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Impulsivity is associated with treatment non-completion in cocaine- and methamphetamine-dependent patients but differs in nature as a function of stimulant-dependence diagnosis

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Abstract

Greater impulsivity, assessed by the Barratt Impulsiveness Scale-11 (BIS-11) and Stroop interference scores, has been associated with treatment completion in cocaine-dependent patients. This study evaluated the relationships among impulsivity, stimulant-dependence diagnosis, and treatment completion. Six sites evaluating 12-step facilitation for stimulant abusers obtained the BIS-11 and Stroop from 182 methamphetamine- and/or cocaine-dependent participants. Methamphetamine-dependent, relative to cocaine-dependent, participants evidenced significantly greater BIS-11 Non-planning and Total scores. There was a trend for poorer response inhibition, measured by the Stroop, in cocaine-dependent, relative to methamphetamine-dependent,

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participants. Accounting for other factors related to treatment completion, BIS-11 Motor score, assessing the tendency to act without thinking, predicted treatment completion for both cocaine-dependent and methamphetamine-dependent patients. These results suggest that methamphetamine-dependent and cocaine-dependent patients may have different impulsivity profiles but that the BIS-11 may be useful in identifying both methamphetamine-dependent and cocaine-dependent patients who are at risk for treatment non-completion.

Keywords

impulsivity; stimulant dependence; Barratt Impulsiveness Scale; Stroop

1. Introduction

Impulsivity is associated with stimulant-use disorders with evidence suggesting that impulsivity increases susceptibility to develop stimulant-use disorders (Adinoff et al., 2007; de Wit, 2009; Ersche et al., 2012) and that stimulant use increases impulsivity (Adinoff et al., 2007; de Wit, 2009; Moeller et al., 2001). Impulsivity is a multi-dimensional construct (Robbins et al., 2012) and measures of its various aspects typically do not correlate, possibly indicating that they reflect different brain processes (de Wit, 2009; Ersche et al., 2011). The Barratt Impulsiveness Scale-11 (BIS-11) is a self-report assessment designed to measure impulsiveness in three domains: Attentional Impulsiveness, Motor Impulsiveness, and Non-Planning Impulsiveness (Patton, Stanford, & Barratt, 1995; Stanford et al., 2009). Attentional Impulsiveness assesses the inability to concentrate/focus attention, Motor Impulsiveness assesses the tendency to act without thinking and Non-Planning Impulsiveness assesses lack of forethought (Stanford et al., 2009). Another aspect of impulsivity that may be important in substance use disorders (SUD) is behavioral inhibition, which is the ability to inhibit a prepotent response (de Wit, 2009). A popular measure of response inhibition is the classical Stroop task (Stroop, 1935). Though numerous versions of the classical Stroop task are available (for review, see MacLeod, 1991), the test has generally been characterized as assessing selective attention and cognitive flexibility (Strauss, Sherman, & Spreen, 2006) and response inhibition (Archibald & Kerns, 1999; Strauss et al., 2006). Of primary importance is the *interference trial*, or the time it takes the participant to name the ink color of names of colors printed in incongruently colored inks. Abnormally slowed performance on the interference trial has been interpreted to reflect difficulty with response inhibition and has been associated with frontal lobe dysfunction (Golden, 1976; Mesulam, 1985; Milner, 1964).

Impulsivity, as measured by the BIS-11, has been shown to be significantly greater in cocaine-dependent (Coffey, Gudleski, Saladin, & Brady, 2003; Ersche et al., 2010; Kjome et al., 2010; Lane, Moeller, Steinberg, Buzby, & Kosten, 2007; Moeller et al., 2002; Moeller et al., 2005; Patkar, Murray, Mannelli, & Gottheil, 2004) and methamphetamine-dependent (Lee et al., 2009) patients relative to normal controls. Similarly, increased Stroop interference has been demonstrated in patients addicted to methamphetamine (Salo et al., 2007; Salo et al., 2002; Simon et al., 2000) and cocaine (Hester, Dixon, & Garavan, 2006; Jovanovski, Erb, Zakzanis, 2005; Rosselli, Ardila, Lubomski, Murray, & King, 2001; Strickland et al., 1993) relative to normal controls, although not all investigators have observed a difference (Bolla et al., 2004; Ersche et al., 2010; Gardini, Caffarra, & Venneri, 2009; Goldstein, Volkow, Wang, Fowler, & Rajaram, 2001). Of note, the relative importance of observed significant differences between normal controls and methamphetamine-dependent patients has been questioned since the scores of the dependent patients typically were within the normal range, and thus, were unlikely to be of clinical significance (Hart, Marvin, Silver, & Smith, 2012).

