

The Role of Mindfulness and Emotion Regulation in Dialectical Behavioural Therapy for Borderline Personality Disorder

**by
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Higher Diploma, Trinity College Dublin, 2018
Bachelor of Arts, Dublin City University, 2014

Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Arts

in the
Department of Psychology
Faculty of Arts and Social Sciences

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Spring 2021

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Abstract

Despite substantial research demonstrating its effectiveness in the treatment of borderline personality disorder (BPD), few studies have investigated mechanisms of change for dialectical behavior therapy (DBT). Improvements in mindfulness and emotion regulation have been highlighted as potential mechanisms. This study examined the time course of, and associations between, mindfulness, emotion regulation and BPD symptoms during DBT. Participants were 240 self-harming adults with BPD who were randomly assigned to receive 6- or 12-months of DBT. Results from changepoint analysis indicated that changes in emotion regulation preceded changes in mindfulness. Contrary to hypotheses, cross-lagged analyses did not indicate mediational effects of mindfulness or emotion regulation on the association of either variable with change in BPD symptoms. Supplemental analyses, however, suggested that changes in emotion regulation mediated the inverse association of changes in mindfulness with changes in BPD symptoms. Findings highlight patterns of change in proposed mechanisms of change in DBT.

Keywords: dialectical behavior therapy; borderline personality disorder; mindfulness; emotion regulation; mechanisms

Dedication

For my mother who taught me to pursue my dreams – thank you for being my rock.

Acknowledgements

I would like to thank Dr. Alexander Chapman, my senior research supervisor, for providing guidance and feedback throughout this project. I am forever grateful for his expertise and support. A special thanks also to my supervisor, Dr. Michael Maraun, whose support and mentoring with the statistics really allowed my studies to go the extra mile (you have the patience of a saint!).

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Introduction

Borderline Personality Disorder (BPD) is a debilitating mental illness marked by unstable interpersonal relationships and identity, emotion dysregulation, impulsivity, self-harm, and suicidality (Leichsenring et al., 2011). Epidemiological research suggests BPD occurs in 2-6% of the general population (Grant et al., 2008), approximately 10% of psychiatric outpatients (American Psychiatric Association, 2013), and 15-25% of inpatients (Torgersen et al., 2013). Further, BPD is associated with a high prevalence of self-harm and suicide, with estimates suggesting that the prevalence of mortality by suicide among those with BPD is 8-10% - approximately 50 times higher than that of the general population (American Psychiatric Association, 2001). Considering its prevalence and severity, BPD is also one of the most expensive psychiatric conditions to treat, consequently posing a high economic burden to society (Soeteman et al., 2008).

Theoretical Framework

Biosocial developmental theories of BPD have emphasized the transaction of key biological vulnerabilities for high emotionality and impulsivity with abusive or invalidating rearing environments (Crowell et al., 2009, 2014; Linehan, 1993a, 1993b, 2015). Vulnerability towards high emotionality can be conceptualized as comprising of three core components; including a low threshold for emotion elicitation, intense emotional reactions, and a slow return to their emotional baseline. An invalidating rearing environment is one where the child's communications of their internal experiences (i.e., emotions, thoughts, and sensations) are regularly rejected (i.e., dismissed, criticized, or pathologized), emotion escalation (i.e., extreme expression of emotions) is intermittently reinforced through the inconsistent provision of attention or support, and the child's concerns or problems are trivialized. According to the biosocial theory, emotion vulnerability and the invalidating environment transact, exacerbating each other and result in the development of pervasive emotion dysregulation. Emotion dysregulation increases the risk of other characteristic behaviours (e.g., non-suicidal self-injury [NSSI], suicide attempts, substance abuse, and risky sexual behaviour) associated with BPD, which are often negatively reinforced through the alleviation of emotion dysregulation. For example, research has shown that a desire to regulate emotions often motivates NSSI (Kleindienst et al., 2008; Brown et al., 2002; Chapman et al., 2006).

Since the development of Linehan's biosocial theory, the developmental literature on psychopathology and emotion regulation has proliferated, resulting in an expanded biosocial developmental theory of BPD (Crowell et al., 2009, 2014). This theory purports that trait impulsivity moderates the effects of the invalidating environment on the development of emotion dysregulation (Crowell et al., 2009). As such, emotion dysregulation is seen as developing among vulnerable children (i.e., those with heightened trait impulsivity), in the context of an invalidating rearing environment, particularly through coercive family interaction processes and the reinforcement of extreme emotional responses (Patterson, 1982). These responses become entrenched and lead to maladaptive coping behaviours in adolescence, which can be considered precursors to the development of adult BPD.

