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The association between executive functioning and motivation to enter treatment among regular users of heroin and/or cocaine in Baltimore, MD

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Abstract

This study explored the association between readiness to enter treatment and performance on the Wisconsin Card Sorting Test (WCST), a measure of problem solving ability and executive functioning. Data for this analysis was collected on 258 current regular users of heroin and/or cocaine as part of an epidemiologic study on executive function and drug use. A structural equation model was used to test the hypotheses that poorer performance on the WCST would predict lower scores on two latent constructs measuring motivation to change drug use. Specifically, poorer performance on the WCST was associated with lower recognition of problem use. Associations between treatment enrollment within the past six months and regular use of more than one drug were also observed. Findings highlight the importance of considering cognitive impairment in programs targeting active drug users and promoting treatment participation.

Keywords

Treatment motivation; executive functions; heroin; cocaine

Introduction

Heroin and cocaine present unique problems for addiction treatment as they made up over one quarter of all primary drug use treatment entries in 2005 based on data from the Treatment Episodes Data Set (SAMHSA, 2006). Even with these large numbers enrolled in treatment, Compton and colleagues (Compton, Thomas, Stinson, & Grant, 2007) estimate that nearly a quarter of substance users in need of treatment are not receiving it. While

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external factors are an important barrier to receiving care, continued resistance even when treatment is made more accessible suggests that inconsistent or poor motivation is a key component of treatment avoidance among substance users (Hser, Anglin, Grella, Longshore, & Prendergast, 1997).

Defining ‘motivation to enter treatment’ as a construct has been an important consideration in attempts to understand treatment initiation and treatment success among drug using populations. Although there are variations in the conceptualization of readiness or motivation for treatment across studies and theories, the definition of these constructs often include problem recognition and intention to stop use (L. A. Henderson, Vlahov, Celentano, & Strathdee, 2003; Joe, Simpson, & Broome, 1998; Longshore & Teruya, 2006; Nwakeze, Magura, & Rosenblum, 2002; Prochaska, DiClemente, & Norcross, 1992; Simpson & Joe, 1993). Problem recognition reflects an understanding that current drug use is causing difficulty and that the user is unable to control use; intention to stop use reflects a desire and a plan to stop using drugs.

Though several studies suggest motivation predicts treatment success (Joe, et al., 1998; M. J. Henderson, Saules, & Galen, 2004; Corsi, Kwiatkowski, & Booth, 2007; Longshore & Teruya, 2006), few studies have examined cognitive factors that may be associated with motivation. Executive functions are thought to include the domains of planning, response inhibition, and problem solving (Lezak, 1995) and could be important in recognizing problem use and successfully achieving treatment milestones across different drug treatment modalities. While researchers have examined the association between cognitive function and treatment outcomes (e.g. Fals-Stewart & Lucente, 1994), less research has focused on motivation. Among individuals with problematic drinking, motivation to change is shown to be correlated with intellectual functioning, memory, and a measure of abstraction (Blume, et al., 1999; Blume, et al., 2005), though not executive functions (Blume et al., 2005). Fals-Stewart and Lucente (1994) suggested that the inability of an individual to recognize problem use may be the result of impaired abstraction abilities in a review of studies examining the association between cognitive impairment and substance use treatment. Using a similar rationale, we hypothesized that a measure of conceptual reasoning measured using... would be associated with treatment motivation among out of treatment heroin and cocaine users.

Method

Participants

The current study used baseline data from the Baltimore site of the NEURO-HIV Epidemiologic Study which has been described in detail in other publications (e.g. Severtson, Mitchell, Mancha, & Latimer, in press). The present study sample was based on 258 HIV negative individuals who reported lifetime regular use (defined as daily or nearly daily use for three months or more) and past week use of heroin, cocaine, and/or crack cocaine. Participants were excluded from the analyses if they were 45 or older, if they did not have a conclusive negative test for HIV, if they exceeded 120 omission errors on the Test of Variable of Attention (thought to be related to insufficient effort [Greenberg, et al., 1999]), did not complete neuropsychological measures, or if they reported current

enrollment in a drug treatment program. Demographic information of the final sample is included in Table 1.

Measures

HIV-Risk Behavior Interview.—The HIV-Risk Behavior Interview included detailed behavioral information about drug use and sexual practices. To adjust for drug use severity, years of regular use and number of drugs used regularly were included. Years of regular drug use was calculated by subtracting age of first reported regular use of a drug from last reported regular use of a drug. Regular use was defined as daily or nearly daily use for 3 months or more. Lifetime regular use of more than one drug (heroin, crack-cocaine, and/or cocaine in combination) was categorized as regular use of one drug compared to regular use of more than one drug. Finally, self-reported involvement in drug treatment within the past 6 months was included in the analysis.