A potential indicator of clinical significance would be a significant association between test performance and treatment outcomes, such as the findings of Aharonovich and colleagues that cognitive deficits in cocaine-dependent patients are related to treatment completion (Aharonovich et al., 2006; Aharonovich, Nunes, & Hasin, 2003). Several studies have evaluated the relationship between the BIS-11/Stroop and treatment outcomes in cocaine-dependent participants. These studies have found that the BIS-11 (Patkar et al., 2004) and the Stroop (Brewer, Worhunsky, Carroll, Rounsaville, & Potenza, 2008; Patkar et al., 2004) did not predict stimulant use during treatment. Rather, studies have found that the BIS-11 (Moeller et al., 2002; Moeller et al., 2001; Patkar et al., 2004) and the Stroop (Brewer et al., 2008; Streeter et al., 2008) are predictive of treatment completion. While these findings are of interest, this prior research has consisted of single-site studies and, thus, the generalizability of the results is not clear. Also, the work has been conducted only with cocaine-dependent patients; while one might assume that these findings would generalize to methamphetamine-dependent participants, there is evidence to suggest that cocaine and methamphetamine abusers have different neurocognitive profiles (Simon et al., 2002) so this may not be the case. Still, a recent study evaluating the relationship between the BIS-11 and past substance use in cocaine- and methamphetamine-dependent patients did not find a significant difference in impulsivity based on stimulant-dependence diagnosis (Tziortzis, Mahoney, Kalechstein, Newton, & De la Garza, 2011), suggesting that impulsivity is similar across these diagnostic categories.

To evaluate the relationships among impulsivity, stimulant-dependence diagnosis, and treatment completion in a more diverse sample that included cocaine-dependent and methamphetamine-dependent patients and which included multiple sites, an ancillary study was added to a National Institute on Drug Abuse (NIDA) Clinical Trials Network (CTN) trial on 12-step facilitation for stimulant abusers (STAGE-12). STAGE-12 was designed to evaluate the efficacy of a 12-Step facilitation intervention, relative to substance abuse treatment as usual, in improving outcomes in stimulant abusing individuals. It was predicted that BIS-11 and Stroop scores would differ significantly between cocaine-dependent and methamphetamine-dependent participants, based on the findings of Simon et al. (2002), and that performance on the BIS-11 and the Stroop would be predictive of treatment completion for both groups.

2. Method

2.1. Participants

Six participating substance abuse community treatment programs (CTPs), located in Columbus, Ohio, Dallas, Texas, Eugene, Oregon, Jacksonville, Florida, Portland, Oregon, and Seattle, Washington, recruited stimulant abusers participating in the STAGE-12 trial. Participants in the STAGE-12 trial were adults seeking outpatient substance use disorder treatment who had used stimulants in the prior 60 days, had a current diagnosis of stimulant abuse or dependence (past 6 months) based on the DSM-IV Checklist (Hudziak et al., 1993), and were medically and psychiatrically stable enough to participate in the trial. The 182 eligible participants for the present study were randomized into the NIDA CTN 12-step facilitation trial, endorsed methamphetamine or cocaine as the primary drug of choice, had a current diagnosis of cocaine-and/or methamphetamine-dependence, did not have a seizure disorder or a history of stroke, were able to correctly distinguish the colored stimuli on the Stroop task, and were able to provide written informed consent in English.