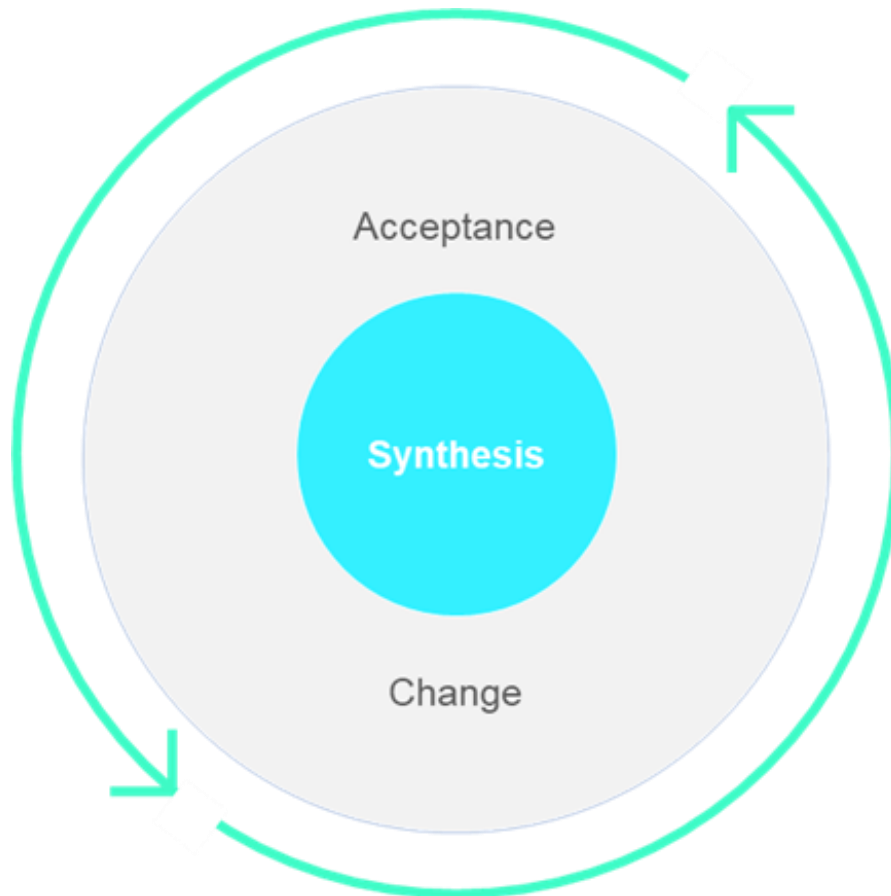
Based on this conceptualization, deficits in emotion regulation are considered central to the symptoms and behavioural problems characteristic of BPD. Accordingly, well-established treatments for BPD (e.g., dialectical behaviour therapy, or DBT), emphasize strategies and skills aiming to improve emotion regulation (Linehan, 1993a, 1993b).

Dialectical Behaviour Therapy

Dialectical Behavioural Therapy (DBT) is a cognitive behavioural treatment that was originally developed by Marsha Linehan (1993) to treat women with a history of chronic suicidal behavior. The National Institute for Health and Clinical Excellence (NICE) guidelines and the Australian National Health and Medical Research Council have both endorsed DBT as the frontline treatment for BPD with the largest evidence base (Ali & Findlay, 2016; NHMRC, 2013).

DBT is underpinned by four theoretical and philosophical pillars: dialectical philosophy, radical-behaviourism, Zen philosophy, and the biosocial theory (Linehan, 1993b, 1993a, 2015). Dialectical philosophy provides a framework for conceptualizing the balance and synthesis of acceptance-oriented approaches deriving from Zen practice with change-oriented approaches consistent with contemporary behavioural and cognitive therapy; this is visualized in Figure 1.

Figure 1. The dialectic between acceptance (the Zen-based mindfulness components) and change (the radical-behaviourist components) lies at the heart of DBT.



The biosocial theory is the fourth pillar underpinning DBT (Linehan, 1993a, 1993b, 2015). As discussed earlier, the biosocial theory emphasizes genotypic vulnerabilities for emotion dysregulation in combination with an invalidating and/or abusive rearing environment in the etiology BPD. This inadequate early environment is associated with deficits in the capacities or skills needed to effectively regulate emotions and behaviors and navigate interpersonal relationships. Thus, the primary aim of DBT is to help clients learn the new behaviors and skills needed to build lives they experience as worth living.

Structure

DBT is a comprehensive treatment often completed over 12 months. The standard treatment structure includes: weekly group skills training sessions (1.5 – 2.5

hours), weekly therapy sessions (1 hour), as-needed phone consultation with the therapist to help the client generalize skills learned in therapy to everyday life, and a weekly therapist consultation team meeting (1 – 2 hours).

There are four group skills training modules: mindfulness, emotional regulation, interpersonal effectiveness, and distress tolerance. It typically takes 24-26 weeks to complete all modules and clients receiving 12 months of DBT complete two cycles of DBT skill modules. Mindfulness skills are normally taught in 2-week segments, while the other three modules are completed in 6-8 week segments.

The hour-long weekly individual therapy sessions are an opportunity for the client to work through difficulties that arose for them over the course of the previous week. Priority is given to dealing with suicidal and self-injurious behaviours, followed by therapy treatment interfering behaviours, quality of life concerns, and other treatment targets (Linehan, 2015). Individual therapy sessions are also an opportunity for the client and therapist to reinforce skills learned during the group training sessions (Linehan, 2015).

