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Behavioral Activation for Depressed Breast Cancer Patients: The Impact of Therapeutic Compliance and Quantity of Activities Completed on Symptom Reduction

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I am submitting herewith a dissertation written by Marlena Maria Ryba entitled "Behavioral Activation for Depressed Breast Cancer Patients: The Impact of Therapeutic Compliance and Quantity of Activities Completed on Symptom Reduction." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Psychology.

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Behavioral Activation for Depressed Breast Cancer Patients: The Impact of Therapeutic Compliance and Quantity of Activities Completed on Symptom Reduction

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DEDICATION

To my beloved family, who always believed in me. This would have remained a dream had it not been for your endless love and support.

Dziękuję.

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ABSTRACT

Behavioral activation (BA) is an empirically validated treatment that reduces depression by increasing overt behaviors and exposure to reinforcing environmental contingencies. Although research has identified an inverse correlation between pleasant or rewarding activities and depression, the causal relation between increased structured activities and reduced depression has not directly been studied. In the context of a recent randomized trial (Hopko et al., 2011), this study used longitudinal data and growth curve modeling to examine relationships among the quantity of activities completed, proportion of activities completed (i.e., therapeutic compliance), environmental reward, and depression in breast cancer patients treated with BATD (n = 23). Results indicated that therapeutic compliance with assigned activities was causally related to depression reduction, whereas the specific quantity of completed activities was not systematically related. Logistic regression indicated that for patients completing all assigned activities, treatment response and remission were nearly certain. Neither therapeutic compliance nor the quantity of completed activities were directly associated with self-reported environmental reward during the BA interval (session three to post-treatment), and environmental reward did not mediate the relation between activation and depression. Study findings are discussed in the context of behavioral models of depression and BA therapy.

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CHAPTER I

INTRODUCTION

Behavioral activation (BA) is the therapeutic process of increasing overt behaviors to facilitate exposure to reinforcing environmental contingencies and subsequent reductions in depression (Hopko, Lejuez, Ruggiero, & Eifert, 2003). BA has evolved significantly in recent decades (Dimidjian et al., 2011; Hopko, Ryba, McIndoo, & File, in press), and with growing empirical support, BA is now considered an empirically validated intervention and is an appealing treatment option for depression across a range of settings (Cuijpers et al., 2007; Ekers et al., 2008; Sturmey, 2009). There is still much to be learned about the process of change in BA, however, and no systematic longitudinal research has explored whether increased activation and environmental reinforcement are in fact central mechanisms of change. Accordingly, in the context of a recently completed randomized trial of BA and problem-solving therapy for depressed breast cancer patients (Hopko et al., 2011), the following study was designed to more clearly explicate the relations among structured BA, environmental reward, and depression.

BA is rooted in behavioral models of depression that implicate decreased response-contingent positive reinforcement (RCPR) for non-depressive behavior as the causal factor in eliciting depression (Ferster, 1973; Lewinsohn, 1974). This reduction in RCPR is attributable to a decrease in the number and range of reinforcing stimuli available to an individual for such behavior, a lack of skill in obtaining reinforcement, and/or an increased frequency of punishment (Lewinsohn, 1974). This view suggests that depressed behavior results from a combination of reinforcement for depressed behavior and a lack of reinforcement or even punishment of more healthy alternative behaviors (Ferster, 1973; Hopko et al., 2003; Lewinsohn, 1974). As a result, depressed individuals often experience significant behavioral inhibition and avoidance behaviors,

the central target of contemporary behavioral treatments for depression: *Behavioral Activation* (BA; Martell et al., 2001) and the *Brief Behavioral Activation Treatment for Depression* (BATD; Lejuez, Hopko, & Hopko, 2001; BATD-R; Lejuez, Hopko, Acierno, Daughters, & Pagoto, 2011). Although BA approaches commonly are based on behavioral principles of reinforcement and functional assessment, specific treatment strategies differ across interventions (Kanter et al., 2010), with activity monitoring and activity scheduling being the two constant features of both BA protocols (Addis & Martell, 2004; Lejuez, Hopko, & Hopko, 2001). The BA method (Martell et al., 2001) incorporates strategies of change including identification of avoidance patterns, teaching functional assessment of behavior, guided activity, mental rehearsal, periodic distraction, mindfulness training, rumination-cued activation, and skills training. Alternatively, BATD focuses on functional assessment of depressed behavior, identification of activities based on individualized goals and a life values assessment, and structured systematic activation using a hierarchy of activities. These contemporary versions of BA are considered more idiographic than conventional behavior therapy (Hopko et al., 2003). Perhaps most importantly, BA and BATD moved away from the assumption that pleasant activities have reinforcing properties and instead focus on environmental contingencies maintaining depressed behavior, unique value systems, and the targeting of avoidance through an emotional acceptance and behavior change paradigm.

Compelling treatment outcome research suggests BA strategies have broad applicability across a wide range of settings and clinical populations. In one of the more compelling studies, behavioral activation was comparable to antidepressant medication and superior to cognitive therapy in treating severe depression (Dimidjian et al. 2006), results that were maintained at 2-year follow-up (Dobson et al., 2008). Behavioral activation also has been effectively used with depressed patients in various settings and among individuals with co-existent medical problems

such as HIV, cancer, brain trauma, and obesity, as well as co-existent psychiatric problems such as anxiety disorders, schizophrenia, and borderline personality disorder (see Hopko et al., in press for a comprehensive review). Three independent meta-analyses support the efficacy of BA in treating depression (Cuijpers et al., 2007; Ekers et al., 2008; Mazzucchelli et al., 2009).

BA models of depression attribute affective change to increases in RCPR for healthy behaviors. Several studies support this model, demonstrating a relationship between depressed mood and the frequency of pleasant activities and increased reinforcement (Grosscup & Lewinsohn, 1980; Hopko, Armento et al., 2003; Lewinsohn & Graf, 1973; Lewinsohn & Libet, 1972; Lewinsohn & Shaffer, 1971; Lewinsohn & Shaw, 1969; MacPhillamy & Lewinsohn, 1974). In a study examining the relation of activation and depression using daily diary methods, self-reported depression was inversely related to general activity level as well as the level of self-reported reward or pleasure obtained through engaging in overt behaviors (Hopko, Armento et al., 2003). Another recent study showed depressed college students engaged less frequently in social, physical, and educational behaviors (Hopko & Mullane, 2008). Although these cross-sectional data are significant, there continues to be a paucity of systematic longitudinal research that adequately demonstrates the process by which therapeutic effects are obtained in BA. The lack of research documenting a causal relationship between exposure to reinforcers and depression reduction was partially due to the lack of available statistical meditational analyses during early stages of BA research. Although three recent studies render support for a relationship between activation and reduced depression via meditational effects of environmental reinforcement (Carvalho & Hopko, 2011; Carvalho, Trent, & Hopko, 2011; Ryba & Hopko, 2012), none of these studies incorporated a sophisticated longitudinal design that allowed examination of a definitive temporal relationship between BA and reduced depressive affect.