2.2. Measures

2.2.1. Baseline characteristics—Several baseline assessments were obtained including basic demographic information as well as factors that may be related to treatment completion including the presence of Attention Deficit Hyperactivity Disorder (ADHD) and mood disorders. ADHD status was assessed with the Wender Utah Rating Scale (WURS), which is a 61-item self-report questionnaire with good validity and reliability in identifying adults with ADHD (McCann, Scheele, Ward, & Roy-Byrne, 2000; Rossini & O'Connor, 1995; Stein et al., 1995). The Patient Health Questionnaire (PHQ; Spitzer, Kroenke, Williams, & the PHQ Primary Care Study Group, 1999) was used to assess for the PHQ diagnoses of Major Depressive Syndrome, other Depressive Syndrome, Panic Syndrome, and other Anxiety Syndrome. Studies have found good agreement between PHQ diagnoses and those of independent mental health professionals (Spitzer et al., 1999). The measures of stimulant use included self-report of use assessed using the Timeline Follow-Back procedure (Fals-Stewart, O'Farrell, Freitas, McFarlin, & Rutigliano, 2000; Sobell et al., 2001; Sobell & Sobell 1996;) and qualitative urine drug screen (UDS) results.

2.2.2. Impulsivity—Measures of impulsivity included the BIS-11 (Patton et al., 1995; Stanford et al., 2009) and the Comalli-Kaplan version of the Stroop Color Word test that allows for self-correction of errors (Comalli, Wapner, & Werner, 1962). The BIS-11 consists of 30 self-report items, with responses in a four-point Likert-type scale ranging from "Rarely/Never" to "Almost Always/Always" and comprises three domains: Attentional Impulsiveness, Motor Impulsiveness, and Non-Planning Impulsiveness; these three domains are summed to yield a total score. The Comalli-Kaplan version of the Stroop Color Word test utilizes timed trials in which three stimulus cards are presented in a standard order. Card 1 presents multiple blocks of color and asks the participant to name the color of each block (Trial 1). Card 2 involves asking the participant to read text of multiple color names that are printed in black and white (Trial 2). Card 3 is an interference task in which multiple color names are printed in incongruently-colored ink, and the participant is asked to name the ink color (Trial 3). Study staff recorded the time the participant took to complete each of the three trials. In addition, a derived interference time was calculated by taking the difference between the time taken to complete the color naming and interference trials. The interference and derived interference reaction times (RT) were the measures of interest.

2.2.3. Treatment completion—The sites participating in the STAGE-12 trial differed in the standard length of treatment offered. Five weeks was the minimum time to deliver the full STAGE-12 intervention (5 groups and 3 individual sessions). The treatment window was expanded to 8 weeks to accommodate participants/counselors schedules and to allow time for participants to make up missed sessions. To assess treatment completion, study staff used clinic records to record each participant's treatment attendance during the first 8 weeks of the STAGE-12 trial, which provided information for each participant's full intervention period. Completers were defined a priori as those who attended the first 5 weeks of treatment without missing two or more consecutive weeks; a participant who attended the first 4 weeks of treatment and missed the fifth week was considered a treatment completer if s/he attended treatment during the sixth week. STAGE-12 research visits were completed at screening/baseline, study weeks 2, 4, and 8, and at three and six months following randomization.

2.3. Procedures

See Donovan et al. (Donovan et al., 2012) for a description of the STAGE-12 study procedures. Briefly, participants who met full eligibility criteria were randomized to Stimulant Abuser Groups to Engage in 12-Step (STAGE-12) or treatment as usual (TAU). Participants assigned to STAGE-12 received a combination of five group and three individual sessions that replaced the five group and three individual sessions that would typically be provided. Participants randomized to TAU received treatment as ordinarily provided by the participating CTP, which included at least five group and three individual sessions. Participants in the present study completed a single session in which baseline characteristics were assessed and the BIS-11 and Stroop were completed. This ancillary testing session was typically completed within a week of randomization into the STAGE-12 trial.