Neuropsychological Measures

Raw scores for each measure were adjusted for gender, education, ethnicity, and age using standardized residuals from linear regressions. The following neuropsychological measures from the study battery were included as part of this study:

The *Wisconsin Card Sorting Test* (WCST; Heaton, Chelune, Talley, Kay, & Curtiss, 1993), a measure of abstraction and problem solving, was the variable of interest. The computerized version of the WCST was utilized. Categories Completed and Perseverative Errors scores are most commonly used in identifying impairment (Lezak, 2005). However, inclusion of both items to test the hypothesis would lead to multicollinearity problems. For this analysis, the global score described by Laiacona and colleagues (Laiacona, Inzaghi, De Tanti, & Capitani, 2000) was utilized. The global score is generated by subtracting the number of completed categories multiplied by 10 from the number of cards administered.

The lowest quartile as a cutoff for impairment of the adjusted global score was used. This impairment classification corresponded well with the 10th percentile cutoffs for Perseverative Errors and Categories Completed. There was 84.8% agreement between those classified as impaired or not impaired using standard scores for Perseverative Errors and 93.0% agreement using standard scores for Categories Completed. The kappa statistics were .55 for Perseverative Errors and .82 for Categories Completed, suggesting moderate to excellent agreement.

To adjust for pre-morbid intellectual functioning, the *Shipley Institute of Living Scale* (SILS; Zachary, 1991) was used. The SILS is comprised of two components. The first component is a vocabulary test with a list of forty target words. The second component of the SILS is the Abstraction section and participants are asked to complete twenty word problems. An age-adjusted total score of both sections has been used as an estimate of pre-morbid IQ in drug using samples (Bolla, et al., 2000).

Treatment readiness questionnaire

The HIV-Risk Behavior interview included a brief questionnaire containing 16 Likert-type items. Participants responded with values ranging from 1 to 4 indicating strong disagreement to strong agreement regarding treatment motivation. For the current analysis, the six items that were similar to those used by Henderson and colleagues (2003) were utilized for assessing the constructs of problem recognition and intention to stop use. The two constructs were examined simultaneously rather than ordered because motivation researchers note the difficulty in distinguishing between completion of distinct stages (DiClemente, Schlundt, & Gemmell, 2004) and correlated but distinct constructs can predict unique treatment outcomes (Longshore & Teruya, 2006).

Data analysis

A confirmatory factor analysis (CFA) was used to determine the suitability of the six items from the treatment readiness questionnaire in assessing the constructs “problem recognition” and “intention to stop use.” The Root Mean Squared Error of Approximation (RMSEA) and the Comparative Fit Index (CFI) were used to assess model fit (Hu & Benter, 1999). An ordinal factor analysis using a robust weighted least squares approach was used. The second stage of the analysis was a structural equation model (SEM) with the motivation factors regressed on the WCST adjusted for potential confounders. missing information on at least one item of the two scales ranged from 5% to 15%. Therefore, individual items were imputed using multiple imputation (MI; Rubin, 1987; Schafer, 1999). MI is a missing data method that imputes items with a set of plausible values and takes into account the uncertainty in the estimation of missing items. Five multiply imputed datasets were used to obtain estimates. Estimates were based on responses to other items within the scale and participation in a treatment program with the past 6 months. Estimates were generated using multinomial logistic regression in the ICE addition to Stata (Royston, 2004). Analyses were then conducted using MPlus 5.0 software. Estimates from the analysis on each of the multiply imputed data sets were then combined using Rubin’s rules of inference (Rubin, 1987; Schafer, 1999).

Results

The results of first stage of the analysis, the CFA of the WISC, are in Table 2. The first model using all 6 items had less than ideal fit (RMSEA=.08). It was determined that item 6, “I plan to quit using in the next six months” thought to load onto the intention to stop use scale correlated strongly with the problem recognition construct as well. Because of concerns regarding the discriminant validity and redundancy with other items, we fit a second CFA without item 6. This improved the fit and was used to test the hypotheses with respect to the performance on the WCST (CFI=1.00, RMSEA=.03). Therefore, item 6 was excluded from further analyses.

The final step of the analysis was a SEM with the regression of the latent variables on the WCST adjusted for potential confounders. The model was a good fit for the data (CFI=1.00, RMSEA<.01). In examining the factor loadings from the SEM which are presented in Table 2, there is little change across models. The regression coefficients and the standard errors

from the SEM are presented in Table 1. With respect to the primary hypothesis, performance in the highest quartile on the global measure from the WCST (indicative of poorer performance) was associated with lower scores on the problem recognition construct ($\beta = -0.71$, $t = 3.61$, $p < .001$). The findings with respect to intention to stop use were in the anticipated direction yet failed to achieve statistical significance ($\beta = -0.37$, $t = 1.86$, $p = .06$).