A number of theoretical and empirical questions pertaining to BA remain unanswered and warrant continued scientific investigation to better conceptualize and refine behavioral treatments for depression. For example, although BA researchers and theorists implicate activity scheduling (and subsequent exposure to environmental reward) as the primary active component in BA, no systematic research has supported this hypothesis. Indeed, some versions of BA include many treatment components (e.g., skills training, rumination-cued activation, cognitive rehearsal) that raise speculation of whether alternate change mechanisms account for favorable treatment outcomes (Addis & Martell, 2004; Martell, Addis, & Jacobson, 2001). Second, at this stage of BA research it is largely unclear whether the specific quantity of behaviors or the proportion completed (i.e., treatment compliance) is more essential toward conceptualizing positive treatment outcome. Clarification of the process of change in BA would assist mental health providers and facilitate further BA treatment refinement by identifying components of BA that account for significant outcome variance. To address these issues, this study examined relationships among the quantity of activities completed, proportion of activities completed (i.e., therapeutic compliance), environmental reward, and depression reduction in breast cancer patient treated with eight sessions of BATD. Study hypotheses were as follows: (a) the overall quantity of activities assigned would increase as BATD progressed, (b) treatment compliance (i.e., proportion of activities completed) would increase as BATD progressed, (c) increases in the proportion of activities completed would correspond with reduced depression and increased environmental reward, (d) quantity of activities completed would correspond with reduced depression and increased environmental reward, and (e) individuals completing a greater quantity of activities and greater proportion of assigned activities would be more likely to achieve treatment response and remission at post-treatment.

CHAPTER II

METHOD

Participants

Participants were 23 breast cancer patients with a diagnosis of major depression who were treated at the University of Tennessee Medical Center's Cancer Institute as part of a randomized clinical trial (Hopko et al., 2011). All participants provided informed consent prior to study enrollment. Patients were recruited through clinic screening, clinic brochures, and oncologist referral. Patients interested in study participation completed a pre-treatment diagnostic assessment that included the Anxiety Disorders Interview Schedule - IV (ADIS-IV; Brown, Di Nardo, & Barlow, 1994) and self-report instruments outlined below. Advanced doctoral students conducted psychological assessments and were supervised by the principal investigator (DH) in the context of audiotape review and discussion, resulting in a consensus diagnosis. Individuals were eligible to participate if they were above age 18, diagnosed with breast cancer, had a principle (and primary) diagnosis of major depression, and were not psychotic or cognitively impaired. The clinical trial included 80 depressed breast cancer patients, of which 42 were assigned to BATD. For the purposes of this study, only BATD patients who completed and returned all behavioral activation monitoring logs were included (n = 23). The majority of these patients were Caucasian [(91.3%: 8.7% African American) (mean age = 57 years (SD = 11.3)] and had an average education of 15.2 years (SD = 2.2). Marital status was as follows: Married (56.5%), Single (21.7%), Divorced (17.4%), Separated (4.3%). Important as far as assessing representation of the entire BATD sample (n = 42), other than failing to maintain monitoring logs, a series of analyses of variance for continuous variables and chi-square analyses for categorical variables indicated that the study sample (n = 23) and hold-out sample (n = 19)

did not statistically differ on any demographic, cancer-related, or psychological variables, including response and remission rates following BATD (see Hopko et al., 2011).

Assessment Measures

Behavioral Monitoring In BATD, The *master activity log* is used by the clinician to track weekly patient progress. All activities are listed on the master activity log, including: (a) the number of times the patient eventually would like to complete the activity in a 1-week period (i.e., ideal frequency) and (b) the duration of the activity. In the initial session of BATD, fewer activities are monitored, with the number of activities progressively increasing in subsequent weeks as a function of patient success. On the *behavioral checkout* that is maintained by the patient, the frequency and duration of goals for each week also are listed, and the patient records which behaviors are completed on a daily basis. The patient returns the behavioral checkout to the clinician each week, and the information is transferred to the master activity log. If the patient has achieved (or exceeded) goals, the clinician likely will increase the frequency and/or duration for the following week (assuming the patient has not met the ideal goal). If a behavioral assignment was not completed, the clinician and patient decide if the assignment was reasonable, or whether it was excessive or improbable given the patient's abilities. In the former case, the goal might be the same for the next week or its importance (i.e., consistency with life values) re-evaluated. In the latter case, the clinician and patient might strongly consider reducing the weekly goal, and potentially the ideal goal. The rate at which new activities are added can occur slowly or rapidly across patients and generally is determined based on individual circumstances.

The *Beck Depression Inventory-II* (BDI-II; Beck et al. 1996) consists of 21 items rated on a 4-point Likert scale. The BDI-II has excellent reliability and validity in depressed adults (Beck et al., 1996). The psychometric properties of the BDI-II also have been studied in cancer patients

and a medical care sample, with strong predictive validity as it pertains to a diagnosis of clinical depression, strong internal consistency (α = .94), and adequate item-total correlations (Range = .54-.74; Arnau, Meagher, Norris, & Bramson; 2001; Katz, Kopek, Waldron, Devins, & Thomlinson, 2004) (α = .84; Range = 14-60; *M* = 27.0, *SD* = 8.5 for the present study).

The *Environmental Reward Observation Scale* (EROS; Armento & Hopko, 2007) is a 10-item measure that assesses exposure to environmental rewards deemed essential for increasing response-contingent positive reinforcement (RCPR; Lewinsohn, 1974). RCPR is defined as positive or pleasurable outcomes or rewards that follow behaviors [i.e., extrinsic (e.g., social, monetary) or intrinsic (e.g., physiological, feeling of achievement)] and increase the likelihood of those behaviors occurring in the future. Decreased RCPR is a central predictor of increased depression (Lewinsohn, 1974; Lewinsohn & Graf, 1973). Higher scores on the EROS suggest increased environmental reward. Sample items include "the activities I engage in have positive consequences," and "lots of activities in my life are pleasurable." Based on psychometric research with three independent college samples, the EROS has strong internal consistency (α = .85-.86), excellent test-retest reliability (*r* = .85), and correlates strongly with other psychometrically sound measures of depression (*r* = -.63 to -.69) and anxiety (Armento & Hopko, 2007). In this study, internal consistency was adequate (α = .78; *M* = 22.7, *SD* = 4.6).