2.4. Data analysis

All analyses were completed using SAS, Version 9. 3 (SAS Institute, 2010). Pearson correlations between the Stroop and BIS-11 subscales were all non-significant (all p-values >.05).

2.4.1. Impulsivity as a function of stimulant-dependence diagnosis—Ordinary least squares regressions were used to evaluate the relationship between impulsivity and stimulant-dependence diagnosis. To determine whether any differences in impulsivity were specific to stimulant-dependence diagnosis, characteristics on which the groups significantly differed (see Table 1) were evaluated, via the corrected Akaike Information Criteria (AICC), for inclusion as covariates in the ordinary least squares regressions testing the association between stimulant-dependence diagnosis (e.g., cocaine vs. methamphetamine) and impulsivity. This approach allowed an evaluation of the association of impulsivity with stimulant-dependence diagnosis when other variables related to stimulant-dependence diagnosis were controlled. However, site and race were not evaluated for inclusion since these variables were confounded with stimulant-dependence diagnosis (i.e., sites primarily had either cocaine- or methamphetamine-dependent patients, and methamphetamine-dependent patients were primarily Caucasian while cocaine-dependent patients were primarily African American). Thus, their inclusion tended to obscure all other relationships. Based on AICC, no participant characteristics were included in BIS-11 regressions except for route of stimulant administration and non-stimulant SUD diagnosis being included for Attentional Impulsiveness. For the Stroop, years of stimulant use was included for all scores except Color Naming time, court mandate status and years of non-stimulant use were additionally included for Word Reading time and Interference score, and age and stimulant UDS results on the day of testing were additionally included for Word Reading time.

2.4.2. Treatment completion analyses All participants (N=182)—To determine whether impulsivity differed significantly between treatment completers and non-completers, the demographic and baseline characteristics of the completers and non-completers were first compared using either the Pearson Chi Square or the Fisher Exact for categorical variables (depending on expected category counts) and either the Wilcoxon or Student's *t* for numeric variables (depending on whether or not values for completers and non-completers had similar variance). Characteristics on which the groups differed significantly (see Table 1) were evaluated, via AICC, for inclusion as covariates in the ordinary least squares regressions comparing the groups on impulsivity. This approach allowed an evaluation of the association of impulsivity with treatment completion status when other variables related to completion status were controlled. Covariates for the BIS-11 Total Impulsiveness analysis included site, stimulant UDS result on the day of testing, and stimulant-dependence diagnosis. Stimulant UDS result on the day of testing and reported stimulant use days in the 30 days before testing were included for Stroop Interference score and stimulant dependence diagnosis was included for the Derived Interference score.

Cocaine-dependent or Methamphetamine-dependent (N=172): To determine whether impulsivity differed significantly between completers and non-completers in the stimulant-dependent subgroups, the analytic approach taken for the entire sample was repeated with the participants who were either cocaine-dependent or methamphetamine-dependent (i.e., the 10 participants meeting criteria for dependence on both cocaine and methamphetamine were excluded) but the model was expanded to include diagnostic group, and the interaction between diagnostic group and treatment completion status. Covariates for the BIS-11 Total Impulsiveness analysis included site and stimulant UDS result on the day of testing. Reported stimulant use days in the 30 days before testing was included for the Stroop Interference score analysis.

2.4.3. Cohen's d—It has been recommended that effect sizes be reported along with p-values to provide information about the clinical significance of an effect in addition to its statistical significance (Nakagawa 2004). Consistent with this recommendation, we calculated the Cohen's *d* (Cohen, 1988) associated with the comparisons described in sections 2.4.1 and 2.4.2. Specifically, the Cohen's d was calculated from the regression coefficient and variance estimates in order to reflect the difference in the mean estimates from the regression.

3. Results

3.1. Sample characteristics

Characteristics of the 182 stimulant-dependent participants, as a function of stimulant-dependence diagnosis (e.g., cocaine vs. methamphetamine) and treatment completion status, are provided in Table 1. Participants averaged 38.5 years of age and had 12 years of education on average. Approximately 31% were male, and roughly 43% were non-Hispanic Caucasians.