Furthermore, having less than a high school education was associated with lower intention to stop use ($\beta = -0.36$, $t = 2.14$, $p = .03$). Also, regular use of more than one drug was associated with greater problem recognition ($\beta = 0.55$, $t = 3.54$, $p < .001$) and intention to stop use ($\beta = 0.40$, $t = 2.49$, $p = .01$). Enrollment in treatment within the past six months was associated with greater problem recognition ($\beta = 0.55$, $t = 3.15$, $p = .002$) and a trend was observed with respect to intention to stop use ($\beta = 0.34$, $t = 1.96$, $p = .051$).

Discussion

The results partially supported the hypothesis. Recognition of problem use was associated with poorer performance on the WCST. Although in the anticipated direction, the association between intention to stop use and WCST was not statistically significant. These results are consistent with previous findings showing lower stage completion among individuals with cognitive impairment (e.g. Blume, et al., 1999). The difference by construct could be explained by a number of factors. Problem recognition may be associated with conceptual reasoning and the ability to respond to feedback whereas impulse control or risk taking measures may relate more strongly with intention to stop use. The findings may also indicate a problem in the measurement or utility of the intention to stop use construct. Problem recognition was associated with treatment seeking given the stronger associations observed with past 6 month treatment involvement whereas intention to stop use was not statistically significant.

The current study does have some notable limitations. Cross-sectional data was used, reducing the ability to make assumptions with regard to causal associations. Longitudinal observations could reveal more complex relationships between treatment motivation and executive functions as well as limit potential selection biases possibly present in the current study. Furthermore, an examination of the temporal relationship between motivation constructs can be more adequately assessed with longitudinal designs. Future analyses may explore the modifying effects of cognitive functioning on the association between type of treatment and the consequential improvements in motivation to change behavior and treatment success.

Despite the noted limitations, the current study provides insight into individual level characteristics that may influence the decisions to seek and participate in treatment programs among heroin and cocaine users. The study also has implications for the design of treatments for individuals with cognitive impairment. In summary, cognitive impairments observed in individuals with chronic drug use behaviors may account for an inability to incorporate attitudinal changes. Considering cognitive variables in the design and methods of drug treatment plans may have important treatment implications for vulnerable populations.

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Table 1.

Demographic data and structural equation model for problem recognition and intention to stop use regressed on covariates (n=258).

Variable	Mean(SD) or %	Problem Recognition	Intention to stop use
		coeff. (se)	coeff. (se)
WCST Global Scale: Impaired vs. not impaired	59.59 (35.52) [†]	−0.71 (0.20) **	−0.37 (0.20)
Age	31.24 (6.60)	−0.01 (0.01)	<0.00 (0.01)
Gender: Female vs. male	32.17% (Female) 67.83% (Male)	0.02 (0.16)	0.18 (0.17)
Education: less than 12 years vs 12 years or more	48.45% (Less than 12 years) 51.55% (12 years or more)	−0.23 (0.16)	−0.36 (0.17) *
Regular drug use: More than one drug vs. one drug regularly used	50.30 % (More than one drug) 49.70% (One drug)	0.55 (0.16) **	0.40 (0.16) *
Years of regular use: 4 years or less vs. more than 4 years	9.08 (5.93) [†]	0.01 (0.19)	0.06 (0.19)
Ethnicity: White vs. other ethnicities	59.30% (White) 40.70% (Other)	0.27 (0.18)	0.20 (0.18)
Past 6 month treatment: Yes vs. no	66.28 (Yes) 33.72 (No)	0.55 (0.18) **	0.34 (0.17)
Shipley Institute of Living Scale	44.43 (13.27)	−0.06 (0.09)	−0.12 (0.09)

Note:

*= p<.05,

**= p<.01.

[†]= Represent mean and standard deviation prior to dichotomy for the model. Estimates represent non-standardized estimates across 5 multiply imputed datasets.

Table 2.

Results from the confirmatory factor analyses and structural equation model of Problem Recognition and Intention to Stop Use (N=258).

	CFA1		CFA2		SEM	
Item	Problem Recognition	Intention to stop use	Problem Recognition	Intention to stop use	Problem Recognition	Intention to stop use
1. Your drug use is a problem for you	0.95	---	0.94	---	0.93	---
2. Your drug use is more trouble than it's worth	0.92	---	0.93	---	0.92	---
3. Your drug use is under control	-0.66	---	-0.66		-0.62	---
4. You plan to quit using drugs in the next 30 days	---	0.83	---	0.83	---	0.84
5. You are ready to quit using right now	---	0.78	---	0.82	---	0.81
6. You plan to quit using in the next six months	---	0.83	---	---	---	---
Problem Recognition with Intention to stop use	0.66		0.60		0.56	
CFI	0.99		1.00		1.00	
RMSEA	0.08		0.03		<0.01	

Note: Estimates represent average over 5 multiply imputed datasets.