Behavioral Activation Therapy for Depression (BATD)

BATD focuses on increasing overt behaviors to bring patients into contact with reinforcing environmental contingencies and corresponding improvements in thoughts, mood, and quality of life (Hopko et al., 2003). Within BATD (Hopko & Lejuez, 2007; Lejuez, Hopko, & Hopko, 2001; Lejuez, Hopko, Acierno, Daughters, & Pagoto, 2011), the process of increasing RCPR follows the basic principles of extinction, shaping, fading, and in vivo exposure (Hopko et

al., 2003). Initial sessions involved assessing the function of depressed behavior, establishing patient rapport, motivational exercises focused on the pros and cons of behavioral change, depression and breast cancer psychoeducation, and introduction of the treatment rationale. Within BATD, systematically increased activity is a necessary precursor toward the reduction of overt and covert depressed behavior. Patients began with a self-monitoring (daily diary) exercise to examine already occurring daily activities to provide a baseline measurement and ideas of activities to target during treatment. Patients were asked to keep a daily diary during four days of the week, and to monitor their primary overt behaviors at half-hour intervals (from 8:00 A.M. to 2:00 A.M.). For each behavior, they also were asked to indicate their level of reward or pleasure on a 4-point Likert scale. Following monitoring, emphasis shifted to identifying values and goals within life areas that included family, social, and intimate relationships, education, employment/career, hobbies/recreation, volunteer work/charity, physical/health issues, spirituality, and anxiety-eliciting situations (Hayes, Strosahl, & Wilson, 1999). An activity hierarchy was then constructed in which 15 activities were rated from "easiest" to "most difficult" to accomplish. Using the master activity log and behavioral checkout to monitor progress, patients progressively moved through the hierarchy, from easier behaviors to the more difficult. The process of assigning behavioral activation goals began in session 3. Weekly goals were recorded on a behavioral checkout form that the patient returned to therapy each week. At the start of each session, the behavioral checkout was examined and discussed, with the following weekly goals established as a function of patient success or difficulty. In total, BATD involved 8 sessions of approximately 1 hour in duration.

Therapists and Treatment Integrity

Advanced clinical psychology (doctoral) students served as therapists in this study. All therapists were skilled in the administration of BATD and were trained by the principal investigator (DH). To ensure competent provision of BATD, all sessions were audio taped and all therapists met for weekly individual supervision meetings with the principal investigator (DH). A total of 15% of tapes were selected randomly for ratings of therapist competence and adherence by an independent evaluator with expertise in behavioral therapy (S.D.H., M.A.). Ratings were made on 0- (no adherence/competence) to 8- (complete adherence/competence) point Likert scales on a session-by-session basis, with ratings based on adherence and ability in completing session objectives highlighted in the BATD treatment manual. Consistent with the very high ratings previously reported for the entire BATD sample (Hopko et al., 2011), ratings of sessions conducted with this patient sample indicated high therapist adherence (M = 7.2; SD = 0.7) and competence (M = 6.9; SD = 1.0) to the BATD protocol.

Procedure

Following recruitment and screening procedures, eligible participants were administered the ADIS-IV and all self-report measures. All psychological assessments and treatment sessions were conducted at the Cancer Institute. Advanced doctoral students in clinical psychology conducted the comprehensive assessments. Patients subsequently engaged in their 8-week (one-on-one) treatment. At the beginning of each session, the BDI-II and EROS were completed to assess depression and environmental reward. For the purposes of this study, the master activity logs and behavioral checkouts were reviewed to assess the number of activities assigned and the proportion of activities completed by each patient.

Statistical Analyses

Behavioral activation assignments commenced in the third session, meaning that the impact of the quantity and proportion of activities completed as they related to depression and environmental reward began to be assessed at week four of treatment through the post treatment assessment. Accordingly, the longitudinal data consisted of six observations (i.e., sessions 4 through 8 and post-treatment). Growth curve modeling was used to test levels of change in a dependent variable over time and incorporated within- and between-subjects predictors. The general model was as follows:

$$DV_{it} = \gamma_{0i} + \gamma_{1i}(\text{Time})_{it} + e_{it}$$

The value of the dependent variable for patient *i* at time *t* was equal to a subject-specific intercept plus a subject-specific time slope. Setting $t_1 = 0$, $t_2 = 1$, $t_3 = 2$, and so on, the intercept γ_{0i} is the expected value for patient *i* at the first observation. If the expectation is that all patients have a similar baseline score that is not dependent on other variables, it can be written as a function of the overall average baseline across all individuals plus a random noise component representing person-specific differences from the mean.

$$\gamma_{oi} = \beta_{00} + r_{0i}$$

The value of γ_{1i} reflects how rapidly each patient's score on the dependent variable changes over time. Because each patient has her own growth trajectory, differences in the intercept and slopes are also modeled by individual-specific covariates. For example, it is expected that depression severity declines more quickly as patients engage in more activities. Thus, we can model γ_{0i} as a function of total activities completed (or proportion completed).

$$\gamma_{1i} = \beta_{10} + \beta_{11}(\text{Total Activities}) + r_{1i}$$

Substituting:

$$DV_{it} = \beta_{00} + \beta_{10}(\text{Time})_{it} + \beta_{11}(\text{Total Activities})(\text{Time})_{it} + r_{0i} + r_{1i}(\text{Time})_{it} + e_{it}$$

where the coefficient β_{11} on the interaction tests the significance of total activities completed on time. Because there is an interaction, a main effect for total activities completed also is included. This is done by adding total activities completed to the model for the intercept.

$$\gamma_{oi} = \beta_{00} + \beta_{01}(\text{Total Activities}) + r_{0i}$$

This yields the final model:

$$DV_{it} = \beta_{00} + \beta_{01}(\text{Total Activities})_{it} + \beta_{10}(\text{Time})_{it} + \beta_{11}(\text{Total Activities})(\text{Time})_{it} + r_{0i} + r_{1i}(\text{Time})_{it} + e_{it}$$

The beta parameters represent fixed effects, or the average slopes and intercept across all patients in the sample. The *r* parameters represent random effects. They are not estimated as traditional regression coefficients. Rather, they are summarized by their variances as variance components. The larger the variance component, the greater the variability in growth trajectories between patients.

