ORIGINAL ARTICLES

Two Models of Impulsivity: Relationship to Personality Traits and Psychopathology

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Background: *Impulsivity is prominent in psychiatric disorders. Two dominant models of impulsivity are the reward-discounting model, where impulsivity is defined as inability to wait for a larger reward, and the rapid-response model, where impulsivity is defined as responding without adequate assessment of context. We have compared the role of these models of impulsivity in human psychopathology, based on the hypothesis that rapid-response impulsivity would be more strongly related to other aspects of psychopathology and to impulsivity as described by questionnaires.*

Methods: *We investigated relationships between personality and laboratory measures of impulsivity, and between these measures and clinical characteristics, in parents of adolescent subjects with disruptive behavioral disorders (DBDs) and matched control subjects. Diagnoses were rendered using the Structured Interview for DSM-IV. The Barratt Impulsiveness Scale (BIS) was used as a trait measure of impulsivity. Rapid-response impulsivity was assessed using a form of the Continuous Performance Test, the Immediate Memory-Delayed Memory Task (IMT/DMT). Reward-delay impulsivity was measured using two tasks where subjects could choose between smaller immediate or larger delayed rewards.*

Results: *Rapid-response, but not reward-delay impulsivity, was significantly higher in subjects with lifetime Axis I or Axis II diagnoses. Scores on the BIS were elevated in subjects with Axis I diagnoses and correlated significantly with both rapid-response and reward-delay tests, but more strongly with the former. Multiple regression showed that rapid-response, but not reward-delay performance or intelligence quotient, contributed significantly to BIS scores. Correlations were similar in parents of control subjects and of DBD subjects.*

Conclusions: *These data suggest that measures of rapid-response impulsivity and of reward-delay impulsivity are both related to impulsivity as a personality characteristic. The relationship appears stronger, however, for rapid-response impulsivity, as measured by the IMT/DMT. Laboratory and personality measures of impulsivity appear to be related to risk of psychopathology.* Biol Psychiatry 2002;51:988–994

Key Words: Impulsivity, impulse control disorders, personality, assessment

Introduction

Impulsivity is a component of the initiation of behavior (Barratt and Patton 1983; Evenden 1999a). It appears to be a basic part of disruptive behavior disorders (Dougherty et al 2000), substance abuse (Allen et al 1998), personality disorders (Mulder et al 1999), aggression (Barratt et al 1999), bipolar disorder (Swann et al 2001), suicide (Corruble et al 1999), and other potentially destructive behavioral problems (Brady et al 1998). Rigorous definitions have been elusive: impulsivity can be a component of any motivated behavior, and it can have multiple expressions, including neurophysiology, laboratory performance, and action (Barratt and Patton 1983).

Research on impulsivity has generally relied on self-report, or on measurements or observations of behavior whose impulsivity was open to interpretation (Barratt and Patton 1983; Johnson et al 1998). These measures have yielded valuable information about impulsivity as a stable trait in individuals with a wide range of behavioral disturbances (Barratt and Patton 1983). They do not, however, lend themselves well to pharmacologic or physiologic studies of impulsivity, because they are subjective, they measure a relatively stable characteristic, and they cannot be related directly to biological models of impulsivity based on animal studies.

Laboratory measures of impulsivity have been developed in an effort to overcome these problems. These measures are based on two animal models of impulsivity: inability to delay reward, leading to an increased tendency to choose immediate small rewards over larger delayed ones (Monterosso and Aimslie 1999); and inability to conform responses to environmental context, leading to errors of commission on tests that required careful checking of stimuli (Evenden 1999b). There is little information, however, relating measures of these models of impulsivity to each other or to established personality measures.

