerald (2008)
with schizophrenia	18	36.1	5/13	16.1 (3.2)	24.1 (3.2)	24.9 (4.7)	65.1 (8.9)	
BPD prisoners	18	34.4	0/18	18.9 (3.5)	27.3 (1.5)	31.8 (1.5)	77.4 (3.5)	Kirkpatrick et al. (2007)
Offender + Axis I	42.2	0/40						Dolan & Fullam (2004)
High impulsivity	20			16.0 (6.4)	18.1 (9.7)	18.7 (7.0)	52.9 (15.2)	
Low impulsivity	20			6.4 (3.0)	6.1 (3.9)	11.4 (5.6)	23.9 (8.4)	

(*continued on next page*)

Table 5 (*continued*)

Sample	*n*	*M* Age	F/M	ATT *M* (*SD*)	MOT *M* (*SD*)	NP *M* (*SD*)	TOT *M* (*SD*)	Source
Offenders								Smith et al. (2006)
Violent male	57	27.9	0/57	18.6 (5.6)*	27.8 (7.5)	28.1 (7.5)	74.5 (18.9)	
Nonviolent male	58	27.9	0/58	16.1 (4.6)	23.7 (6.3)	23.6 (6.4)	63.4 (16.0)	
Violent female	66	26.8	66/0	16.0 (4.3)*	22.6 (6.2)	24.0 (7.0)	62.8 (15.6)	
Nonviolent female	67	26.8	67/0	15.5 (4.8)	22.7 (6.7)	23.8 (7.5)	62.0 (17.0)	
DUI conviction	104	44.7	0/104	16.1 (3.0)*	21.8 (4.0)	25.2 (4.6)	?	Brown et al. (2005)
Female offenders								Warren & South (2006)
ASPD	23		23/0	20.2 (4.2)	24.8 (4.7)	28.5 (7.4)	72.5 (15.5)	
PCL-R >25	21		21/0	19.6 (2.8)	23.8 (4.7)	26.8 (4.2)	71.2 (8.05)	
ASPD + PCL-R>25	44		44/0	19.9 (3.5)	23.8 (4.6)	28.0 (5.3)	72.0 (11.4)	
Axis II disorders								
Hospitalized BPD	14	32.9	14/0	18.2 (5.0)	27.5 (7.0)	26.9 (8.0)	75.1 (14.3)	Dougherty, Bjork, Huckabee, Moeller, & Swann (1999)
Personality disorder								Bunce, Noblett, McCloskey, & Coccaro (2005)
–Axis I	45	28.3	11/36	16.4 (3.1)	19.2 (4.1)	27.2 (4.6)	?	
+Axis I	59	31.2	13/50	16.2 (3.3)	20.4 (4.1)	28.4 (5.0)	?	
Lifetime psychiatry DX								Swann, Bjork, Moeller, & Dougherty (2002)
Axis I	12			18.8 (5.3)	22.7 (3.4)	25.3 (5.6)	66.8 (11.8)	
Axis II	22			16.8 (5.0)	23.0 (3.8)	24.1 (5.3)	63.8 (11.4)	
Alcohol dependent								Rubio et al. (2007)
No PD	178	41.4	0/178	19.5 (5.0)*	17.0 (5.7)	18.6 (8.1)	55.1 (14.2)	
+BPD	29	37.0	0/29	21.3 (5.8)*	21.8 (8.6)	24.6 (9.2)	68.1 (22.0)	
+ASPD	40	38.0	0/40	21.9 (5.3)*	19.8 (6.2)	23.1 (7.2)	64.2 (16.0)	
Alcohol dependent								Dom, De Wilde, Hulstijn, Van Brink, & Sabbe (2006b)
No PD	40	42.1		14.7 (5.8)*	14.9 (6.3)	20.2 (7.8)	49.8 (16.1)	
Cluster B	22	42.1		18.1 (6.2)*	18.9 (8.9)	24.7 (8.8)	61.7 (17.1)	
Neurodegenerative disorders and traumatic brain injury								
Traumatic brain injury								Greve et al. (2002)
Non-aggressive	18	38.9	1/17	15.1 (4.7)	23.2 (5.8)	25.1 (4.9)	60.0 (12.9)	
Impulsive aggression	18	35.9	2/16	16.8 (4.4)	23.3 (4.3)	24.5 (6.9)	64.5 (12.9)	
Traumatic brain injury								Greve et al. (2001)
Non-aggressive	19	38.9	2/17	14.7 (4.9)	22.8 (5.9)	21.2 (5.0)	44.2 (13.2)	
Impulsive aggression	26	33.9	2/24	17.6 (4.6)	24.4 (4.7)	25.3 (6.6)	52.4 (13.2)	
Parkinson disease								Voon et al. (2007)
–Path. gambling	42	65.7	21/21	15.6 (4.1)	17.3 (4.4)	21.1 (4.6)	54.1 (10.1)	
+Path. gambling	21	60.2	6/15	16.9 (3.8)	20.9 (5.6)	27.0 (6.0)	65.2 (12.2)	
Axis I/II mixed samples								
Recommended therapy								Visintini, Ubbiali, Donati, Chiorri, & Maffei (2007)
Group	50			23.5 (4.3)*	21.1 (5.0)	20.8 (5.0)	?	
Individual	25			24.4 (4.4)*	22.2 (5.8)	19.7 (5.1)	?	
None	14			25.1 (5.8)	24.1 (5.6)	20.6 (4.8)	?	
Veteran Med/Psych	474	55.6	43/431	17.3 (4.0)	20.3 (4.7)	25.6 (6.2)	63.3 (12.6)	Suris et al. (2005)
Physically aggressive	170	37.0	42/128	16.2 (5.1)	22.2 (5.3)	24.1 (5.9)	?	Kockler & Stanford (2008)