The previous model represents a between-subjects analysis, since it uses the total number of activities completed across time as the primary predictor. The data also contain week-specific values for the number of activities completed and proportion completed. Growth models also allow for the inclusion of time varying predictors. In this case, the model simplifies to:

$$DV_{it} = \beta_{00} + \beta_{10}(\text{Time})_{it} + \beta_{20}(\text{Activities})_{it} + r_{01} + r_{1i}(\text{Time})_{it} + e_{it}$$

Due to perfect multicolinearity between the time-varying activities measure and the total activities completed variable, the within-subjects model was tested separately from the between-subjects model. Both were estimated to determine whether there were differences between week-

specific activities completed and the total number of activities completed across the assessment period. The models described were all estimated using the MIXED command in SPSS 20.

Finally, it is also possible to test for mediation using a growth curve model, although it is more complicated for longitudinal relative to cross-sectional data (Selig & Preacher, 2009). Testing mediation is simplified in within-subjects analyses, since the between-subjects model involves an interaction. The process for within-subjects data amounts to fitting a simultaneous equations model in which the activities variable is both a predictor of depression severity and an outcome determined by environmental reward. Due to the fact that both equations involve random effects (as they are both growth models with time-varying variables), this part of the estimation was done using Mplus 6.1. Standard errors for the indirect effects were estimated using bootstrapping.

The first hypothesis was that the number of activities assigned would increase as therapy progressed. For this hypothesis, the number of activities at time point *t* was the dependent variable in a growth model, and time was the sole predictor. The second hypothesis was that general compliance (proportion of activities completed) would increase as therapy progressed. This assertion was tested in the same manner as the first hypothesis, except that proportion of activities completed was the dependent variable. The third hypothesis pertained to how much depression severity changed as the proportion of activities completed increased. In this case, depression was the dependent variable in the growth model. In the between-subjects model, the total proportion of activities completed was the predictor, and its interaction with time was tested to determine if a higher level of compliance resulted in quicker reductions in depression. A within-subjects analysis determined if variations in weekly compliance had short-term effects on depression. A mediation analysis assessed whether any observed relationship between

compliance and depression was partially or fully accounted for by the relationship between compliance and environmental reward. The third hypothesis also proposed that compliance (proportion of activities completed) would lead to increased environmental reward. Due to the simultaneous equations used to test mediation in hypothesis 3, this test was integrated into the same model. Specifically, the model included an equation in which environmental reward was a direct consequence of compliance. If the coefficient for the effect of compliance on reward was significant, hypothesis four would be supported. The fourth hypothesis was similar to the third, except total activities completed, rather than proportion completed, was the dependent variable. The same tests for direct effects and mediation were conducted. The fifth hypothesis was that the proportion of activities and quantity of completed activities would significantly impact treatment response and remission. Because each of these dependent variables was measured on a dichotomous scale, logistic regression was used. The independent variables were total proportion of activities completed and total quantity of activities completed. Results are reported as odds ratios, where a one unit increase in the proportion of activities completed (or quantity of activities completed) is associated with a β increase in the odds of response or remission.

Response and Remission Criteria

Consistent with methods highlighted in previous trials of behavioral activation (Dimidjian et al., 2006; Hopko et al., 2011), response represented significant symptomatic improvement, whereas remission represented improvement to the point of being asymptomatic within normal range. On the BDI-II, response was defined as at least a 50% reduction from baseline. Remission was defined as scores $\leq$ 10 on the BDI-II.

CHAPTER III

RESULTS

Supporting the first hypothesis and consistent with the progressive framework of BATD, results indicated that the number of assigned activities and number of completed activities significantly increased over time. As illustrated in Figure 1, during the first week of behavioral activation assignments, the average number of assigned activities was 12 (95% CI 9.29, 14.62), nearly doubling to 23.39 (95% CI 17.84, 28.94) at the conclusion of treatment. Additionally, there was greater variability in the number of assigned activities at the end of treatment. The number of activities assigned was expected to increase weekly by 2.16 (SE = .49, $p < .01$). However, the rate of increase was higher for some individuals and lower for others ($\sigma^2 = 4.35$, SE = 1.66, $p = .01$). There was also significant variability in the initial number of assigned activities ($\sigma^2 = 29.36$, SE = 14.21, $p = .04$). Patients who initially had fewer assigned activities had more substantial increases throughout treatment, consistent with the philosophy of BATD whereby reinforced behaviors result in improved affect and increased motivation to pursue larger-scale behavioral goals. The trend of completed activities over time is highlighted in Figure 2. During the first week of treatment, the average number of completed activities was 12.91 (95% CI 9.90, 15.93) and 22.56 (95% CI 17.03, 28.10) in the final week. Patients on average completed an additional 1.9 (SE = .51, $p < .01$) activities each week.

When examining hypothesis 2, results were non-significant and indicated that the proportion of activities completed did not systematically increase during the course of BATD (B = -.01, SE = .01, $p = .36$). As illustrated in Figure 3, following the first assignment, the average proportion of activities completed was 1.12 (95% CI .95, 1.30), compared with 1.00 (95% CI .85, 1.16) following the final activation session. The proportion of activities completed was

essentially unchanged over time, primarily due to a ceiling effect whereby all patients were largely compliant with behavioral activation assignments.

Results partially supported hypotheses 3 and 4. Figure 4 displays depression severity as a function of treatment session. Significant patient improvement was evident across behavioral activation sessions, whereby during the first week, the average BDI-II score was 14.83 (95% CI 11.53, 18.13), decreasing to 10.04 (95% CI 6.87, 13.21) by the final week of BATD. Figure 5 also shows a trend for increased environmental reward over time as a function of behavioral activation, with initial environmental reward of 26.13 (95% CI 24.45, 27.81) increasing to 29.22 (95% CI 27.34, 31.06) by the final week of treatment. Between-subjects analysis demonstrated that the average proportion of activities completed was significantly associated with decreased depression (B = -13.53, SE = 6.97, $p < .05$). The interaction between average proportion of completed activities and time was tested to determine if higher levels of compliance led to faster reductions in depression. The interaction was not significant (B = -.12, SE = 1.11, $p = .91$). When a similar model was applied with environmental reward as the dependent variable, the average proportion of activities completed did not have a significant main effect (B = 2.19, SE = 3.69, $p = .56$) or interaction with time (B = .33, SE = .68, $p = .63$).