3.2. Relationship between impulsivity and stimulant-dependence diagnosis

Table 2 provides impulsivity scores as a function of stimulant-dependence diagnosis (methamphetamine vs. cocaine). For BIS-11 scores, methamphetamine-dependent participants had significantly higher Non-Planning Impulsiveness (P=0.045) and Total Impulsiveness (P=0.010) scores indicating greater impulsivity on these factors in the methamphetamine-dependent, relative to the cocaine-dependent, participants. As can be seen in Table 2, the difference in Non-Planning Impulsiveness score was a small effect (d=0.35) while the difference in Total Impulsiveness score was a medium effect (d=0.45). For the Stroop, cocaine-dependent participants had significantly longer Color Naming times (P=0.018) and a trend towards significantly longer Interference (P=0.058) and Derived Interference (P=0.061) times.

3.3. Relationship between impulsivity and treatment completion

Table 3 displays impulsivity scores as a function of treatment completion status for the entire sample (N=182). Non-completers had significantly higher BIS-11 Motor Impulsiveness scores (P=0.002) and a trend toward significantly higher BIS-11 Total Impulsiveness scores (P=0.053). As can be seen in Table 3, the association between Motor Impulsiveness and treatment completion status had a medium effect size (d=0.53). The analyses evaluating the interaction of stimulant-dependence diagnosis and completion status revealed no significant interaction effects (data not shown) suggesting that the relationship between the BIS-11 and treatment completion did not differ significantly between the cocaine-dependent and methamphetamine-dependent participants. As can be seen in Table 3, none of the Stroop scores differed significantly between completers and non-completers for the total sample. The analyses evaluating the interaction of stimulant-dependence diagnosis and completion status revealed no significant interaction effects (data not shown) suggesting that the relationship between the Stroop and treatment completion did not differ significantly between the cocaine-dependent and methamphetamine-dependent participants.

4. Discussion

The present study evaluated the relationships among impulsivity, stimulant-dependence diagnosis, and treatment completion in 182 methamphetamine- and/or cocaine-dependent participants in a clinical trial of a 12-step facilitation intervention. The present results suggest that methamphetamine-dependent, relative to cocaine-dependent, participants evidence greater impulsivity as measured by the BIS-11. In contrast, there was a trend for poorer response inhibition in the cocaine-dependent, relative to methamphetamine-dependent, participants as measured by the Stroop. The clinical significance of BIS-11/ Stroop performance was assessed by evaluating the association between baseline BIS-11/ Stroop scores and treatment completion. The BIS-11 Motor scale, which reflects the tendency to act without thinking, differed significantly between treatment completers and non-completers and had a medium-sized effect. For the Stroop, there were no significant differences between treatment completers and non-completers. The results indicated that the relationship between impulsivity and treatment completion did not differ significantly between the cocaine-dependent and methamphetamine-dependent participants.

Impulsivity represents a complex construct and measures of its varying aspects often fail to be significantly related to one another (Coffey et al., 2003; de Wit, 2009; Kjome et al., 2010); this was also the case in the present study in that there were no significant correlations between the subscales of the Stroop and the BIS-11. The present finding of differential impulsivity scores between the methamphetamine- and cocaine-dependent participants suggests that there may be functional differences between stimulant-dependence diagnostic groups and is consistent with the results of Simon et al. (2002) who found differences in neurocognitive functioning (e.g., perceptual speed, manipulation of information, verbal recall) between methamphetamine- and cocaine-dependent participants. While methamphetamine and cocaine are both stimulants, they have some key differences that could lead to different impulsivity profiles in their users. One key difference entails the relative length of subjective effects, which is considerably shorter for cocaine and can lead to bingeing behavior in cocaine abusers (Newton et al., 2005); this difference, as well as others, could lead to different brain adaptations which would manifest themselves in different behavior profiles. The present finding of significantly higher BIS-11 Impulsiveness scores in methamphetamine-dependent, relative to cocaine-dependent, participants is inconsistent with the finding of a recent study by Tziortzis et al. (2011). In the Tziortzis et al. (2011) study, BIS-11 Total Impulsiveness did not differ significantly between non-treatment-seeking methamphetamine- and/or cocaine-dependent participants being screened for participation in phase I clinical trials. The difference in findings may reflect the different patient samples being evaluated in the two studies; the present study included treatment-seeking patients entering treatment at CTPs while Tziortzis et al. (2011) was conducted with patients who were explicitly non-treatment seekers.