* Indicates this value was reported as the Cognitive score, but referenced Patton et al. (1995) as the source, so it is assumed that this is equivalent to the Attentional Impulsiveness score.

from investigating the general nature of impulsivity to developmental issues and employment screening. In this section we will review articles in three areas of significant importance to the measurement of impulsiveness.

4.2.1. Punishment and reinforcement sensitivity

Impulsivity has long been considered from the perspective of reduced punishment sensitivity or response inhibition. In studies using the BIS-11 with psychophysiological measures, impulsivity appears related to Gray's (1981) behavioral inhibition and activation systems. One study (Potts, George, Martin, & Barratt, 2005) found evidence of reduced behavioral inhibition among those with higher BIS-11 scores. This study classified adults as low or high in impulsivity and measured sensitivity to punishment using the error-related negativity (ErN). Another study of college students using the BIS-11 reported evidence of increased sensitivity to reward for the high impulsive group. This study (Martin & Potts, 2004) found increased P2a event related potential activity for the high group performing a stimulus match/mismatch paradigm in which non-predicted rewards were occasionally delivered. The finding of both low behavioral inhibition and high behavioral activation in high impulsive individuals is consistent with Gray's theory (Gray, 1987).

4.2.2. Vigilance and attention

While impulsivity is a distinct psychological process from lapses in attention (Sonuga-Barke, 2002), problems with the attention system may result in impulsive behavior. BIS-11 scores do seem to be related to problems with attention. While one study (Markus & Jonkman, 2007) failed to find any differences in attention between those scoring high and low on the BIS-11 at baseline, attention on a task-switching paradigm was reduced among the high BIS-11 group following a tryptophan-enriched breakfast. This effect was interpreted as reflecting a greater susceptibility of high impulsive individuals to changes in arousal produced by the tryptophan enhancement. Another study (Levine, Waite, & Bowman, 2007) tested impulsivity as it relates to lapses in attention or distractibility. BIS-11 scores were significantly correlated with scores on a measure of academic distractibility.

4.2.3. Executive function and decision making

Problems with the control of information processing or executive functioning can lead to impulsive behaviors and individuals who have executive function deficits tend to score higher on the BIS-11. For instance, the BIS-11 is significantly correlated with measures of cognitive failure, which are also correlated with

anterior cingulate activation (Garavan, Ross, Murphy, Roche, & Stein, 2002). Cingulate activation is important in fast-paced tasks where inhibition of more automatic behaviors is important.

In another study, executive function was assessed using measures of cognitive flexibility (Wisconsin Card Sort Test [WCST], Trail Making Task) and intelligence (WAIS-III). In this study (Cheung, Mitsis, & Halperin, 2004), BIS-11 Motor Impulsiveness accounted for a significant portion of the variance in two measures of executive functioning on the WCST: category fluency and categories achieved. Attentional Impulsiveness accounted for significant variance in the difference between parts A (simple visual search) and B (cognitive set shifting) on the Trail Making Test. Additionally, BIS-11 total score, after controlling for full-scale IQ, accounted for a significant amount of variance in the Letter–Number Sequencing (WAIS-III) task.

Using several measures of executive control Whitney, Jameson, and Hinson (2004) demonstrated that different subtypes of impulsivity are related to different aspects of executive control of working memory. Four measures were derived from the continuous memory scanning task and used to predict BIS-11 scores using regression analysis. Their analysis supported the conclusion that Attentional Impulsiveness was related to participants deleting no-longer-relevant information from working memory while Non-planning Impulsiveness was related to working memory capacity. Motor Impulsiveness proved to be related to a trend towards having a lower overall capacity and a greater ability to restrict access to working memory. They assert that because they were able to show that some forms of impulsiveness are related to problems with different executive control abilities, defining executive control ability as a single index may obscure the role of specific functions in controlling specific behaviors, such as those leading to delinquency.