Within-subjects analysis incorporated week-specific values for proportion of completed activities. The results reinforce findings from the between-subjects model. As the proportion of activities completed in a given week increased, depression severity also decreased for that week (B = -4.04, SE = 1.40, $p < .01$). This result was observed beyond the general trend of diminishing depression severity, which was also significant (B = -1.24, SE = .27, $p < .01$). Thus, higher levels of compliance with behavioral activation assignments were effective in attenuating depression. As in the between-subjects model, the within-subjects model showed that compliance did not

have an effect on environmental reward. That is, the proportion of activities completed in a given week was not significantly related to that week's score on the environmental reward scale (B = .94, SE = .81, p = .25), although the time trend was significant (B = .65, SE = .12, p < .01). With no evidence that proportion of completed activities had a significant effect on environmental reward, it was unlikely that the relationship between proportion of completed activities and depression was mediated by environmental reward. A multilevel mediation model confirmed there was no indirect effect (B = .026, SE = .037, p = .48).

When the total number of completed activities rather than proportion of completed activities was the primary predictor, quantity of completed activities did not affect depression severity either directly (B = -.03, SE = .05, p = .53) or through its interaction with time trend (B = .00, SE = .01, p = .70). Only the time trend was significant in the model, with average depression severity decreasing each week (B = -1.48, SE = .78, p < .05). Similarly, findings showed a null effect of total completed activities on environmental reward. The main effect of total activities completed was not significant (B = .01, SE = .02, p = .71), and neither was the interaction with time (B = .00, SE = .00, p = .89). This was also demonstrated in the within-subjects models, with total activities completed in a given week having no effect on that week's depression score (B = .00, SE = .06, p = .94), and no effect on the respective week's environmental reward score (B = -.02, SE = .03, p = .59). With no effect of quantity of completed activities on depression severity or environmental reward, the key components of mediation were absent. Estimating a mediation model in Mplus yielded an insignificant within-subjects indirect effect of -.966 (SE = 1.128, p = .39), confirming the lack of mediation.

Logistic regression was used to examine hypothesis 5, whether treatment response and remission were more likely to occur with a greater proportion of activities completed and greater

quantity of activities completed. For treatment response, the average proportion of activities completed was significant (-21.19, SE = 9.33, *p* = .02). When patients completed all assigned activities, BDI-II treatment response was almost always observed (exp (B) < .01, 95% CI .00, .06). The high pseudo R^2 values (Cox Snell = .44, Nagelkerke = .64) also suggested very strong effect sizes. For depression remission, results were again significant (B = -9.97, SE = 4.95, *p* = .04). The odds ratio suggested that for those patients who completed all assigned activities, the odds of not achieving remission were essentially zero (exp (B) < .01, 95% CI .00, .77). Model fit statistics indicated that the proportion of activities completed was a good predictor of remission outcomes (Cox Snell = .27, Nagelkerke = .38). No effect was found when considering the predictive power of quantity of completed activities on BDI-II treatment response (B = -.01, SE = .01, p = .55; exp (B) = .99, 95% CI = .97, 1.02) or remission (B = .00, SE = .01, p = .79; exp (B) = 1, 95% CI .98, 1.02). Thus, relative to quantity of activities completed, treatment compliance was a better predictor of treatment outcome.

CHAPTER IV

DISCUSSION

Contemporary BA treatments aim to attenuate depression via increased response-contingent positive reinforcement. Although specific intervention strategies differ across BA protocols, structured activation assignments are common to all approaches. This study examined longitudinal data to better explicate the process of change in BATD via growth curve modeling and examining relationships among the quantity of activities completed, proportion of activities completed (i.e., therapeutic compliance), environmental reward, and depression reduction. Findings demonstrate that while the average number of assigned and completed activities systematically increased over time, there was no progressive change in therapeutic compliance, with overall compliance exceptionally high throughout psychotherapy. Extraordinary patient compliance with BATD may be reflective of a number of patient-centered, therapy-related, and social and economic factors, and potentially high therapist competence in assigning and reviewing homework (Jin, Sklar, Oh, & Li, 2008; Weck et al., 2013). This finding is significant in that it supports the feasibility and tolerability of BATD for patients presenting with complex clinical presentations including a co-existent psychological disorder and medical illness.

When examining the effect of therapeutic compliance and quantity of completed activities on depression, study hypotheses were partially supported. Results indicated that from pre- to post-treatment, depression decreased as patients completed a higher proportion of activities. On a more micro-analytical level, results revealed systematic reductions in depression during weeks where therapeutic compliance was highest. Somewhat unexpectedly, there was no significant effect on depression as a function of increased quantity of completed activities. Therefore, results suggest patient adherence to behavioral assignments is more critical in

reducing depression relative to simply completing a greater number of activities. In fact, when examining the impact of therapeutic compliance on treatment response and remission, results were highly compelling and emphasize the importance of patient compliance toward positive BATD treatment outcome. Indeed, patient compliance with activation assignments resulted in an almost certain favorable BATD treatment outcome. In terms of understanding BATD process of change, completing a greater proportion of assigned activities not only presumably increases response-contingent positive reinforcement, but also likely facilitates greater self-efficacy, accomplishment and mastery within valued life areas, and subsequent reductions in depression.

The finding of a limited relationship between quantity of activities completed and depression reduction is somewhat inconsistent with previous research showing a positive correlation between activity level and elevated mood. Accounting for this finding, it is conceivable that as the quantity of behavioral assignments increases, their significance pertaining to identified life values decreases. Indeed, initial behavioral assignments are not only prescribed according to their level of difficulty, but also their relevance toward addressing the most important life values and their significance toward achieving the most principal life goals. Accordingly, a greater breadth of assigned behaviors may involve activities becoming more generic, less salient in terms of being value-based and directly related to immediate life goals, and consequently less apt to result in environmental reinforcement and decreased depression. Another possible explanation may be related to the process of activity scheduling that involves assigning activities of progressively increasing difficulty (e.g., they require more time or effort, require underdeveloped skills, are associated with more anxiety, and avoidance motivation is stronger). With increased behavioral assignments, this process may involve inclusion of activities with less potential reinforcement value and possibly greater likelihood of aversive or

unpleasant experiences and consequences that might prevent depression attenuation (e.g., lack of success, heightened anxiety).

Analyses of the role of environmental reward revealed unexpected results given previous studies demonstrating the meditating effects of reinforcement on the relationship between behavioral activation and depression (Carvalho & Hopko, 2011; Carvalho, Trent, & Hopko, 2011; Ryba & Hopko, 2012). Current findings yielded no support for either the proportion or quantity of completed activities as significantly related to self-reported environmental reward. However, study limitations should be taken into account when interpreting this finding, particularly the self-report method of assessing reinforcement. Because direct measurement of reinforcement would require direct observations of environmental contingencies across time and is not overly pragmatic, self-report strategies of assessing environmental reward, pleasure, and reinforcement is the common alternative. As such, environmental reward as measured in the current study may be an inadequate proxy for actual response-contingent positive reinforcement experienced in the natural environment.