We have compared the two dominant models of laboratory impulsivity in parents of subjects and control

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subjects who participated in an investigation of disruptive behavior disorders. Impulsivity as a stable personality trait was measured using the Barratt Impulsiveness Scale (BIS) total and subscale scores (Patton et al 1995). Rapid-response impulsivity was measured using the Immediate Memory-Delayed Memory Task (IMT/DMT), a version of the Continuous Performance Test that has been used successfully in studies of individuals at risk for severely impulsive behavior (Dougherty 1999). Reward-delay impulsivity was measured by the Two-Choice Test (Cherek and Lane 1999) and the Single Key Impulsivity Paradigm (Dougherty et al, manuscript in review), both of which measure the tendency to choose small immediate rewards over larger delayed ones. Our hypothesis was that rapid-response impulsivity would be more strongly related to human psychopathology, as reflected by 1) stronger relationship to presence of a psychiatric diagnosis; 2) stronger relationship to BIS scores; and 3) stronger relationship to overall personality disturbance as reflected by Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II) responses.

Methods and Materials

Subjects

Each subject was a biological parent of a participant (patient or matched control subject) in a study of adolescent inpatients with disruptive behavior disorders (DBDs) including oppositional defiant disorder, conduct disorder, and attention-deficit/hyperactivity disorder (ADHD). Twenty-two (19 women and 3 men, mean age 43 years, range 34–55 years) were parents of control subjects, and 10 (8 women and 2 men, mean age 39.7, range 32–47) were parents of subjects with DBDs. The groups did not differ significantly in age [$t(30) = 1.6$, $p > .2$]. The intent driving this study was to use parents of subjects recruited for an investigation of disruptive behavior disorders to study impulsivity in an adult population that would be expected to exhibit a range of psychopathology related to impulsivity. The size of the sample was a limiting factor in the study, but was adequate to demonstrate relationships that bear further investigation.

After thorough explanation of the study and informed consent, subjects were administered the SCID-NP (Nonpatient) in a clinical interview and the SCID-II as a questionnaire (First et al 1996, 1997). Capacity to consent and continuing consent were monitored by the Harris Country Psychiatric Center (HCPC) Research Intermediary, who is supervised by the institutional review board and is independent of hospital or clinic staffs. Among parents of control subjects, 17 did not meet lifetime criteria for any Axis I disorder, four had met criteria for an affective disorder, and one for a substance use disorder. Among parents of subjects with DBDs, two had never met criteria for an Axis I disorder, one had met criteria for an affective disorder, three for a substance use disorder, and two for combined affective and substance use disorders. No subjects met criteria for a current Axis I disorder. Parents of subjects with DBD were significantly more likely than parents of control subjects to have an Axis I diagnosis (Fisher's Exact Test $p = .012$). For Axis II, 10 parents of control subjects did not endorse symptoms suggesting an Axis II disorder, four endorsed symptoms suggesting a Cluster A disorder, four for Cluster B, and four for a Cluster B disorder and another personality disorder. All parents of subjects with DBDs had questionnaire responses consistent with a personality disorder: three for Cluster B, and the rest for Cluster B plus others. Parents of patients with DBDs were significantly more likely to have a probable Axis II diagnosis than were parents of control subjects (Fisher's Exact Test $p = .029$).

Measures

BARRATT IMPULSIVENESS SCALE. The BIS (Barratt and Patton 1983; Patton et al 1995), a self-report questionnaire, has been validated in impulsive and normal populations. It consists of 30 items that have been divided into three subscales: attentional (inattention and cognitive instability), motor (motor impulsiveness and lack of perseverance), and nonplanning (lack of self-control and intolerance of cognitive complexity).

CONTINUOUS PERFORMANCE TEST (IMT/DMT). The IMT/DMT (Dougherty 1999; Dougherty et al 1999b) was performed as follows: In a sound-attenuated chamber, subjects viewed a series of 5-digit numbers on a computer screen and responded (mouse click) to a number when it matched the previous number. For the IMT, each number was displayed for .5 sec, followed by .5 sec during which the screen was blank. For the DMT, numbers to be compared were separated by 3.5 sec during which a distracter stimulus (12345) was repeated three times. A correct response to a number matching the comparison number was a correct identification, or "hit." In both tasks, numbers were also displayed that differed by only one digit from the number to be matched; responses to these numbers were scored as commission errors, or "false alarms." Increased commission error rates have been associated with high risk for impulsive behavior (Dougherty et al 2000). The proportion of correct responses is an indication of attention and motivation.

