Drug and Alcohol Dependence 114 (2011) 169–176

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Relationship of cognitive function and the acquisition of coping skills in computer assisted treatment for substance use disorders

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ARTICLE INFO

Article history:
Received 9 April 2010
Received in revised form 25 August 2010
Accepted 25 September 2010
Available online 2 November 2010

Keywords:
Coping skills
Cognitive behavioral therapy
Cognitive function
Indirect effects

ABSTRACT

Background: Coping skills training is an important component of cognitive behavioral therapy (CBT), yet cognitive impairment and related limitations that are often associated with chronic substance use may interfere with an ability to learn, retain, or use new information. Little previous research has examined the cognitive or neuropsychological factors that may affect substance users' ability to learn new coping skills in CBT.

Methods: Fifty-two substance dependent individuals randomized to receive a computerized version of cognitive behavioral therapy (CBT4CBT) or treatment as usual (TAU) were administered several cognitive and neuropsychological measures, as well as a coping skills measure prior to and upon completing an 8-week treatment period.

Results: Across treatment conditions, participants who scored above the median on a measure of IQ demonstrated greater improvement in the quality of their coping skills than those below the median on IQ (Group × Time, $F(1,49) = 4.31$, $p < .05$). Also, IQ had a significant indirect effect on substance use outcomes through an effect on the quality of coping skills acquired, specifically for those who received CBT4CBT.

Conclusion: Individuals with higher IQ at baseline improved the quality of their coping skills more than those with lower IQ, which in turn reduced rates of substance use following treatment. This highlights the impact of substance users' cognitive functioning and abilities on the acquisition of coping skills from CBT, and suggests need for greater awareness and tailoring of coping skills training for those with poorer functioning.

1. Introduction

Coping skills play an important role in delaying addiction relapse and preventing recurrence of alcohol and other drug use (Carroll, 1996; Chung et al., 2001; Cooper et al., 1992; Kadden et al., 1989; Monti et al., 1993). Research has found that individuals are significantly more successful in avoiding relapse if they can demonstrate the ability to appraise situations as risky and implement appropriate coping skills (McKay et al., 1996). Although most prominent in cognitive-behavioral therapy (CBT), a focus on skills to support abstinence or prevent relapse is a component in multiple interventions with substance using populations (Carroll et al., 1994; Moos, 2007; Morgenstern and Longabaugh, 2000; Witkiewitz and Marlatt, 2004). However, the cognitive deficits associated with chronic substance use are substantial (Vik et al., 2004), and very few studies have examined the influence of neurocognitive factors on individuals' ability to acquire effective coping techniques through treatment, even though such skills can be cognitively demanding.

The cognitive impairments and neuropsychological deficits associated with chronic alcohol and drug use are well documented. Neuroimaging studies of long-term users of alcohol and drugs have revealed multiple cognitive changes and deficits (Bolla et al., 2004; Goldstein and Volkow, 2002). It is estimated that more than half of individuals entering treatment for alcohol or substance use disorders show mild to severe neuropsychological impairment, particularly in tasks requiring new learning, memory, executive control, and other fluid cognitive abilities (Bates and Convit, 1999; Meek et al., 1989; O'Malley et al., 1992). In poly-substance abusers, evidence has suggested a dose-response relationship between severity of drug use and performance on tests of executive function (Verdejo-Garcia et al., 2005), and a recent meta-analysis on the neurocognitive deficits in cocaine users compared to healthy normal controls found cocaine use had the largest effect on attention and executive functions, such as decision making and mental flexibility (Jovanovski et al., 2005). Coupled with the evidence that substance users often display

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doi:10.1016/j.drugalcdep.2010.09.019

higher rates of impulsivity and poorer decision making compared to non-substance-using controls (Hanson et al., 2008; Moeller and Dougherty, 2002; Verdejo-Garcia et al., 2007), these issues are likely to present challenges when using interventions that emphasize learning, retaining, and implementing new strategies, such as CBT.

Although cognitive and neuropsychological deficits have long been thought to affect addiction treatment outcomes, the empirical evidence of a direct relationship between various cognitive abilities and treatment outcome, particularly substance use and abstinence rates, has been relatively weak (Alterman et al., 1990; Donovan et al., 1984; Fals-Stewart et al., 1994). There is evidence that performance on impulsivity and decision-making tasks are related to treatment dropout rates (Moeller et al., 2001; Passetti et al., 2008), and some research has indicated that poorer cognitive functioning is associated with worse treatment retention in CBT (Aharonovich et al., 2006; Aharonovich et al., 2003). Some studies have suggested that neuropsychological impairments may affect treatment outcome through an effect on therapeutic change mechanisms, with a focus on self-efficacy in particular (Bates et al., 2006; Morgenstern and Bates, 1999). Virtually no research has examined the influence of cognitive and neuropsychological factors, including impulsivity and risk-taking, on the acquisition of coping skills from CBT for substance use.