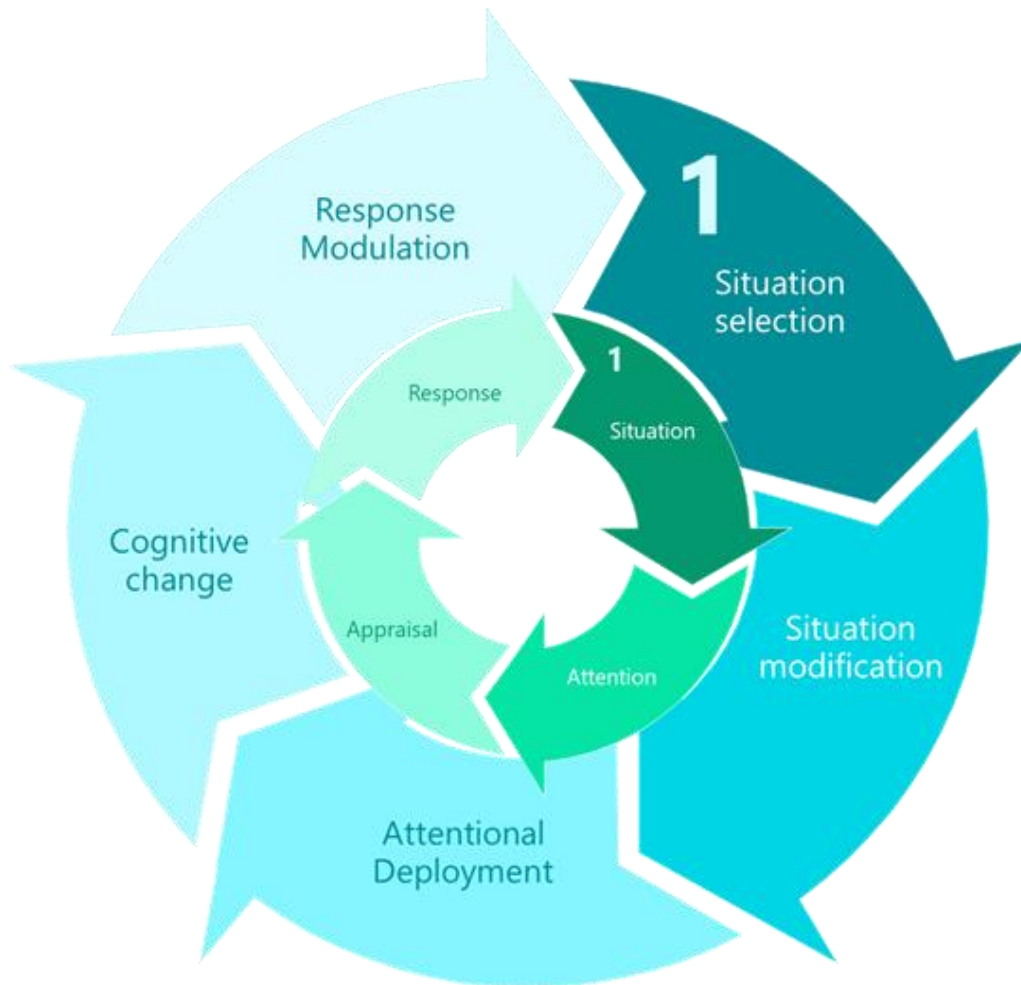
Proposed Mechanisms of Change in DBT

Although a substantial body of evidence supports the effectiveness of DBT in treating BPD and related clinical problems (Koons et al., 2001; Linehan, Armstrong, Suarez, Allmon, & Heard, 1991; Linehan et al., 2006, 2002, 1999; Turner, 2006; Verheul et al., 1990), research into the mechanisms behind such effects is still in its nascent stages. In an early theoretical review exploring potential mechanisms of change in DBT, Lynch and colleagues proposed that mindfulness, validation, behavioural targeting and chain analysis, and the application of dialectical principles may induce change in DBT (Lynch et al., 2006b). The authors also discussed the processes by which these mechanisms may operate. Relevant to this thesis, mindfulness was proposed to operate through behavioural exposure and learning new responses to emotionally evocative situations, improving emotion regulation, and reducing literal belief in rules (Lynch et al., 2006b). More recently, Rudge and colleagues conducted a critical review of research on mechanisms of change in DBT and CBT for BPD (Rudge et al., 2017). The authors identified 12 relevant papers examining mechanisms of change in DBT. Three broad mechanisms were identified: emotion regulation/self-control, DBT skills use, and therapeutic alliance/investment in treatment (Rudge et al., 2017).

Emotion Regulation as a Mechanism of Change

Emotion regulation can be defined as a goal-oriented action, initiated to up- or -down regulate the degree and duration of an emotional response (Gross et al., 2011). According to the prevailing theory of emotion regulation, the process model, there are four stages to emotion generation (situation, attention, appraisal, response), and these four stages are associated with five opportunities for emotion regulation (situation selection, situation modification, attentional deployment, cognitive change, and response modulation) (Gross, 1998, 2013). The model is cyclical as the emotion generated, or emotion regulation strategy implemented, alters the situation and causes another situation to arise (Gross, 1998, 2013); this is outlined in figure 2.

Figure 2. The Process Model of Emotion Regulation



Different emotion regulation strategies influence different stages of the emotion generation trajectory, and consequently have different outcomes. In DBT, emotion regulation is taught around three broad goals. Firstly, individuals are taught to understand and label their emotions (appraisal stage). Secondly, they are taught to reduce emotional vulnerability by taking care of their physical and psychological wellbeing (e.g., by avoiding drug use, engaging in good sleep hygiene, eating well, exercising regularly, mastering skills, etc.). Finally, they are taught to decrease emotional suffering by engaging in mindful awareness of emotions as they arise, engaging in behaviors that run counter to the emotional response (opposite action), and examining their thoughts and appraisals of emotionally evocative events (checking the facts) (Linehan, 2015).

