Journal of Affective Disorders 210 (2017) 265–268

Contents lists available at ScienceDirect

Journal of Affective Disorders

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

Brief report

Behavioral activation treatment for major depression: A randomized trial of the efficacy of augmentation with cognitive control training

Samantha J. Moshier*, Michael W. Otto

Boston University Department of Psychological & Brain Sciences, United States

ARTICLE INFO

Keywords:
Cognitive control training
Major depressive disorder
Rumination
Behavioral activation
Randomized controlled trial

ABSTRACT

Background: Major depressive disorder (MDD) is associated with hypoactivation of the dorsolateral prefrontal cortex, a brain region involved in emotion regulation and basic cognitive control processes. Recent studies have indicated that computerized interventions designed to activate this region may reduce depressive and ruminative symptoms. In this double-blind randomized controlled trial, we tested whether one such program, called Cognitive Control Training (CCT), enhanced treatment outcomes when used in adjunct to brief behavior therapy for MDD.

Methods: Thirty-four adults with MDD were randomly assigned to complete four sessions of either computerized CCT or a control task, concurrently with four sessions of Brief Behavioral Activation Therapy for Depression (BATD). Post-treatment and one-month follow-up assessments were conducted, with self-reported depressive symptoms as the primary outcome and clinician-rated depressive symptoms and self-reported rumination as secondary outcomes.

Results: In both intent-to-treat and completer analyses, depressive symptoms and rumination decreased significantly over the course of treatment in both treatment conditions. There were no significant differences in treatment outcome depending on the augmentation condition.

Limitations: The sample size was small, hindering secondary analyses and identification of potential predictors or moderators of treatment effect.

Conclusions: Results demonstrate substantial clinical benefit following four sessions of BATD; however, adjunctive CCT did not enhance outcomes. This study and other recent research suggest that the effects of CCT may not be as robust as previously indicated, highlighting the need for continued investigation of the conditions under which CCT may be effective.

Cognitive Control Training (CCT) is a computer-based cognitive training intervention designed to activate and strengthen the dorsolateral prefrontal cortex (DLPFC), with the goal of correcting the hypoactivity apparent in these areas during depressed mood states (Siegle et al., 2007). Consisting of two computerized training tasks which take 30 min to complete, CCT is easily implemented, low cost, and brief, making it a potentially efficient, transportable, and cost-effective intervention. Initial studies have shown that low doses of CCT (3–10 sessions over two weeks) may significantly reduce depressive symptoms in both severely (Siegle et al., 2007) and more mildly depressed (Calkins et al., 2014) samples, as well as when administered alone or in combination with transcranial direct current stimulation (tDCS; Brunoni et al., 2014). Preliminary neuroimaging evidence from a small subsample of patients (n=6) also provides support for the purported neural mechanisms of CCT, showing increased DLPFC activation and reduced amygdala activation during an emotional response task (Siegle et al., 2007).

Although CCT was designed as an adjunctive intervention, it has been tested only in adjunct to intensive outpatient (Siegle et al., 2007) or biological (tDCS; Brunoni et al., 2014; Segrave et al., 2014) treatments for depression. It remains unknown whether CCT might enhance treatment outcomes for major depressive disorder (MDD) when used in adjunct to an empirically-supported psychosocial intervention. Accordingly, this investigation tests the efficacy of CCT in adjunct to a four-week version of Brief Behavioral Activation Therapy for Depression (BATD; Lejuez et al., 2011) in a double-blind, randomized trial. Individuals with MDD received four sessions of BATD and were randomly assigned to concurrently complete either four sessions of CCT or four sessions of a sham condition (Peripheral Vision Training; PVT). We hypothesized that relative to those in the BATD +PVT condition, patients in the BATD+CCT condition would demonstrate greater reduction in depression symptoms and rumination, and

* Correspondence to: Boston VA Healthcare System, 150 S. Huntington Avenue, Jamaica Plain, MA 02130, United States.
E-mail address: samantha.moshier@va.gov (S.J. Moshier).

http://dx.doi.org/10.1016/j.jad.2017.01.003
Received 22 September 2016; Received in revised form 27 December 2016; Accepted 2 January 2017
Available online 03 January 2017
0165-0327/ Published by Elsevier B.V.

that this effect would be maintained over the four-week follow-up period.

1. Methods

1.1. Participant enrollment and randomization

Participants were recruited through advertisements and referrals from an outpatient clinic and were required to be between ages 18 and 65 and have a primary psychiatric diagnosis of MDD. Exclusion Criteria included a history of psychotic, bipolar, or neurological disorder or alcohol/substance dependence in the past 6 months; current use of modafinil, or antipsychotic or stimulant medications; or use of an antidepressant or anxiolytic medication if not taken at a stable dose for at least 8 weeks prior to study entry.

Forty-three individuals were evaluated and 37 were eligible to participate. Three participants dropped out prior to treatment randomization. The remaining 34 participants were randomly assigned to CCT or PVT, and 26 participants completed the study (see supplemental materials for study flow chart). Randomization was stratified by severity of depression, and adaptively blocked to ensure similar numbers of treatment completers in each condition. The randomization sequence was generated by the primary author using a computerized random number generator and was not concealed. Randomization was stratified by severity of depression, where a Beck Depression Inventory-II (BDI) score greater than 29 was considered severe (consistent with clinical severity ranges; Beck et al., 1996). The trial was registered with clinicaltrials.gov (identifier NCT01694719) and study procedures were approved by the relevant Institutional Review Board.