The finding of a significant association between impulsivity as measured by the BIS-11 and treatment completion is consistent with previous findings that the BIS-11 is predictive of treatment dropout (Moeller et al., 2001) and is inversely related to time in treatment in cocaine-dependent patients (Moeller et al., 2001; Patkar et al., 2004). There are no prior published studies evaluating the relationship between the BIS-11 and treatment completion in methamphetamine-dependent patients. The present results did not find a significant interaction effect between stimulant diagnosis and treatment completion, suggesting that the relationship between BIS-11 and treatment completion did not differ significantly between cocaine-dependent and methamphetamine-dependent participants. Taken together, the present findings suggest that impulsivity is associated with worse treatment outcome in stimulant-dependent patients and supports the suggestion that medication development for stimulant use disorders should include medications to improve cognitive performance including better impulse control (Sofuoglu, 2009). In contrast, the present study revealed no significant difference in Comalli-Kaplan Stroop interference scores between completers and non-completers for any of the analyses. This is inconsistent with Streeter et al.'s (2008) finding that performance on this task was predictive of treatment completion in cocaine-dependent participants. A potentially important difference between the Streeter et al. (2008) and the present study is the recruitment source for the study participants. Streeter et al. (2008) assessed individuals participating in cocaine clinical trials that primarily relied on advertising for study recruitment (Ciraulo personal communication August 2011) while those in the present study were recruited from clinic intakes at participating CTPs. A recent analysis by Winhusen, Winstanley, Somoza, & Brigham (2012) revealed that in a psychosocial trial for women with co-occurring substance use disorder and PTSD, participants recruited through advertising, relative to those from the clinic, had significantly higher levels of baseline drug use and higher rates of meeting DSM-IV-TR criteria for full PTSD. This finding suggests that substance-abusing participants recruited via advertising may be more severely impaired relative to participants recruited through the clinic. Indeed, the average Stroop interference scores in the Streeter et al. (2008) study were substantially higher than those in the present study. This suggests that the Streeter et al. (2008) sample was more impaired and this may account for the difference in findings. The present findings are also inconsistent with those of Brewer et al. (2008) who reported a significant correlation between Stroop interference, as measured by the computerized Stroop, and treatment retention in cocaine-dependent participants. It has been noted that different versions of the Stroop yield different performance results (Salo, Henik, & Robertson, 2001) and, thus, the Stroop scores from the present study, which utilized the Comalli-Kaplan version of the Stroop, cannot be directly compared with the Stroop scores from Brewer et al. (2008). There are no prior published studies evaluating the relationship between the Stroop and treatment completion in methamphetamine-dependent patients and, thus, no literature with which to compare the present results.