Emotion regulation has been examined as a potential mechanism of change in DBT. In a study examining the relationship between emotion regulation and substance use frequency in women with BPD and comorbid substance use disorder undergoing DBT, Axelrod et al. (2011) found that changes in self-reported emotion regulation were negatively associated with self-reported emotion regulation changes in frequency of substance use. Similarly, in a 9-month, randomized controlled trial McMMain et al. (2013) examined the relationship between specific emotion processes and treatment outcomes (symptom distress and interpersonal function) for participants with BPD undergoing DBT treatment. Participants who had greater improvements in affect balance (measured by the Derogatis Affect Balance Scale; Derogatis & Rutigliano, 1996) and the ability to identify and describe emotions also had better treatment outcomes. More specifically, changes in emotional balance were negatively associated with changes in symptom distress and positively associated with changes in problem solving abilities, while changes in participants ability to describe feelings was negatively associated with changes in interpersonal difficulties (McMMain et al., 2013). In an RCT comparing DBT skills training to treatment as usual, Kramer et al. (2015) found that DBT skills training resulted in increased so-called adaptive, or assertive anger. In addition, adaptive anger mediated the association between group assignment and symptom decrease post-intervention (Kramer et al., 2015).

The results from these studies highlight the important role of emotion regulation as a potential mechanism of change in DBT. Nevertheless, the conclusions derived from

these results require careful interpretation, as it is also possible emotion regulation may be a mediator between mindfulness and treatment outcomes (Lynch et al., 2006b).

Mindfulness as a Mechanism of Change in DBT

DBT strongly emphasizes the development of mindfulness skills, including such skills in a standalone module in DBT skills training groups, as well as throughout the other modules (Interpersonal Effectiveness, Emotion Regulation, and Distress Tolerance) (Linehan, 1993; Linehan et al., 2015). Further, there is preliminary evidence that mindfulness skills training, a core component of DBT, is associated with treatment outcomes. Indeed, research has shown that mindfulness is negatively associated with BPD features, even when interpersonal effectiveness, emotion regulation and neuroticism are controlled for (Wupperman et al., 2009). While in a 12-month longitudinal study, Perroud and colleagues found that a dimension of mindfulness, "accepting without judgement" increased significantly following DBT (Perroud et al., 2012). Furthermore, increases in this dimension were associated with improvements in BPD symptoms (Perroud et al., 2012). Similarly, O'Toole and colleagues looked at the relationship between mindfulness and emotional well-being for individuals with BPD engaged in DBT (O'Toole et al., 2012). The authors found that, out of four predictors (mindfulness, social support, general physical health, and physical functioning), mindfulness was the strongest correlate of emotional well-being. Furthermore, greater mindfulness skills use was associated with less frequent healthcare usage (O'Toole et al., 2012). This study was limited by its cross-sectional design, and further research is needed to elucidate the progression between mindfulness and the other variables of interest (O'Toole et al., 2012). Nevertheless, considering the association between mindfulness and relevant treatment outcomes, it is possible that mindfulness may be a mechanism through which DBT confers its salutary effects.

It is also possible that mindfulness may act as an underlying mechanism in other aspects of DBT treatment. In a pilot study, Dixon-Gordon and colleagues compared the effects of two specific DBT skills modules: emotion regulation and interpersonal effectiveness, and a control group (Dixon-Gordon et al., 2015). Unexpectedly, the authors found that emotion regulation skills training had a strong effect on mindfulness, relative to the other two groups; this led the authors to consider that mindfulness may be central to understanding the emotion regulatory difficulties associated with BPD (Dixon-

Gordon et al., 2015). As the authors did not examine the temporal ordering of changes between mindfulness and emotion regulation, the nature of the relationship between them remains unclear. If a low level of mindfulness is a proximal factor in poor emotion regulatory capacity, then improvements in mindfulness may lead to changes in emotion regulation, which in turn exerts beneficial effects on other features such as, substance use, symptom distress, improved interpersonal function, and anger. While improvements in these features have been previously attributed to improvements in emotion regulation, it may be that enhanced mindfulness is the initial catalyst.

Mindfulness, Emotion Regulation, and BPD

Deficits in dispositional mindfulness, or trait levels of the ability to be aware of and attend to the present moment without judgement (Kabat-Zinn et al., 1985), may play an important role in the development of emotion regulation problems and BPD. The ability to mindfully attend to emotional experiences and their antecedents and consequences could be an important prerequisite for the development or improvement of emotion regulation capacities. Because DBT emphasizes the development of mindfulness and emotion regulation skills, it is possible that changes in mindfulness precede changes in emotion regulation, and that changes in emotion regulation mediate the effects of mindfulness on other outcomes in DBT.

The idea that deficits in mindfulness may pre-empt emotion regulation difficulties in BPD is supported by the mindfulness literature, where researchers have explored the inverse relationship between mindfulness and a range of psychopathological outcomes, finding that this relationship is mediated by increased emotion regulation (Coffey & Hartman, 2008; Desrosiers et al., 2013). Laboratory findings, examining the relationship between mindfulness and emotion regulation also suggest that changes in mindfulness might lead to changes in emotion regulation. For example, Goldin and Gross (2010) used fMRI pre- and post-intervention to examine the effects of mindfulness-based stress reduction (MBSR) on emotion regulation in individuals with social anxiety disorder. During a negative self-belief task (where participants reacted to 18 social anxiety related beliefs while engaging in either breath-focused attention, or distraction-focused attention), post-MBSR participants demonstrated decreased negative emotional responses, reduced amygdala activity, and increased activity in brain regions associated with attentional control (Goldin & Gross, 2010). Extended to processes that may operate

in DBT, these findings suggest that improvements in mindfulness may precede and set the stage for improvements in emotion regulation.