Spinella (2005) developed a self-rated index of executive function (Executive Function Index, EFI) composed of five subscales. Of these five subscales the Strategic Planning subscale, which is reflective of activity in the dorsolateral prefrontal cortex, premotor cortex, supplementary motor area, striatum, and visuospatial system, correlated (negatively) most strongly with the BIS-11 Non-planning Impulsiveness subscale. The Impulse Control subscale, which addresses self-inhibition and is reflective of orbitofrontal activity, negatively correlated most significantly with the BIS-11 Motor Impulsiveness subscale. Spinella found that these correlations were independent of age, sex, or education and found that the EFI negatively correlated with other measures reflective of impulsive behavior such as poor college GPA (Spinella & Miley, 2003).

Although trait impulsivity seems a distinct latent variable, impulsivity in general, including state impulsivity, is clearly related to and interacts with the processes of attention and executive function. These variables may therefore contribute to the modulation of state impulsivity in certain situations.

4.3. Genetic studies with the BIS-11

A number of studies have tested genetic correlates of impulsiveness using the BIS-11. A majority of these studies have focused on genetic polymorphisms having to do with the function of the serotonin system. It has been reported that those with the short allele polymorphism of the serotonin transporter gene promoter region (5-HTTLPR), which is associated with reduced serotonin turnover (Greenberg, Tolliver, Huang, Bengel, & Murphy, 1999; Lesch et al., 1996), have increased impulsivity scores on the BIS-11 (Baca-Garcia et al., 2005). Further, these differences may be greatest for the Attentional subscale of the BIS-11 (Sakado, Sakado, Muratake, Mundt, & Someya, 2003). However, not all studies have found a significant relationship between this polymorphism and BIS-11 (Paaver et al., 2007; Roiser, Müller, Clark, & Sahakian, 2007). Studies have also reported significant relationships between the BIS-11 and other aspects of the serotonin system including single nucleotide polymorphisms of the tryptophan hydroxylase-2 (TPH2) gene (de Lara et al., 2007), the C allele of the T102C serotonin 2a receptor (Bjork et al., 2002) and T allele at the A-161T locus of the 5-HT1b receptor gene (Zouk et al., 2007).

Moving beyond the serotonin system, some other genetic variations have been explored with regard to BIS-11 scores, although in a much less systematic manner. For instance one study with children reported a significant negative relationship between MAO activity and the BIS-11 (Paaver et al., 2007), while another found no difference among those with low or high activity MAO-A alleles (Passamonti et al., 2006). No significant relationships or group differences have been found for BIS-11 subscale scores and genetic or allelic polymorphisms of dopamine (Congdon, Lesch, & Canli, 2008; Eisenberg et al., 2007), the andenosine receptor (Alsene, Deckert, Sand, & de Wit, 2003), or the alpha 2a noradrenergic receptor (Sequeira et al., 2004).

In summary, of the various genes tested, those involved in serotonin function (e.g. 5-HTTLPR, TPH2, 5-HT1b, 5-HT2a, and MAO) have been the most commonly studied in relation to the BIS-11. However, the vast differences in sample size, age of sample, health/clinical characteristics of the sample, and language of the BIS-11 make direct comparison across these studies difficult. Further, gene by environment interactions may account for the mixed findings, since simple Mendelian genetic influences are rare for complex phenotypes like impulsivity. In summary, for some but not all cases, it appears that genetic polymorphisms that would result in lower serotonergic activity predict higher impulsiveness. For any definitive statement to be made about genetic correlates of impulsiveness, more research needs to be accomplished with replication and greater consistency in terms of sampling characteristics and environmental variables.

4.4. The BIS-11a problem

The BIS-11 as described in Patton et al. (1995) is the most up to date and psychometrically sound version of the Barratt Impulsiveness Scale. Other versions of the instrument should not be used unless the goal is to make comparisons with data obtained using an earlier version of the BIS. During the development of the BIS-11, an intermediate version of the scale often designated in the literature as the BIS-11a (Barratt, 1994) was distributed to several labs for review. This version resulted from a partial analysis of BIS-10 data during the early development phase of version 11. Unfortunately, this "working" version of the scale has been more widely disseminated than was ever intended or anticipated by Barratt and his colleagues. The main problem is that the BIS-11a and BIS-11 only share 24 items in common and thus the scores on these two instruments cannot be accurately compared to one another. Given its limited psychometric development (Barratt, 1994) the authors suggest that the BIS-11a not be considered a reliable or valid measure of impulsiveness and strongly recommend that it not be used.