Important to highlight, it would be premature to suggest environmental reinforcement is not a central mechanism of change in BATD. For example, the sudden gain literature suggests the beneficial effects of BATD are at least partially independent of the activation process itself, with 50% of sudden gains, or large symptom improvements between one treatment interval, occurring prior to the activation process that commences in session three (Hopko, Robertson, & Carvalho, 2009; Kelly et al., 2007; Tang & DeRubeis, 1999). This means that sudden gains may be partially reflective of developing therapeutic alliance, psychoeducation, environmental modification (i.e., reducing reinforcement for depressed behavior), and structured value assessment that occur in the first two BA sessions. Additionally, it is conceivable that sudden

gains partially reflect self-activation in the absence of therapist guidance. The important point here is that in the context of methodological problems with directly measuring environmental reinforcement and frequently large reductions in depression that occur prior to activation (that may partially result from increased social reinforcement), environmental reinforcement may remain highly operative as a change mechanism in the greater scope of BATD.

Although findings are noteworthy, several important study limitations are noteworthy. First, a larger sample size would have increased power and confidence in study findings. Second, as this study followed from a randomized clinical trial and was not specifically designed to account for all possible mechanism of change factors, future work should assess the impact of common factors on treatment outcome (e.g., therapeutic alliance, level of therapist reinforcement, patient self-efficacy). Third, as discussed, the ideal method of assessing reinforcement via direct observations of environmental contingencies was not feasible, resulting in the use of a self-report measure of environmental reward. As "environmental reward" is not synonymous with "environmental reinforcement," no definitive conclusion can be drawn about the relationship of reinforcement with treatment response to BATD. Although still not optimal, the Reward Probability Index (RPI; Carvalho et al., 2011) may have been a preferred proxy measure of environmental reinforcement as unlike the EROS, the RPI better assesses the construct of response-contingent positive reinforcement (i.e., number of potential reinforcers, availability of reinforcers, ability to obtain reinforcement, and exposure to aversive events; Lewinsohn, 1974). Fourth, daily diary logs were used to track activity assignments and completion. Although patients received careful instruction and reported procedural adherence, it cannot be definitively stated that activities were logged reliably or accurately. Fifth, the study examined the quantity and proportion of completed activities but did not differentiate among

types of activities (e.g., social, physical, educational). Categorization of activities may have provided a more detailed understanding of whether engagement in certain types of activities was relevant in the process and outcome of BA. Finally, since the study examined process of change among a highly educated and largely Caucasian sample of depressed breast cancer patients, further inquiry into the generalizability of study findings to other patient samples is warranted.

In closing, study findings provide novel insight into the process and outcome of BA and have important clinical and research implications. Results highlight the efficacy of BA and suggest therapeutic compliance is a vital component toward increasing the probability of positive treatment outcome. Highly provocative, findings also suggested that "more" behavioral activation as defined by an increased quantity of completed behaviors does not necessarily correspond with improved treatment response. Further research should more systematically examine dose-response relationships associated with BA while also being mindful of whether certain categories or types of activities are more relevant toward conceptualizing treatment outcome. Given the empirical support and practicality of BA, continued investigation of process factors is warranted. Dismantling studies of treatment components of differing BA approaches also may be beneficial toward better isolating strategies most essential to engendering healthy behaviors. In addition, although factors associated with treatment failure in behavior activation have been discussed that include non-compliance with behavioral assignments (Hopko, Magidson, & Lejuez, 2011), strategies most effective in promoting compliance with activation are largely unknown and require further investigation. The uncomplicated and easily disseminated approach of BA has many potential applications in a broad range of clinical settings and by a diverse network of providers (Ekers et al., 2011). The more precisely the

process of change is understood, the better equipped researchers and clinicians will be to further refine and deliver the most parsimonious and efficacious form of BA.