The Present Study

Both emotion regulation and mindfulness are potential mechanisms accounting for the effects of DBT on key outcomes (e.g., self harm, suicidality, self-esteem, loneliness, affect regulation, loneliness etc.) (Bohus et al., 2007). Research is needed, however, to better understand how emotion regulation and mindfulness may work together to account for changes in BPD symptoms. Some of the theory and research reviewed above suggests that changes in mindfulness precede and set the stage for changes in emotion regulation. From this perspective, we would hypothesize that changes in mindfulness occur before changes in emotion regulation, and that changes in emotion regulation should mediate the association of changes in mindfulness with key outcomes (e.g., BPD symptoms). The specific nature of the relationship between mindfulness and emotion regulation in DBT also remains unclear. Much of the extant research, for example, has assumed a linear relationship. In contrast, it may be that the relationship between mindfulness and emotion regulation is particularly strong at low levels, but that this relationship weakens at higher levels. Understanding the shape of the relationship could be crucial for treatment refinement, potentially indicating a crucial time period for specific treatment ingredients to be implemented and maintained. The primary hypotheses for this research were:

1) A) BPD symptoms at baseline will be a monotone non-increasing function of mindfulness at baseline; i.e., BPD symptoms at baseline are expected to decrease as baseline mindfulness increases; linearity is not assumed. **B)** BPD symptoms at baseline will be a monotone non-decreasing function of emotion regulation difficulties at baseline; i.e., BPD symptoms at baseline are expected to increase as emotion regulation difficulties at baseline increase; linearity is not assumed.

2) A) Change in emotion regulation difficulties between baseline and 24 months will be a monotone non-decreasing function of mindfulness at baseline; i.e., as the level of mindfulness at baseline goes up, so too will the mean change in emotion regulation difficulties. **B)** Change in emotion regulation difficulties between baseline and 24 months will be a monotone non-increasing function of mindfulness between baseline and 24

months; i.e., as the level of mindfulness between baseline and 24 months goes up, so too will the mean change in emotion regulation difficulties go down.

3) Over the course of 24 months, baseline to end of follow-up period, the first change in mindfulness will precede the first change in emotion regulation.

4) The relationship between changes in mindfulness and BPD symptoms will be mediated by changes in emotion regulation.

Method

Participants

Participants (N=240) were recruited as part of a multi-site (Centre for Addiction and Mental Health; Simon Fraser University), CIHR-funded randomized trial, comparing 6- to 12-months of comprehensive DBT for suicidal or self-harming individuals with BPD (McMain et al., 2018). Recruitment was conducted through advertisements at health centres and hospitals, and through referrals from health care professionals.

Inclusion Criteria

To be eligible to participate, individuals had to: 1) be 18-65 years of age; 2) meet DSM-IV criteria for BPD; 3) exhibiting recent and chronic self-injurious behaviour, where recent and chronic self-injurious behaviour was operationalized as at least 2 episodes of self-injury or suicide attempts in the past 5 years, including at least 1 episode in the past 8 weeks; 4) have had either British Columbia Medical Services Plan (MSP) health insurance, or Ontario Health Insurance Plan (OHIP) coverage for one year or more at the time of study enrollment (McMain et al., 2018).

Exclusion Criteria

Individuals were excluded from participating if they: 1) were screened as having an estimated IQ of less than or equal to 70; 2) met the DSM-IV criteria for bipolar disorder type I, dementia, or a specific psychotic disorder; 3) had a chronic, physical, medical concern likely requiring hospitalization within 12 months from study initiation; 4) had plans to move out of province within 24 months from study initiation (McMain et al., 2018).

Participant Screening

Prospective participants were screened for meeting inclusion/exclusion criteria using the following tools: 1) DSM-IV criteria for BPD were assessed using the International Personality Disorder Examination (Loranger et al., 1994); 2) DSM-IV criteria for bipolar disorder type I and specific psychotic disorders were assessed using the

Structured Clinical Interview for DSM-IV, Axis II and Axis I (SCID-II; SCID-I) (First, 1997; Gibbon & Spitzer, 1997); 3) IQ and general cognitive functioning was assessed using the Wechsler Test of Adult Reading (WTAR) (Wechsler, 2001).

Randomization

Eligible participants first provided informed consent and then completed baseline assessment interviews and questionnaires, after which they were informed of their treatment arm allocation. Randomization occurred independently at each site and consisted of variable block sizes with four variations. A research assistant then transferred this randomization blueprint into numbered, sealed, white envelopes, which were consecutively opened by the research coordinator prior to informing the participant of their treatment arm allocation (McMain et al., 2018). Assessors (at baseline and subsequent timepoints) remained blind to condition assignment.

Treatment

The treatment for both the 6- and 12-month conditions included comprehensive, standard DBT, consisting of individual therapy, group skills training, and as-needed phone consultation with the client's therapist. As the DBT skills training group operates based on 24 – 26 week cycles, the 6-month participants received one full cycle of skills training, and the 12-month participants received two full cycles. A sample skills module training structure is outlined in Figure 3.