THE TWO-CHOICE TEST. This test measured the tendency to choose a small immediate reward over a larger delayed one (Cherek and Lane 1999). Subjects were presented with 50 trials in which they could choose to wait 5 sec for 5 cents, or 15 sec for 15 cents. Variables scored include number of short-delay responses and maximum number of consecutive long-delay responses. The procedure was modified from previous versions to reduce left-right bias in responding (Mathias et al, in press).

THE SINGLE KEY IMPULSIVITY PARADIGM (SKIP). The SKIP is a free operant procedure measuring the ability to endure long delays between reward-directed responses. In a 20-min session, subjects were free to click a mouse button whenever desired to add monetary reward to a counter. Each response earned 1 cent for every 2 sec since the previous response. The reward from each response was displayed briefly to enable the subject to detect the delay contingency (Mathias et al, in press). Variables scored include maximal and average delay between reward responses and total number of responses.

Table 1. Correlations between BIS Scores and IMT/DMT Commission Errors

	IMT hits	DMT hits	IMT CE	DMT CE	IMT C/H	DMT C/H
Total	−.147	−.124	.455[b]	.433[b]	.510[c]	.450[b]
Attention	−.399	−.267	.333	.294	.415[a]	.301
Motor	.123	.014	.234	.182	.231	.202
Nonplanning	−.020	−.174	.481[c]	.477[c]	.532[c]	.511[c]

Table shows Spearman rank-order correlation coefficients, $n = 32$.
BIS, Barratt Impulsiveness Scale; IMT, Immediate Memory Task; DMT, Delayed Memory Task; CE, commission errors; C/H, ratio of commission errors to correct responses.
[a] $p < .05$.
[b] $p < .01$.
[c] $p < .005$.

WECHSLER ABBREVIATED SCALE OF INTELLIGENCE (WASI). The WASI (The Psychological Corporation, San Antonio, TX, 1999) is a version of the Wechsler intelligence quotient (IQ) battery that has four subscales for research use and yields verbal, performance, and total IQ scores. We included IQ scores in this investigation as a covariate to isolate components of impulsivity that are not related to overall impaired cognition.

Statistics

Groups were compared using analysis of variance or *t* test if the assumptions of homogeneity of variance and normality of distribution were met. Otherwise, nonparametric statistics were used. For a correlation to be considered significant both Pearson and Spearman correlation coefficients had to be significant. The usual requirement for statistical significance was a two-tailed probability of less than .05.

Based on the hypothesis stated in the introduction, we focused on the following: 1) relationships between BIS and the two models of laboratory impulsivity; 2) comparison of subjects with versus without Axis I or II disorders; and 3) relationship to overall personality disturbance as reflected by SCID-II questionnaire results.

Results

Barratt Impulsiveness Scale and Laboratory Measures of Impulsivity

RAPID-RESPONSE. Table 1 shows that total and nonplanning BIS scores correlated significantly with commission error rates on both the IMT and DMT. The pattern of correlations was strongest for BIS nonplanning scores. Although correlations did not reach significance in parents of subjects with DBDs, owing to the small number, the regression was essentially identical for the two groups, as shown in Figure 1.

REWARD-DELAY. *SKIP.* In the SKIP, the total number of free-operant reward-directed responses correlated significantly with motor and nonplanning impulsivity, as shown in Table 2. Total responses also correlated with BIS motor scores in parents of control subjects ($r = .443$, $n = 22$, $p < .05$), with a similar trend in parents of patients ($r = .569$, $n = 10$, $p = .086$). Scores on the BIS did not correlate significantly with the maximal response delay.

Two-Choice Test. Table 2 shows that, for the total group, BIS nonplanning correlated positively with short-delay responses and negatively with the maximum number of consecutive long-delay responses. As shown in Figure 2 for consecutive long-delay responses, these correlations were also significant in parents of control subjects ($r = .448$ and $-.428$, respectively, with $n = 22$ and $p < .05$), but did not approach significance in parents of patients ($p > .2$), probably owing to a single outlier.

