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Short communication

Cognitive deficits in marijuana users: Effects on motivational enhancement therapy plus cognitive behavioral therapy treatment outcome

Efrat Aharonovich [a,b,*], Adam C. Brooks [c], Edward V. Nunes [a,b], Deborah S. Hasin [a,b,d]

[a] Columbia University, Department of Psychiatry, College of Physicians and Surgeons, 1051 Riverside Drive, New York, NY 10032, USA
[b] New York State Psychiatric Institute, 1051 Riverside Drive, New York, NY 10032, USA
[c] Treatment Research Institute, Philadelphia, PA 19106, USA
[d] Columbia University, Mailman School of Public Health, Department of Epidemiology, 722 West 168th Street, New York, NY 10032, USA

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Abstract

Clinical variables that affect treatment outcome for marijuana-dependent individuals are not yet well understood, including the effects of cognitive functioning. To address this, level of cognitive functioning and treatment outcome were investigated. Twenty marijuana-dependent outpatients were administered a neuropsychological battery at treatment entry. All patients received 12 weekly individual sessions of combined motivational enhancement therapy and cognitive behavioral therapy. The Wilcoxon Exact Test was used to compare cognitive functioning test scores between completers and dropouts, and the Fisher Exact Test was used to compare proportion of negative urines between those with higher and lower scores on the cognitive tests. Marijuana abstinence was unrelated to cognitive functioning. However, dropouts scored significantly lower than completers on measures of abstract reasoning and processing accuracy, providing initial evidence that cognitive functioning plays a role in treatment retention of adult marijuana-dependent patients. If supported by further studies, the findings may help inform the development of interventions tailored for cognitively impaired marijuana-dependent patients.

Keywords: Marijuana; Cognitive functioning; Treatment; Motivational enhancement therapy; Cognitive behavioral therapy

1. Introduction

Approximately 14.6 million Americans use cannabis (Substance Abuse and Mental Health Services Administration (SAMHSA), 2005); 36% of current users have DSM-IV marijuana disorders (Compton et al., 2004). Thus, effective interventions are needed. Promising therapies adapted for marijuana patients include cognitive behavioral therapy (CBT), motivational enhancement therapy (MET), and contingency management, which all assume adequate cognitive functioning. Thus, patients with less cognitive ability may be vulnerable to dropout or poor outcome. Subjective reports of deficits in memory, attention or concentration are common among marijuana users (e.g., Stephens et al., 2002; Gruber et al., 2003), and neuropsychological testing in chronic marijuana abusers shows impaired memory, attention (Solowij et al., 1995, 2002), abstraction, decision-making and executive functioning (Fletcher et al., 1996; Lamers et al., 2006; Pope and Yurgelun-Todd, 1996; Whitlow et al., 2004).

Effects of cognitive functioning on treatment outcome have been studied among cocaine dependent patients (Aharonovich et al., 2006) but not marijuana-dependent patients. We studied cognitive functioning at treatment entry and outcome among marijuana-dependent patients. The behavioral treatment included weekly sessions combining MET and CBT. Based on previous work (Aharonovich et al., 2003, 2006), we predicted that lower scores on neuropsychological measures, specifically attention and memory, would predict poorer treatment outcome.

2. Methods

2.1. Participants

Participants were 20 consecutively enrolled marijuana-dependent outpatients in a parent study (a placebo-controlled randomized trial) consisting of 12

* Corresponding author at: NYSPI, 1051 Riverside Drive, Unit 123, New York, NY 10032, USA. Tel.: +1 212 543 6547; fax: +1 212 453 5319.
E-mail address: EA2017@columbia.edu (E. Aharonovich).

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weeks of MET + CBT combined with medication (nefazodone ($n = 7$), bupropion ($n = 9$) or placebo ($n = 4$)). Eligible participants were those aged 18–50 meeting DSM-IV criteria for cannabis dependence. Participants were excluded if they (1) met DSM-IV criteria for current psychiatric disorders requiring intervention (assessed by the SCID) or substance dependence other than cannabis; (2) current use of prescription psychoactive medication; (3) history of seizure disorder or head injury with loss of consciousness >1 h; or (4) prior diagnosis of learning disability. The study was described to patients as assessment of marijuana effects on cognitive functioning. All patients approached agreed to participate and gave written consent as approved by the New York State Psychiatric Institute IRB.

2.2. Neuropsychological measures

All patients were assessed with the computerized Microcog (MC) Assessment of Cognitive Functioning (Powell et al., 1993). This 45–60 min battery is normed and standardized for adults, with population mean scores for each component of 100 (S.D. = 15). Patients also took the Wisconsin Card Sort Test (WCST), Computer Version—2 Research Edition (Heaton, 1999). This 15–20 min non-verbal test assesses executive functioning, including strategic planning, cognitive flexibility, and use of environmental feedback to shift cognitive sets. We report on perseverative error and response scores as they indicate cognitive flexibility and are widely used. The WCST raw scores were transformed to standard scores (mean = 100, S.D. = 15).