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APPENDIX

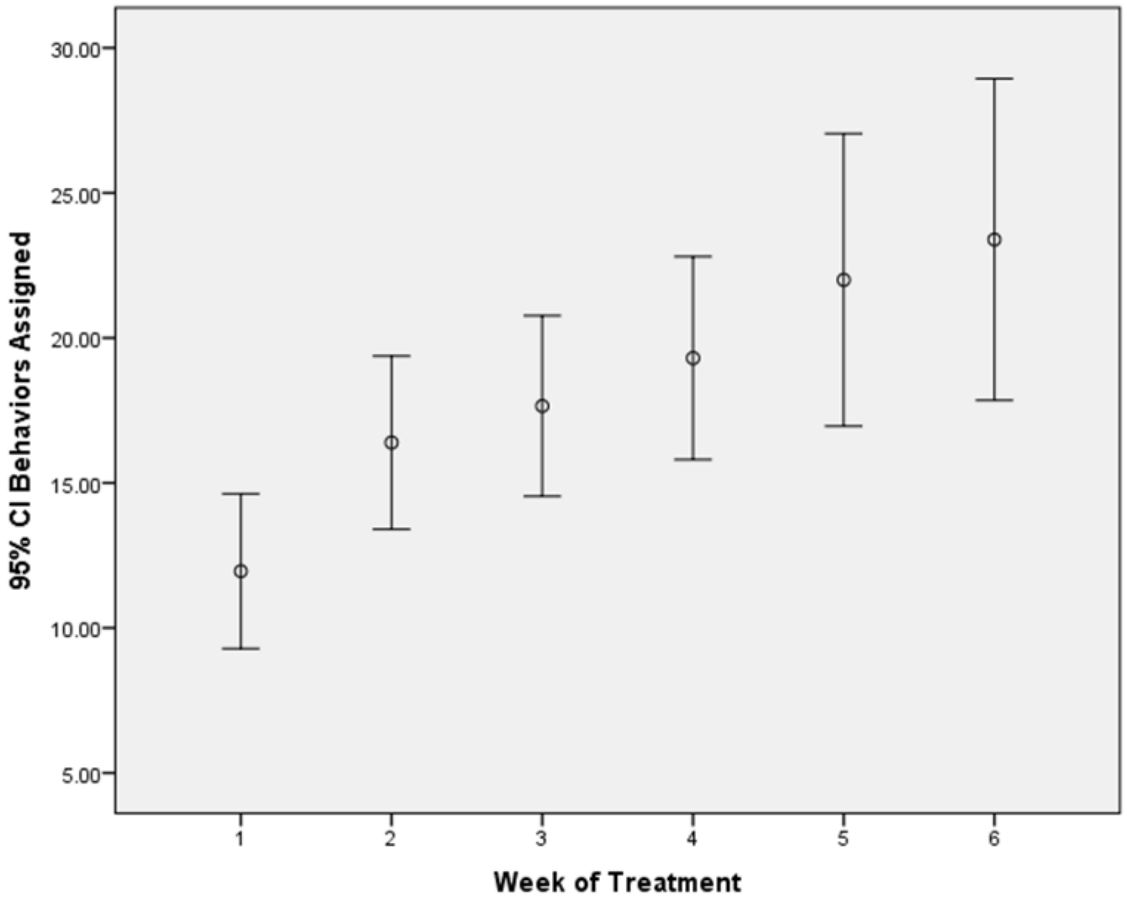

Figure 1

Average Number of Assigned Behaviors

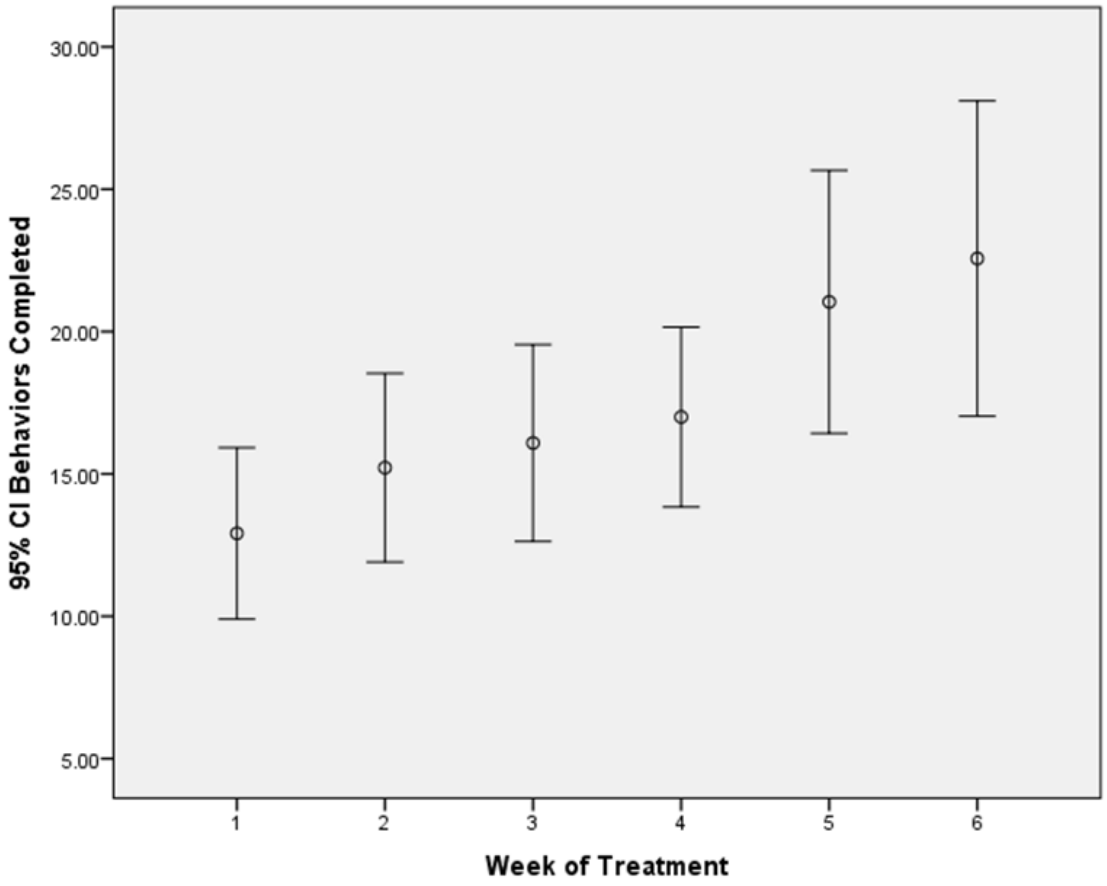

Figure 2

Average Number of Completed Behaviors

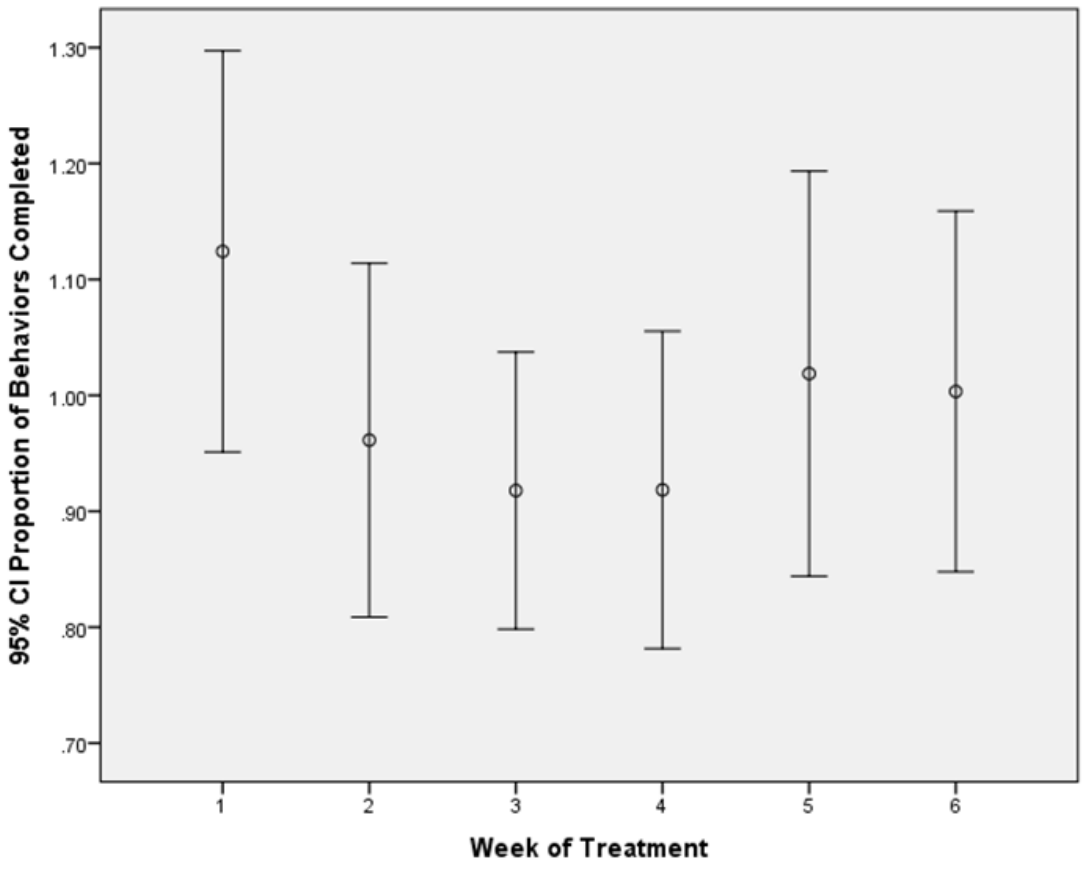