The present study has several strengths and a few limitations. A clear strength of the present study is that it was conducted at multiple sites, which enhances the generalizability of the results, and included a relative large sample of stimulant-dependent participants. A recent meta-analysis found that effect sizes are larger in single-site, compared to multi-site, trials (Dechartres, Boutron, Trinquart, Charles, & Ravaud, 2011). Thus the moderate effect size found for the relationship between BIS-11 Motor Impulsiveness score and treatment completion status is notable. Another study strength is the provision of preliminary data on the relationship between BIS-11/Stroop performance and treatment completion in methamphetamine-dependent patients; the present findings suggest that the significant association between BIS-11 and treatment completion that has been found for cocaine-dependent patients likely applies to methamphetamine-dependent patients as well. Another study strength is that it was conducted with individuals seeking SUD treatment at CTPs and, thus, the results are likely generalizable to individuals in treatment for stimulant-dependence disorders. A final strength was our accounting for other factors related to treatment completion (e.g., stimulant use status at baseline, ADHD, mood disorders, etc.) to determine the predictive validity of the BIS-11 and Stroop beyond that contributed by known factors. One limitation of this study was that, while we controlled for a number of the baseline characteristics on which the cocaine-dependent and methamphetamine-dependent participants differed, we could not control for race or site because these variables were highly correlated with stimulant-dependence diagnoses (i.e., sites primarily had either cocaine- or methamphetamine-dependent patients, and methamphetamine-dependent patients were primarily Caucasian while cocaine-dependent patients were primarily African American). Thus, the differences in impulsivity found between the methamphetamine and cocaine dependent participants may have been due in part to site- or race-related factors. The degree to which this might be the case is unknown since past research on both the Stroop

(Mitrushina, Boone, Razani, & D'Elia, 2005) and the BIS-11 (Stanford et al., 2009) has not addressed the impact of race and geographic area on test performance. A final limitation was the relatively small sample of methamphetamine-dependent patients, which likely resulted in our analyses being underpowered for potential stimulant-dependence diagnosis by treatment completion interaction effects.

In summary, the present results suggest that the impulsivity profiles of treatment-seeking methamphetamine-dependent and cocaine-dependent patients might differ; should this finding be replicated it might shed light on some of the key differences between abusers of those substances. Consistent with past research with cocaine-dependent participants, the BIS-11 was significantly associated with treatment completion in this more diverse sample that included cocaine and methamphetamine-dependent patients. The present study, taken together with past research, suggests that it may be useful to obtain the BIS-11 at treatment intake to help identify stimulant-dependent patients at risk for treatment non-completion, with additional interventions applied to prevent premature termination.

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Table 1

Baseline sample characteristics as a function of stimulant-dependence diagnosis and treatment completion

Characteristic	METH[a] (N=47)	Cocaine (N=125)	Stimulant Diagnosis Analysis Test Statistic	Non-Completers (N=51)	Completers (N=131)	Completer Analysis Test Statistic
Age (years)	34.8 (8.4)	40.4 (9.1)	W= −3.6**	36.9 (8.4)	39.2 (9.6)	W= −1.7
Education (years)	11.7 (1.4)	12.1 (1.6)	W= −1.5	12.1 (1.4)	12.0 (1.7)	W= −0.1
Male	17.0%	36.8%	χ^2 (1)= 6.2*	31.4%	31.3%	χ^2 (1) = 0.0
Race			P=0.00**			χ^2 (2) = 1.1
White	87.3%	25.8%		44.0%	42.7%	
Black	2.1%	66.9%		42.0%	48.1%	
Other / Mixed	10.6%	7.3%		14.0%	9.2%	
Ethnicity-Hispanic	6.4%	2.4%	P = 0.16	10.0%	3.8%	P = 0.08
Court Mandate	29.8%	15.2%	χ^2 (1)= 4.7*	23.5%	16.8%	χ^2 (1) = 1.1
ADHD[b] (%)	27.7%	36.0%	χ^2 (1)= 1.1	45.1%	29.8%	χ^2 (1) = 3.8
Currently Smoking Cigarettes	80.9%	78.4%	χ^2 (1) = 0.1	80.4%	78.6%	χ^2 (1) = 0.1
Stimulant Positive UDS[c]	36.2%	16.1%	χ^2 (1)= 8.1**	35.3%	15.4%	χ^2 (1) = 8.8**
Stimulant use days in last 30	6.3 (8.0)	4.5 (5.6)	T(63.6)= 1.4	7.6 (8.0)	3.9 (5.1)	T(66.5)= 3.1**
Stimulant Route of Administration:			χ^2 (2)= 30.1**			χ^2 (2) = 2.6
Smoking	54.4%	81.5%		65.3%	74.8%	
Oral/Nasal	6.5%	12.9%		16.3%	8.4%	
IV	39.1%	5.6%		18.4%	16.8%	
Years of Stimulant Use	10.3 (6.8)	13.1 (7.6)	W= −2.1*	11.4 (7.6)	12.5 (7.7)	W= −0.9
Years of Non-Stimulant Use	7.3 (6.7)	18.0 (10.4)	T (128.4)=−7.9**	13.2 (10.3)	15.4 (10.6)	W= −1.3
Non-Stimulant SUD[d] Diagnosis	48.9%	79.2%	χ^2 (1)= 15.2**	76.5%	69.5%	χ^2 (1) = 0.9
Mood/Anxiety Disorder	52.3%	37.6%	χ^2 (1)= 2.8	52.2%	36.8%	χ^2 (1) = 3.3
Stage 12 treatment assignment:			χ^2 (1)= 0.2			χ^2 (1) = 0.6
12-step facilitation	42.6%	46.4%		41.2%	47.3%	
Treatment as usual	57.4%	53.6%		58.8%	52.7%	
Dependence Diagnosis:						P = 0.00*