Figure 3. Sample of skills training program to be completed over 6 months, and then repeated over the subsequent 6 months.



Treatment Dropouts

According to the DBT treatment protocol, clients who miss four consecutive group or individual sessions are discontinued from treatment. This protocol was adhered to in the study, with such participants being categorized as dropouts (McMain et al., 2018). Treatment dropouts (N = 70; 22.5% of initial recruits) were encouraged to continue to return and complete all assessments every 3 months until the 24-month point; of the 70 dropouts, 19 completed all follow-up appointments (27% of total dropouts).

Therapists

The study therapists were doctoral and master's level, had formal DBT training, and all had at least two years of supervised experience providing DBT and treating

patients with BPD. Three senior DBT therapists, certified with the Linehan Board of Certification and Accreditation supervised the frontline study therapists and functioned as DBT team leaders at both sites.

Treatment Adherence

DBT quality assurance was conducted in the form of therapist adherence ratings, one-on-one supervision, and weekly team meetings. All therapy sessions were video-recorded and 5% of each dyad's individual sessions, as well as 5% of all group sessions, were then rated for treatment adherence using the University of Washington DBT Adherence Rating Scale (M. M. Linehan & Korslund, 2003). Raters were psychology graduate students who were masked to treatment allocation, and had been trained to suitable level of reliability at the University of Washington in Seattle (McMain et al., 2018). As of the writing of this manuscript, adherence data were being cleaned, entered, and analyzed for presentation in the study's primary outcome paper (in preparation).

Measures

Participants were compensated \$10.00 per hour for completion a large battery of study measures, including questionnaires and laboratory measures (see McMain et al., 2018). The measures used in the current study are described below.

Mindfulness

Kentucky Inventory of Mindfulness Skills. The Kentucky Inventory of Mindfulness Skills (KIMS) is a 39-item, self-report scale that measures mindfulness on four scales: 1) Observing, 2) Describing, 3) Acting with Awareness, and 4) Accepting Without Judgement (Baer et al., 2004). The KIMS has demonstrated satisfactory evidence of internal consistency ($\alpha = .86$), construct validity, and test-retest reliability (Baer et al., 2004; Park et al., 2013).

Emotion Regulation

Difficulties in Emotion Regulation Scale. The Difficulties in Emotion Regulation Scale (DERS) is a 36-item, self-report scale that measures emotion regulation on six factors: 1) Nonacceptance of Emotional Responses; 2) Difficulties Engaging in Goal-Directed Behaviour; 3) Impulse Control Difficulties; 4) Lack of Emotional Awareness; 5) Limited Access to Emotion Regulation Strategies; 6) Lack of Emotional Clarity (Gratz & Roemer, 2004). The DERS has demonstrated satisfactory evidence of internal consistency ($\alpha = .93$), test-retest reliability, construct validity, and predictive validity (Gratz & Roemer, 2004).

BPD Symptoms

Borderline Symptom List-23. The Borderline Symptom List-23 (BSL-23) is a 35-item, self-report scale used to assess endorsement of BPD symptoms (Bohus et al., 2009). The BSL-23 has demonstrated satisfactory evidence of internal consistency ($\alpha = .97$), test-retest reliability, and sensitivity to therapeutic change in DBT (Bohus et al., 2007, 2009).

Data Analysis

Descriptive analyses, relevant to each hypothesis and participant demographics, were first conducted to provide a clear picture of the extant data. Analyses examining the hypotheses were designed on a hypothesis-specific basis and are described below. All analyses were conducted using the statistical platform R. 3.4.3 (R Development Core Team, 2017).

The data were visually inspected for outliers using timeseries boxplots for each variable. These plots indicated 13 outliers for mindfulness, 4 outliers for emotion regulation difficulties, and no outliers for BPD symptoms (figure 5). Considering the large sample size, the small number of outliers, their lack of extremity, and to maintain the integrity of the dataset, no outliers were removed from subsequent analyses (Kruskal et al., 1960).

Hypotheses 1A-2B

Hypothesis 1A was summarized as [$H_0: \mu_2 \geq 0, H_1: \mu_2 < 0$], while hypothesis, 1B, 2A and 2B, were summarized as [$H_0: \mu_2 \leq 0, H_1: \mu_2 > 0$], wherein μ_2 is Guttman's coefficient of monotonicity. The four hypothesis pairs were tested by means of an asymptotic z-test, in which the test statistic was $\frac{\hat{\mu}_2}{\hat{\sigma}_{\hat{\mu}_2}}$, $\hat{\sigma}_{\hat{\mu}_2}$, a bootstrap estimator of the standard deviation of the sampling distribution of $\hat{\mu}_2$, the number of bootstrap replications was 1000, and the Type I error rate was set to .05. As the procedure was asymptotic distribution free, its valid employment did not rest on the satisfaction of any assumptions. Visual depiction of relationships was provided by means of scatterplot, into which was projected LOESS non-parametric regression functions. Finally, in the event that the decision was made that a relationship was monotonic, in the direction prescribed under a particular hypothesis, the degree to which it was linear monotonic was assessed through estimation of the PPMC (ρ_{xy}).