MULTIPLE REGRESSION ANALYSES. Multiple regression analysis was carried out using BIS nonplanning score as the dependent variable and IMT commission errors/correct identifications, verbal IQ, SKIP average response delay, and two-choice consecutive long delays as the independent measures. These measures were chosen because they had the best individual correlations with BIS nonplanning score. The BIS nonplanning score appeared to be the most sensitive measure in terms of relationship to laboratory measures of impulsivity. Overall distributions

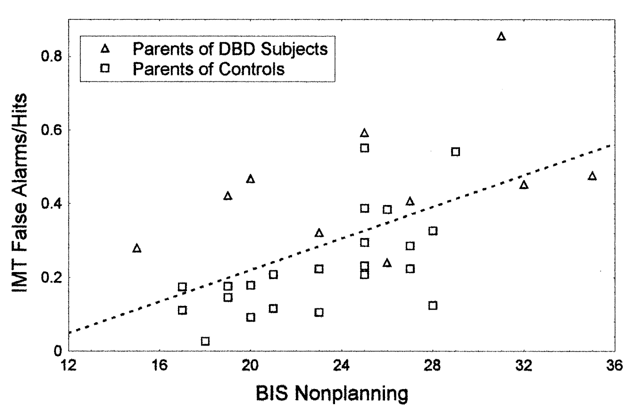

Figure 1. Correlation between Barratt Impulsiveness Scale (BIS) nonplanning score and Immediate Memory Task (IMT) false alarm/hit ratio. For parents of control subjects, $r = .678$, $n = 22$, $p = .00052$. For parents of subjects with disruptive behavior disorders (DBDs), $r = .430$, $n = 10$, $p =$ ns. For the group as a whole, $r = .530$, $n = 32$, $p = .001$.

Table 2. Correlations between BIS Scores and Reward Discounting

	SKIP total responses	SKIP average	SKIP longest	Two-choice short	Two-choice consecutive long
Total	.273	−.319	−.089	.284	−.342[a]
Attention	.024	−.050	−.097	.195	−.226
Motor	.438[b]	−.444[b]	−.153	.149	−.170
Nonplanning	.290	−.377[a]	−.150	.356[a]	−.443[b]

Table shows Spearman rank-order correlation coefficients, $n = 32$.
BIS, Barratt Impulsiveness Scale; SKIP, Single Key Impulsivity Paradigm.
[a] $p < .05$.
[b] $p < .01$.

of the independent variables, according to Kolmogorov-Smirnov and chi-squared tests, did not depart significantly from normality. As shown in Table 3, only IMT commission errors/correct identifications had a significant slope. When the analysis was restricted to parents of control subjects, or to parents not having a lifetime Axis I diagnosis, the results were essentially identical (for parents of control subjects, partial correlation of IMT commission errors/correct identifications was .525, $p < .005$, with no other variable contributing significantly).

Relationship between Impulsivity Models

No measure of rapid-response impulsivity correlated significantly with any measure of reward-delay impulsivity over the entire group (generally $p > .6$), except for a modest correlation between IMT commission error rate or commission error/correct identification ratio and number of consecutive long-delay choices ($r = -.34$ and $-.37$, respectively, $p = .03$). Among parents of control subjects, DMT commission errors correlated with two-choice short delay ($r = .538$, $n = 22$, $p < .01$) and consecutive long-delay responses ($r = -.528$, $n = 22$, $p = .011$); no other correlations approached significance. Therefore, the two laboratory models of impulsivity appeared correlated more with BIS nonplanning scores than with each other.