Figure 3

Proportion of Completed Behaviors

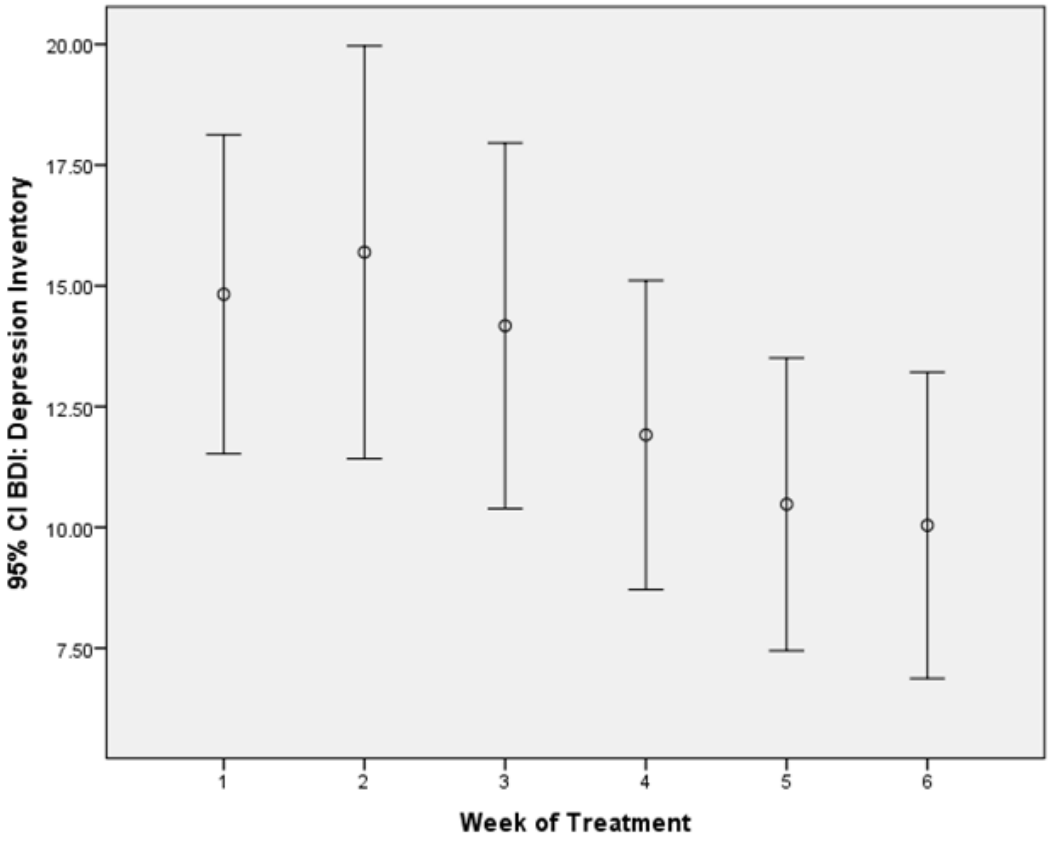

Figure 4

Average Depression (BDI-II) Scores

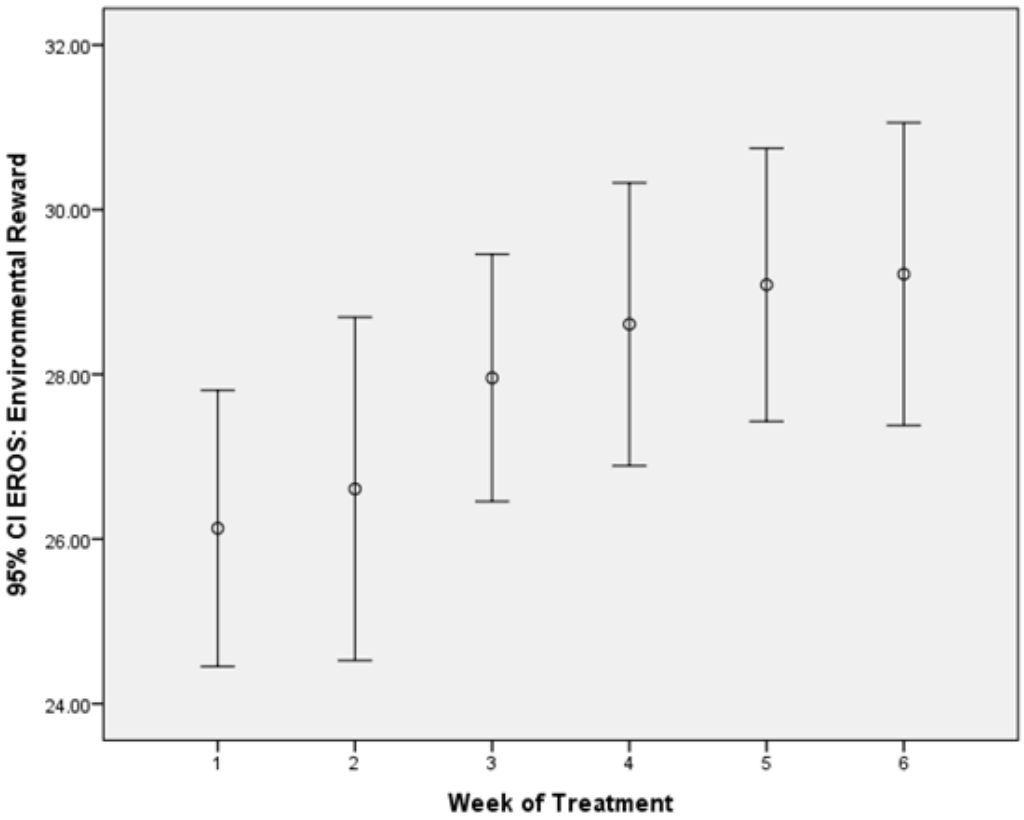

Figure 5

Average Environmental Reward (EROS) Scores

VITA

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