Hypothesis 3

The first changepoint in each of the two series, mindfulness and emotion regulation, baseline to 24 months, was identified by means of the likelihood ratio based approach implemented in R's Changepoint package (Killick & Eckley, 2014); as the approach operates only on complete data, and imputation of missing data would seem inadvisable, given the sensitive nature of changepoint detection, only the 113 cases with complete data on emotion regulation and mindfulness were included. Prior to analysis, the time points comprising of each series were transformed into new variables, $T_{ij}-B_i$, wherein T_{ij} is the score of person i at month j , and B_i is their score at baseline. Accordingly, change was interpreted relative to baseline level, and the possible outcomes were no change, first change at 3 months, first change at 6 months, etc. Letting P_{ij} be the population proportion of cases for which the first change in mindfulness occurred at month i , and, in emotion regulation, at month j , and, accordingly, that

$P_{M \rightarrow E} = \sum_{i < j} P_{ij}$ is the proportion of cases for which the first change in mindfulness

precedes that in emotion regulation, hypothesis 3 was summarized as [H_0 :

$$P_{M \rightarrow E} \leq .5, H_1: P_{M \rightarrow E} > .5].$$

Hypothesis 4

To determine the direct and mediational roles played by mindfulness and emotion regulation in the longitudinal trajectory of BPD symptoms, structural equation modelling was employed, as implemented in R's Lavaan package (Rosseel, 2012). The analysis was organized around the fitting of two core candidate longitudinal models: i) the standard cross-lag regression model for latent constructs (for a summary see, Kearney, 2017); and ii) the more recent state-trait extension of this model, in which a trait component is associated with each time series (e.g., Bailey & Littlefield, 2017). Each latent variable corresponding to a particular time point within a given series was assigned a single manifest indicator (in this case, the total score on the KIMS, DERS, and BSL-23 computed at that time point). Input error variances for the 15 single indicators, were calculated on the basis of a Cronbach's α (lower bound to reliability) of $\rho_{cc'} = .95^1$, in accordance with the usual formula, $\sigma_{\varepsilon_i}^2 = (1 - \hat{\rho}_{cc'})\sigma_i^2$, wherein σ_i^2 is the observed variance of the indicator. As the processes underlying change might well be expected to differ between the two periods of time, baseline to end of treatment, on the one hand, and 12 to 24 months (the follow-up period), on the other, models were fit only to the first time period (the 5 time points during which the treatment was ongoing)². Separate analyses were conducted for mindfulness, emotion regulation, and BPD symptoms, together, and mindfulness and emotion regulation, alone.

Identification of each of the two core, candidate models was established in accordance with the two-step rule (see e.g., Bollen, 1984). As the data contained a considerable number of missing values, parameters were estimated by means of full information maximum likelihood (see, e.g., Allison, 2003). In the case of model fitting wherein parameter estimates were admissible and the information matrix was positive definite, model fit was assessed by means of standardized residuals, RMSEA, and the

¹ A value in line with those reported in many empirical investigations featuring these scales (e.g., Baer et al., 2004; Bohus et al., 2009; Gratz & Roemer, 2004)

² A separate study to be undertaken will explore the issue of the processes underlying change occurring within the follow-up period.

ratio of likelihood ratio chi-square statistic to degrees of freedom. In the search for an acceptable accounting of the data, with the guidance of standardized residuals and modification indices, modifications were made where necessary. Differences in correlation coefficients were assessed using Cocor (Diedenhofen & Musch, 2015).

Finally, with the aim of gaining insight into the patterns of mediation linking distinct time series, matrices of total, direct, and indirect effects were computed on the basis of parameter estimates, in accordance with the matrix formulas outlined in Bollen (1984). To examine the potential mediational role of each variable (emotion regulation and mindfulness) on BPD symptoms at each time point, the total indirect effects of each was further decomposed into those only running through the other (i.e., the share of the total mediated association of each, involving pathways running through the other).

Results

In the final sample (N=240), 79.2% of participants identified as female, 15.8% identified as male, and 5.0% identified as other. Participants' ages ranged from 18 – 59 years (M=27.75). Most participants identified their ethnicity as White (67.5%), reported that they were single, never married (75.4%), and reported “some post-secondary education” (32.5%) as the highest level of education received. Detailed participant demographics are outlined in Table 1.

Table 1. Participant demographics.