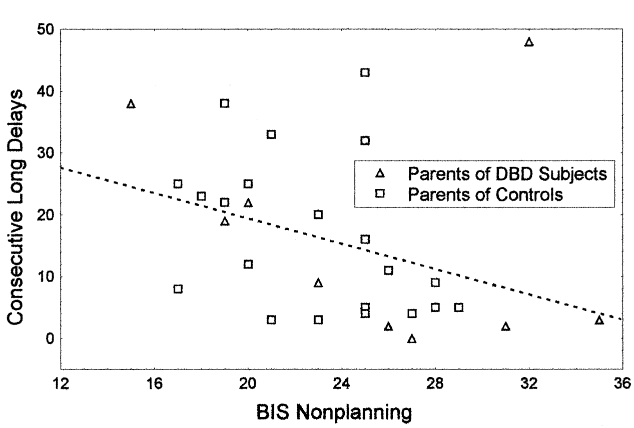

Figure 2. Correlation between Barratt Impulsiveness Scale (BIS) nonplanning score and consecutive long delay responses on the two-choice test. For parents of control subjects, $r = -.427$, $n = 22$, $p = .046$. For parents of subjects with disruptive behavior disorders (DBDs), $r = -.419$, $n = 10$, $p =$ ns. For the group as a whole, $r = -.443$, $n = 32$, $p = .008$.

Impulsivity and Psychiatric Diagnosis

PRESENCE OF AXIS I DIAGNOSIS. As shown in Table 4, subjects with a lifetime diagnosis of an Axis I disorder had higher scores on the Attention and Total BIS scores and made a higher proportion of commission error responses on the IMT/DMT. The groups did not differ with respect to IQ [verbal 105 ± 15 vs. 99 ± 15, $t(29) = 1.0$, $p = .35$] or any measure of reward-delay impulsivity.

PRESENCE OF AXIS II DIAGNOSIS. As shown in Table 5, subjects endorsing questionnaire items consistent with an Axis II diagnosis had a significantly higher ratio of IMT/DMT commission errors to correct responses, and a trend ($p = .069$) toward a higher rate of commission error responses. The groups did not differ significantly in BIS scores, IQ [verbal 109 ± 15 vs. 100 ± 14, $t(29) = 1.7$, $p = .11$], or in measures of reward-delay impulsivity.

Relationships between Laboratory Measures and Personality Disturbance

We investigated relationships between measures of impulsivity and the number of total or borderline symptoms endorsed on the SCID-II as an index of personality disturbance. As summarized in Table 6, the BIS score correlated significantly with the numbers of borderline, but not total, symptoms endorsed. The BIS attention subscale was the only subscale to correlate significantly with total ($r = .434$, $n = 32$, $p < .01$) or borderline ($r = .6$, $n = 32$, $p < .0005$) symptoms. The IMT/DMT commission error rates correlated significantly with the number of symptoms endorsed (Table 6), whereas none of the reward-discounting measures did ($r < .225$ for all measures; not shown).

Discussion

Commission errors on the IMT/DMT, a potential measure of rapid-response impulsivity, (Halperin et al 1991), cor-

Table 3. Multiple Regression Analysis of Laboratory Measure and IQ Contributions to BIS Nonplanning Score

Variable	Slope	Partial *R*	Significance
IMT C/H	.470 ± .158	.496	.006
IQ	−.176 ± .170	−.195	.310
SKIP average delay	−.007 ± .152	−.009	.962
Two-choice long delays	−.173 ± .168	−.194	.314delays

The dependent variable was the BIS nonplanning score; $n = 32$. For the regression, $F(4,27) = 4.35$, $p = .0076$, multiple $R = .626$.

BIS, Barratt Impulsiveness Scale; IQ, intelligence quotient; IMT, Immediate Memory Task; C/H, ratio of commission errors to correct responses; SKIP, Single Key Impulsivity Paradigm.

related with Barratt Impulsiveness Scale scores. Reward-delay measures did not correlate as strongly with BIS scores and did not contribute significantly to a multiple regression model. IMT/DMT performance was also more strongly related to the presence of an Axis I or Axis II diagnosis and to overall personality disturbance as reflected by SCID-II results. These data suggest that the IMT/DMT and two-choice tests measure distinct aspects of impulsivity, and that rapid-response impulsivity, rather than reward-delay impulsivity, is more closely related to trait impulsivity as measured by BIS scores and as reflected by symptoms of personality disorder (Table 6).

Before these conclusions can be accepted, possible shortcomings in the data must be addressed. These include 1) the sample of subjects; 2) the validity of the laboratory measures relative to models of impulsivity; 3) the validity of the BIS as a measure of trait impulsivity; and 4) the reliance on questionnaire responses of Axis II symptoms rather than a formal interview.