The purpose of this study was to examine the relationship between cognitive/neuropsychological functioning, the acquisition of coping skills, and treatment outcome, using data drawn from a randomized clinical trial evaluating a computer-assisted version of CBT for substance use as an enhancement to treatment as usual. A previous analysis from this trial indicated that participants who received the computerized CBT demonstrated greater improvement in their coping skills than those who only received treatment as usual, and improvement in coping skills was in turn related to a decrease in substance use (Kiluk et al., 2010). The current study sought to extend these findings by exploring cognitive factors that may have affected the acquisition of coping skills during treatment and the subsequent frequency of substance use following treatment. Our focus was not on the direct relationship between neurocognitive indicators and treatment outcome, which has been evaluated elsewhere (Carroll et al., in press), but rather on a potential indirect relationship through an effect on coping skills. We hypothesized that individuals with poorer cognitive functioning, as well as greater impulsivity and risk-taking, at the time of treatment entry would show fewer increases in their coping skills acquired than those with higher cognitive functioning, which in turn would be associated with higher levels of substance use following treatment.

2. Methods

2.1. Participants

As described in more detail in the main study report (Carroll et al., 2008), participants were 77 individuals seeking treatment for substance abuse at a community based outpatient treatment center. These participants were drawn from a larger pool of 158 individuals screened, and 77 were determined to be eligible for participation in the RCT. Individuals were excluded if (1) they had not used alcohol or illegal drugs within the past 28 days or failed to meet DSM-IV criteria for a current substance dependence disorder, (2) had an untreated psychotic disorder which precluded outpatient treatment, or (3) were unlikely to be able to complete 8 weeks of outpatient treatment due to a planned move or pending court case from which incarceration was likely to be imminent.

2.2. Measures

2.2.1. Substance use. To assess substance use, the Substance Use Calendar, similar to the Timeline Follow Back (Fals-Stewart et al., 2000) was administered to collect self-reports of drug and alcohol use. Urine toxicology screens (testing for cocaine, marijuana, opiates, amphetamines, and benzodiazepines) and breath samples were obtained at every assessment visit to verify participant self-report of substance use. Two primary outcome measures were used: duration of longest continuous period of abstinence (urine confirmed), and the percentage of urine specimens positive for any type of drug use.

2.2.2. Coping skills. Coping skills were assessed with the Drug Risk Response Test (DRRT), which involved a series of audio-taped role plays of 6 situations associated with a high risk for drug and alcohol relapse that correspond directly with coping skills taught in CBT. The six situations were played for the participant and a tape recorder was used to record the participant's response. Participants were instructed to imagine themselves in each situation and indicate how they would respond to the situation if it were occurring at that moment. The DRRT was administered at treatment entry (week 0) and at the end of treatment time point (week 8).

A scoring manual was utilized that included clarification of the intent of each scoring dimension, anchor points for Likert scale ratings, and example responses and ratings. Participants' responses to each of the eight situations were scored on the following variables: (1) *latency*, (2) *number of coping responses provided*, (3) *number of activities in each response*, (4) *quality of best coping response* (rated on a 7-point Likert scale ranging from *1-"would definitely use drugs or alcohol"* to *7- "excellent response indicated complete confidence, no chance of using")*; (5) *quality of overall response*, (6) *type of coping response*, (7) *category of response*, and (8) *specificity* – to assess whether the participant's response was specific to the particular situation, rather than a general, all-purpose response. This was scored dichotomously (yes/no).

Three experienced independent evaluators blind to treatment assignment rated the participants' DRRT responses. Raters were trained through a didactic seminar that included review of the coding manual and group practice ratings on five tapes until consensus was achieved. Given that these were experienced raters who had participated in multiple previous trials using a similar instrument, a reliability sample of four additional tapes (total of nine tapes) was deemed adequate. Intraclass correlation coefficient (ICC) estimates for the reliability sample of tapes was .86 for the *quality of overall response* variable, and between .85 and .93 for other variables from the DRRT.

Presented elsewhere, analyses from the DRRT indicated that participants assigned to a computerized version of CBT demonstrated a significantly greater increase in the quality of their overall responses (week 0 mean = 3.7, sd = .76; Week 8 mean = 4.4, sd = 1.0) compared with participants assigned to treatment as usual (week 0 mean = 3.8, sd = .80; Week 8 mean = 3.8, sd = .82) (Group × Time, $F(1,51) = 6.77$, $p < .05$), whereas no such differences were evident for the quantity of coping responses, and this increase in the quality of coping was related to the amount of substance use following treatment (Kiluk et al., 2010). Therefore, the *quality of overall response* variable was considered the indicator of effective coping skills and was the main variable of interest for the current study. Coping skill ability and acquisition was indicated by the mean quality of overall responses across the six situations from the DRRT, for both the baseline and end-of-treatment time points.

2.2.3. Cognitive function. Measures utilized to assess aspects of cognitive function found to be impaired in drug users included the Vocabulary and Abstraction subtests of the Shipley Institute of