4.5. Translations

While originally developed and normed in English, the BIS-11 has been translated into at least 11 other languages. Translations of the BIS-11 are available in Chinese (Yang, Yao, & Zhu, 2007), Dutch (Goudriaan, Oosterlaan, De Beurs, & van den Brink, 2008), Estonian (Paaver et al., 2007), French (Bayle et al., 2000), German (Preuss et al., 2003), Greek (Giotakos, Markianos, Vaidakis, & Christodoulou, 2003), Hebrew (Glicksohn & Nahari, 2007), Italian (Fos-

sati, Di Ceglie, Acquarini, & Barratt, 2001), Japanese (Someya et al., 2001), Korean (Chung & Lee, 1997), Portuguese (von Diemen, Szobot, Kessler, & Pechansky, 2007) and Spanish (Oquendo et al., 2001). Because the availability of psychometric data related to the reliability and validity of these translations varies greatly, as does the translation techniques used in their development, caution is suggested when interpreting outcomes from translated instruments or comparing them to the original. That having been said, the internal consistencies (Cronbach's α) reported for the BIS-11 total score from these translations all fall within an acceptable range (0.71–0.83) suggesting that the scale is reliable across these diverse cultures. For future research we recommend that back translation (Brislin, 1970; Cha, Kim, & Erlen, 2007) be used when conducting research with the BIS-11 in a language other than English. Back translation significantly improves the reliability and validity of a scale by requiring that the quality of the translation be verified by an independent translator translating back into the original language.

5. Conclusions

It is clear even from this brief review of the literature that the Barratt Impulsiveness Scale has not only shaped the current conceptualization of impulsiveness as a construct but continues to be an important tool in sparking further research in personality 50 years after its initial development. Few personality traits are as socially relevant as impulsiveness. Its impact is felt across a broad range of domains including mental health, business, criminal justice, and education. It is our hope that as research on impulsiveness moves forward that the BIS-11 might be viewed as a standard point of reference. Its inclusion in all future studies of impulsiveness and consistent reporting of its subscales would help bring about uniformity in definition that has been missing in the impulsivity literature and allow for a level of comparison across studies that would be unparalleled in personality research. In addition, it is suggested that a more detailed investigation of the BIS-11 subscales within differing psychopathologies, as has been done in Bipolar Disorder (Swann et al., 2008), may result in more effective diagnosis and treatment.

There have been great advances during the past 50 years in terms of the assessment of impulsivity. Dr. Ernest S. Barratt and his impulsiveness scale have played a significant role in that progress. Sadly, with Dr. Barratt's unexpected passing in 2005, the field lost a visionary leader. We have conducted this review of the BIS-11 as a resource to other investigators in order to maintain the momentum generated by Dr. Barratt's significant body of work. Dr. Stanford is active in maintaining the BIS-11 and advising other investigators on its use and interpretation. For questions pertaining to the instrument please contact the corresponding author.

Appendix

Directions: People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement and put an X on the appropriate circle on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly

	○ Rarely/Never	○ Occasionally	○ Often	○ Almost Always/Always			
1	I plan tasks carefully.			○	○	○	○
2	I do things without thinking.			○	○	○	○
3	I make-up my mind quickly.			○	○	○	○
4	I am happy-go-lucky.			○	○	○	○
5	I don't "pay attention."			○	○	○	○
6	I have "racing" thoughts.			○	○	○	○
7	I plan trips well ahead of time.			○	○	○	○
8	I am self controlled.			○	○	○	○
9	I concentrate easily.			○	○	○	○
10	I save regularly.			○	○	○	○
11	I "squirm" at plays or lectures.			○	○	○	○
12	I am a careful thinker.			○	○	○	○
13	I plan for job security.			○	○	○	○
14	I say things without thinking.			○	○	○	○
15	I like to think about complex problems.			○	○	○	○
16	I change jobs.			○	○	○	○
17	I act "on impulse."			○	○	○	○
18	I get easily bored when solving thought problems.			○	○	○	○
19	I act on the spur of the moment.			○	○	○	○
20	I am a steady thinker.			○	○	○	○
21	I change residences.			○	○	○	○
22	I buy things on impulse.			○	○	○	○
23	I can only think about one thing at a time.			○	○	○	○
24	I change hobbies.			○	○	○	○
25	I spend or charge more than I earn.			○	○	○	○
26	I often have extraneous thoughts when thinking.			○	○	○	○
27	I am more interested in the present than the future.			○	○	○	○
28	I am restless at the theater or lectures.			○	○	○	○
29	I like puzzles.			○	○	○	○
30	I am future oriented.			○	○	○	○

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