The sample was heterogeneous. This provided an opportunity to evaluate relationships over a wide range of apparent impulsivity. The most important relationships were found consistently, whether in the entire sample, in parents of subjects with DBDs or of control subjects, or in subjects with or without Axis I or Axis II diagnoses. Although the sample was too small to determine the role of any specific diagnosis, the results suggest that the relationships found are generalizable over a wide range of personality characteristics.

The two-choice and SKIP measures are based on reward-discounting models of impulsivity. Across all species studied, animals reduce the value of a reward as a hyperbolic function of its delay (Monterosso and Aimslie 1999). The parameters of this function are considered to measure an aspect of impulsivity, as an exaggeration in the normal decrease in value over time. Studies in rats have shown that, in general, choice of a smaller immediate reward varies inversely with serotonergic transmission (Bizot et al 1999). Human tests based on this principle generally use a choice between smaller immediate and larger delayed rewards. Subjects with borderline personality disorders (Dougherty et al 1999a) and parolees with histories of violent crimes (Cherek et al 1997) have been reported to choose more immediate rewards than control subjects. The effects, however, were modest. In this sample, lifetime Axis I or II diagnosis was not associated with statistically significant differences in delayed-reward impulsivity. Humans may be able to develop strategies that defeat reward-discounting models, reducing their utility; in addition, the salience of specific rewards can vary among individuals (Monterosso and Aimslie 1999).

Tests of rapid-response impulsivity, like the IMT/DMT, are designed to measure the tendency to act without adequately assessing context (Evenden 1999b). An exam-

Table 4. Measures of Impulsivity and Lifetime Axis I Diagnosis

	No Axis 1 ($n = 19$)	Axis I ($n = 12$)	Student *t* (*p*)
BIS attention	14.2 ± 2.6	18.8 ± 5.3	3.2 (.003)
BIS motor	22.1 ± 4.2	22.7 ± 3.4	.4
BIS nonplanning	22.6 ± 3.9	25.3 ± 5.6	1.6
BIS total	58.9 ± 9.1	66.8 ± 11.8	2.1 (.04)
IMT C/H	.221 ± .117	.420 ± .204	3.5 (.0017)
DMT C/H	.189 ± .164	.419 ± .283	2.9 (.0076)
SKIP average delay	4.53 ± 14.1	4.25 ± 6.29	.1
Two-choice long	16.9 ± 14.1	14.6 ± 13.5	.5

Table shows means ± SDs. Significance of results was identical whether parametric or nonparametric (Mann-Whitney) tests were used.

BIS, Barratt Impulsiveness Scale; IMT, Immediate Memory Task; C/H, proportion of commission errors to correct identifications; SKIP, Single Key Impulsiveness Paradigm; Two-choice long, consecutive long-delay responses on two-choice test.

Table 5. Measures of Impulsivity and Lifetime Axis II Diagnosis

	No Axis II	Axis II	Student t (p)
BIS attention	14.4 ± 2.5	16.8 ± 5.0	1.5
BIS motor	20.8 ± 3.6	23.0 ± 3.8	1.5
BIS nonplanning	22.9 ± 3.6	24.1 ± 5.3	.6
BIS total	58.1 ± 8.2	63.8 ± 11.4	1.4
IMT C/H	.203 ± .097	.343 ± .197	2.1 (.04)
DMT C/H	.171 ± .150	.330 ± .263	1.8 (.068)
SKIP maximum delay	54.5 ± 52.7	47.6 ± 46.7	.4
Two-choice long	14.2 ± 14.3	16.9 ± 13.6	.5

Significance of differences were the same whether t test or Mann-Whitney statistic was used.