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Characteristic	METH[a] (N=47)	Cocaine (N=125)	Stimulant Diagnosis Analysis Test Statistic	Non-Completers (N=51)	Completers (N=131)	Completer Analysis Test Statistic
Methamphetamine	100%	0%		29.4%	24.4%	
Cocaine	0%	100%		58.8%	72.5%	
Both	0%	0%		11.8%	3.1%	

Note: Where not specifically indicated, numbers represent means (standard deviations).

[a] METH=methamphetamine;

[b] ADHD=attention-deficit/ hyperactivity disorder;

[c] UDS=Urine drug screen;

[d] SUD=substance use disorder; W=Wilcoxon Rank Sum, χ^2 (df)=Pearson's Chi Square, P=Fisher's Exact P statistic,

* $p < 0.05$,

** $p<.01$.

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Table 2

Relationship of BIS-11 and Stroop scores to stimulant-dependence diagnosis

Impulsivity Measure	Methamphetamine-dependent (N=47)	Cocaine-dependent (N=125)	X^2	Cohen's d
BIS-11:				
Attentional	18.4 (2.7)	17.5 (3.7)	1.26	0.23
Motor	26.1 (3.7	24.8 (4.5)	3.06	0.31
Non-planning	25.6 (4.7)	23.9 (4.6)	4.03*	0.35
Total	70.1 (7.2)	66.2 (9.4)	6.56*	0.45
Stroop:				
Color Naming	60.4 (9.6)	65.8 (14.0)	5.59*	0.41
Word Reading	46.1 (7.4)	50.7 (11.1)	0.81	0.19
Interference	107.9 (26.7)	122.0 (26.8)	3.59	0.37
Derived Interference	47.6 (24.2)	56.1 (21.4)	3.51	0.33

Note: BIS-11=Barratt Impulsiveness Scale-11; Values are Means (standard deviations).

* $p < 0.05$.

Table 3

BIS-11 and Stroop scores as a function of treatment completion status

	Treatment Completion		
Impulsivity Measure	**Completers (N=131)**	**Non-Completers (N=51)**	**X^2 (d)**
BIS-11:			
Attentional	17.6 (3.6)	18.0 (3.1)	0.64 (0.14)
Motor	24.6 (4.4)	26.8 (3.7)	9.99** (0.53)
Non-planning	24.5 (4.7)	24.5 (4.5)	0.01 (0.01)
Total	66.7 (9.3)	69.4 (7.5)	3.74 (0.36)
Stroop:			
Color Naming	64.5 (13.0)	64.3 (12.7)	0.00 (0.01)
Word Reading	49.4 (10.5)	49.1 (9.3)	0.00 (0.01)
Interference	119.9 (27.6)	114.8 (27.0)	0.57 (0.13)
Derived Interference	55.3 (23.0)	50.5 (21.0)	1.66 (0.22)

Note:

** p<01. d=Cohen's d; Where not specifically indicated, numbers represent eans (standard deviations).