There were no significant differences in demographic or baseline clinical characteristics between treatment conditions (Table 1), or between treatment completers (n=26) and non-completers (n=8). Of the eight individuals who dropped out of treatment, seven were assigned to the CCT treatment condition. Reasons for drop-out included changes in work schedule (n=2), a desire to seek a different form of treatment (n=1), and feeling that BATD would not be helpful (n=2). Three participants stopped attending appointments, and their reason for dropout is unknown.

Table 1
Baseline and demographic characteristics of the intent-to-treat sample.

	All participants (N=34)	CCT Group (n=21)	PVT Group (n=13)
Sex, % female (n)	52 (18)	47.6 (10)	61.5 (8)
Age, *Mean* (*SD*)	35.6 (14.6)	36.3 (14.4)	34.38 (15.4)
Race			
Caucasian, % (n)	73.5 (25)	85.7 (18)	53.8 (7)
African American, % (n)	20.6 (7)	9.5 (2)	38.5 (5)
Asian, % (n)	0 (0)	0 (0)	0 (0)
American Indian or Alaskan Native % (n)	0 (0)	0 (0)	0 (0)
Native Hawaiian or Pacific Islander % (n)	0 (0)	0 (0)	0 (0)
Other % (n)	5.9 (2)	4.8 (1)	7.7 (1)
Ethnicity			
Hispanic % (n)	5.9 (2)	4.8 (1)	7.7 (1)
Non-Hispanic % (n)	94.1 (32)	95.2 (20)	92.3 (12)
Education			
No degree	2.9 (1)	4.8 (1)	0 (0)
High School degree	11.8 (4)	9.5 (2)	15.4 (2)
Some college	29.4 (10)	19.0 (4)	46.2 (6)
Bachelor's degree	26.5 (9)	28.6 (6)	23.1 (3)
Graduate training	29.4 (10)	38.1 (8)	15.4 (2)
Current psychiatric medication, % (n)	29.4 (10)	28.6 (6)	30.8 (4)
BDI, *Mean* (*SD*)	29.6 (10.1)	28.8 (9.6)	30.8 (11.0)
MADRS, *Mean* (*SD*)	26.6 (7.6)	26.9 (8.2)	26.2 (6.9)
RRS, *Mean* (*SD*)	58.3 (9.8)	59.1 (7.6)	57.6 (13.2)

Note. BDI=Beck Depression Inventory-II, MADRS=Montgomery-Asberg Depression Rating Scale; RRS=Ruminative Response Scale.

1.2. Measures and procedures

Diagnosis was confirmed using the Structured Clinical Interview for Axis I Disorders for DSM-IV-TR (*SCID-IV;* First et al., 2002*)*. The primary outcome measure was the Beck Depression Inventory-II (BDI; Beck et al., 1996), which was administered weekly (using a modified past-week version for all visits except baseline and one-month follow-up). The Montgomery-Asberg Depression Rating Scale (MADRS; Montgomery and Asberg, 1979), a clinician-rated measure of depression, was a secondary outcome and was administered by trained independent evaluators blind to treatment condition. For analyses of clinical significance, treatment response was defined as a decrease in BDI score of at least 47% and remission was defined as a BDI score of ≤12; these cut-offs were recommended by Reidel et al. (2010) after showing optimal sensitivity and specificity in a sample of 846 patients undergoing treatment. Rumination was assessed with the Ruminative Response Scale (RRS; Nolen-Hoeksema et al., 1993), which contains two subscales: brooding and reflective pondering. Given previous work suggesting that CCT specifically affects brooding rumination, subscale analyses focused on the brooding subscale of the RRS.

1.3. Procedures

Following confirmation of eligibility, participants completed baseline assessment, were then randomized to treatment condition, and began four weekly sessions of BATD. CCT and PVT were completed in the laboratory immediately prior to BATD sessions. Post-treatment assessment took place at Week 5, one week after the fourth and final treatment session. Follow-up assessment took place at Week 8, one-month following the final treatment session.

1.4. BATD Intervention

BATD is a highly structured, goal-directed intervention designed to increase adaptive, rewarding activities. The BATD protocol used in this study was adapted from the 10-session BATD-revised protocol published by Lejuez and colleagues (2011). The core interventions of the 10-session protocol were condensed for delivery within four sessions. The organization of content into four sessions was informed by other brief interventions based on the BATD program (e.g., Daughters et al., 2008; Magidson et al., 2011). Primary treatment strategies include psychoeducation, self-monitoring of daily activities and mood, scheduling of valued activities, and problem-solving around difficulties implementing scheduled activities (see supplement for session outline). Treatment was provided by two doctoral students in psychology who received weekly supervision from a licensed psychologist.

1.5. Computerized experimental tasks

1.5.1. Cognitive control training (CCT) tasks

CCT consists of two computerized tasks which take approximately 25 min to complete. The first is a modified version of the *Paced Auditory Serial Addition Task (PASAT*; Gronwall, 1977; Siegle et al., 2007), a adding task requiring sustained attention and inhibition. The second task is the *Attention Control Intervention* (Wells, 2000), a task designed to train selective attention to specific information by training individuals to attend to multiple auditory sources (e.g., by counting tones, discriminating the location of tones, and moving attention between auditory sources for a prolonged period).

1.5.2. Comparison task

*Peripheral Vision Task (*Siegle et al., 2007; Calkins et al., 2013).