BIS, Barratt Impulsiveness Scale; IMT, Immediate Memory Task; C/H, proportion of commission errors to correct identifications; SKIP, Single Key Impulsiveness Paradigm; Two-choice long, consecutive long-delay responses on two-choice test.

ple of an animal model for this aspect of impulsivity is a paradigm where visual or other cues are initially random but become progressively more accurate; interventions that increase impulsivity reduce the accuracy of the animal's responses because, although it has previously been trained to wait until it can respond accurately, it is unable to do so (Evenden 1999b, 1999c). Impulsivity of this type is increased by stimulants or by serotonin depletion (Harrison et al 1997) and is decreased by serotonin agonists (Evenden 1999c). A potential advantage of this procedure in humans is that the time scale of response precludes conscious choice (Barratt and Patton 1983). Rapid-response impulsivity, as measured by IMT/DMT commission error rates, was increased in subjects with lifetime Axis I or Axis II diagnoses, and correlated strongly with BIS scores.

Rapid-response impulsivity has not been examined as extensively as reward-discounting tests in animal studies. Several lines of evidence, from this and previous work, suggest that the former may represent a promising model of impulsivity in humans. Commission errors on the IMT/DMT contributed significantly with the multiple regression model for BIS, whereas reward-discounting measures did not, correlated more strongly to BIS scores than reward-discounting measures did, differed in subjects with either Axis I or Axis II disorders, and correlated with a crude measure of personality disturbance. Previous work suggests that rapid-response impulsivity is less prone to subject bias (Monterosso and Aimslie 1999) and is consistently affected by stimulants (Harrison et al 1997) or serotonergic manipulations (Evenden 1999c).

Table 6. Correlations between Measures of Impulsivity and Personality Disturbance

	Total SCID-II	Borderline
BIS total score	.336	.549[b]
IMT commission errors	.424[a]	.491[b]
DMT commission errors	.298	.503[b]

Table shows Spearman rank-order correlation coefficients with the numbers of SCID-II symptoms endorsed.

SCID-II, Structured Clinical Interview for DSM-IV Personality Disorders; BIS, Barratt Impulsiveness Scale; IMT, Immediate Memory Task; DMT, Delayed Memory Task.

[a] $p < .05$.

[b] $p < .005$.

The IMT/DMT is a variant of the Continuous Performance Test (CPT). Less complex forms of the CPT have been used extensively to evaluate attention and working memory (Halperin et al 1991). It is possible that results reported here involved attention rather than impulsivity; however, the aspect of the CPT that is best related to attention, "hit" or accurate responses, had essentially no significant correlations with BIS scores or relationship to psychiatric history. Commission errors on the IMT/DMT have been reported to correlate with BIS scores and to be elevated in adults who had disruptive behavior disorders as children (Dougherty et al 2000).

The BIS was developed, over several decades, as a measure of a construct that is related to, but distinct from, other action-oriented traits such as sensation seeking, extraversion, and risk taking (Barratt and Patton 1983; Johnson et al 1998). Elevated BIS scores have been reported consistently in populations with prominent impulsive behavior, including impulsively violent crimes, antisocial personality disorder, and substance abuse (Allen et al 1998; Barratt et al 1999; Brady et al 1998), history of disruptive behavior disorders (Dougherty et al 2000), and borderline personality disorder (Dougherty et al 1999a).

Factor analysis of the BIS revealed three factors (Patton et al 1995). The nonplanning score, which is defined by such items as "I plan tasks carefully" and "I plan for the future," was most strongly associated with laboratory measures of impulsivity. This factor was reported to be increased in subjects with personality disorders (Dougherty et al 2000). The attention score was more strongly related to presence of an Axis I or Axis II diagnosis or with numbers of personality symptoms endorsed. These apparently differential relationships to BIS subscales underscore the fact that impulsivity is not a unitary phenomenon (Barratt and Patton 1983; Carrillo-de-la-Pena et al 1993; Johnson et al 1998).

In summary, BIS nonplanning and total scores correlated with commission errors on the IMT/DMT, a possible measure of rapid-response impulsivity. Multiple regression analysis suggested that rapid-response impulsivity made the more significant contribution to BIS scores. Rapid-response impulsivity, but not reward-delay impulsivity, was elevated in subjects with Axis I or II diagnoses. Rapid-response impulsivity also correlated significantly with total and borderline personality symptoms endorsed on the SCID-II, a crude measure of overall personality disturbance regardless of diagnosis. Rapid-response impulsivity, as measured by the IMT/DMT, therefore appears related to trait impulsiveness and its psychiatric complications.

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