2.3. Outcome measures

2.3.1. Retention. Completion was defined as attending ≥75% of the 12 MI + CBT sessions, compatible with standard CBT length (Carroll, 1998) but allowing for the typical mixed compliance in substance abuse treatment.

2.3.2. Level of abstinence. This was indicated by the proportion of urines negative for marijuana out of total possible urines. Drug use levels were analyzed with the THC fluorescence polarization immunoassay (FPIA). The cutoff for positive was ≥50 ng/mL. Missed urines were considered positive.

2.4. Procedures

During treatment, participants attended weekly 60-min individual MET + CBT sessions and gave observed urine specimens twice a week. Urine samples were analyzed for THC and seven other drugs. No participant was positive for any drug except THC when tested. To preclude acute intoxication at testing, patients reported their last marijuana use and submitted observed urine specimens and a breath alcohol test. Participants reporting any new illicit drug or alcohol use <7 h before testing were rescheduled to avoid acute intoxication effects. The neuropsychological battery was administered immediately after the first therapy session during the placebo lead-in week. Patients were paid $20 for completing the battery.

2.5. Statistical analysis

We tested normality assumptions and homogeneity of variance (Levene's test) on each neuropsychological test score. Several Microcog subtest scores were significantly skewed (z-scores 0.002 to −2.631), as were Completed Categories and Failure to Maintain Set from the WCST (z-scores −3.50 and 2.92, respectively). In addition, two subtests had unequal variances between completers and dropouts (WCST Failure to Maintain Set, $p = 0.008$; Microcog Spatial Processing, $p = 0.08$). Therefore, the Wilcoxon Exact Test was used to compare cognitive functioning in completers and dropouts on the summary scores of attention, abstract reasoning, memory, spatial ability, MC composite scores, and WCST scores. WCST scores were missing for two patients. All scores were adjusted for age and education.

To address the relationship of cognitive functioning to abstinence (proportion of negative urines) during treatment, the General Cognitive Proficiency (GCP) score was dichotomized to represent high and low levels of functioning, using the sample median (90.5) as the cut-off. The GCP score was chosen because it combines accuracy and speed, with more weight to accuracy, consistent with methods used previously (Aharonovich et al., 2006). Fisher's Exact Test was used to test differences in proportions between patients defined by categorical variables (completers/dropouts; high/low cognitive functioning). All tests were two-tailed.

3. Results

3.1. Sample characteristics

Completers ($n = 7$) and dropouts ($n = 13$) did not differ significantly on mean age (completers = 30.0, S.D. = 5.0, dropouts = 31.2, S.D. = 9.6); education (completers = 14.6 years, S.D. = 2.8; dropouts = 13.4 years, S.D. = 2.3) or mean years using marijuana (completers = 12.1, S.D. = 7.3; dropouts = 13.1, S.D. = 7.8). They also did not differ on ethnicity (43% of completers, 31% of dropouts were white); full-time employment (57% of completers, 46% of dropouts); being married (14% of completers, 15% of dropouts); using alcohol (29% of completers, 15% of dropouts) or using cocaine (0% of completers, 15% of dropouts). All patients used marijuana daily in the prior 30 days. No observed urine at the time of testing was positive for drugs other than marijuana. The sample had one left-handed completer and one left-handed dropout. Treatment groups (medication vs. placebo) did not differ on retention (completers vs. dropouts; Fisher Exact $p = 0.10$) or marijuana abstinence (Kruskal–Wallis non-parametric test: $\chi^2 = 0.64$, d.f. = 2, $p = 0.74$).

3.2. Observed urine results at treatment entry

Overall mean THC levels prior to testing were 617.5 ng/mL (S.D. = 603.3). Completers and dropouts did not differ on mean THC levels at the time the battery was administered (635.1; S.D. = 943.1 and 607.9; S.D. = 362.3, respectively; Wilcoxon Test, $p = 0.35$). THC levels did not correlate with cognitive functioning indicated by the cognitive proficiency score (r^2 (20) = 0.018; $p = 0.57$).

3.3. Cognitive functioning and treatment retention

Microcog scores among completers ranged from the population mean to about .5 S.D. = above the mean (99.9–107.1). Microcog scores among dropouts ranged from nearly one standard deviation below the population mean to near the population mean (87.7–99.5). Dropouts had significantly lower scores on abstract reasoning, spatial processing and accuracy (Table 1), with similar trends ($p < 0.10$) for general cognitive performance and general cognitive proficiency. For example, completers scored about 0.5S.D. above the population mean on abstract reasoning, while dropouts scored approximately 0.5S.D. below the population mean. In contrast, WCST scores of perseverative errors and responses were near the mean and similar among completers and dropouts.