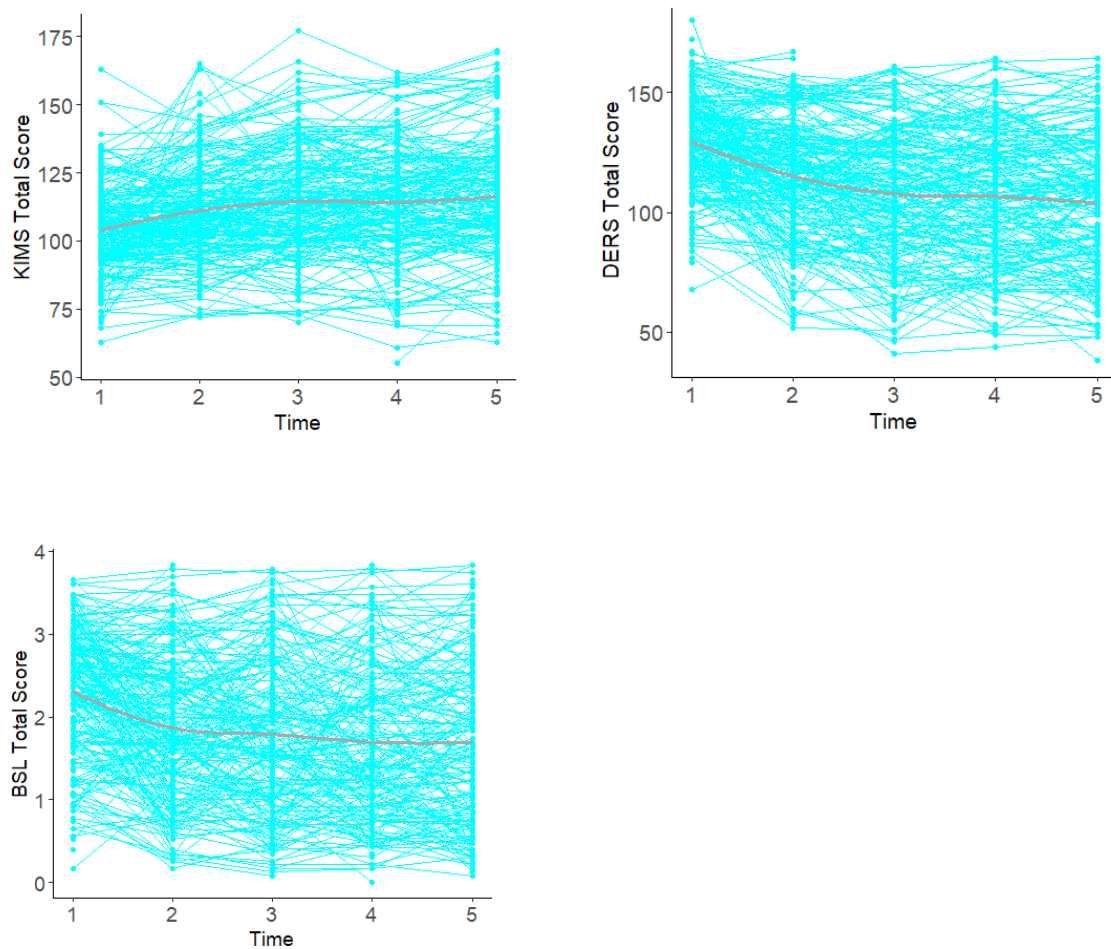
Demographic Variable	<i>N</i>	%
Gender		
Female	190	79.2%
Male	38	15.8%
Other	12	5.0%
Ethnicity		
White	162	67.5%
Chinese	11	4.6%
South Asian (e.g., East Indian, Pakistani, Sri Lankan, etc.)	10	4.2%
Black	4	1.7%
Filipino	2	0.8%
Latin American	2	0.8%
West Asian (Iranian, Afghani)	1	0.4%
Korean	1	0.4%
Indigenous	6	2.5%
Other	40	16.7%
Marital Status		
Single, never married	181	75.4%
Married/Common law	38	15.8%
Separated	12	5.0%
Divorced	9	3.8%
Education		
Did not complete high school	22	9.2%
High school diploma	40	16.7%
Some post-secondary	78	32.5%
College or trade certification	47	19.6%
University degree	41	17.1%
Master's/Doctoral degree	12	5.0%
Income		
Less than \$5000.00	46	19.2%
\$5000.00-\$9999.99	42	17.5%
\$10,000.00-\$14,999.99	46	19.2%
\$15,000.00-\$19,999.99	12	5%
\$20,000.00-\$24,999.99	24	10.0%
\$25,000.00-\$29,999.99	11	4.6%
\$30,000.00-\$49,999.99	31	12.9%
\$50,000.00 or above	19	7.9%

Examining the Baseline Relationship Between, Mindfulness, Emotion Regulation, and BPD Symptomology

Descriptive Analyses

Three plots, one each for mindfulness, emotion regulation difficulties, and BPD symptoms, were generated (see Figure 4). Each plot contained the time series (baseline to 12-months) for all participants, and a lowess smoothed non-parametric regression.

Figure 4. Three time series plots, one each for mindfulness, emotion regulation difficulties, and BPD symptoms, from baseline to 12-months.



For further clarity, Table 2 outlines the means and standard deviations, and Table 3 the correlation matrices, for the three variables over 24 months.

All told, results (a), (b), and (c), together, imply that, for each series, the nature of temporal change was similar across individuals (for mindfulness, an increase until the

end of the treatment period; for emotion regulation difficulties and BPD symptoms, a decrease), and that, once the treatment period has begun, increasing time leads to greater differentiation among individuals [implying a certain sense of stability inherent to the temporal changes occurring during the treatment period].

Table 2. Means and standard deviations for mindfulness (KIMS), emotion regulation difficulties (DERS), and BPD symptoms (BSL) from baseline to 24-months.

Time	KIMS mean	KIMS SD	DERS mean	DERS SD	BSL mean	BSL SD
Baseline	104	15.3	130	19	2.31	0.76
3 months	111	17.5	115	24.1	1.87	0.88
6 months	115	20	108	27.6	1.79	0.94
9 months	114	20.8	107	27.7	1.7	0.93
12 months	116	21.7	104	28.1	1.69	0.97
15 months	117	19.4	103	27.7	1.52	0.92
18 months	117	20.1	102	27.7	1.55	0.97
21 months	116	21.5	104	28.6	1.63	0.94
24 months	118	22.4	102	30.1	1.59	1.01

Table 3. Correlation matrix for mindfulness (KIMS), emotion regulation difficulties (DERS), and BPD symptoms (BSL) from baseline to 24-months.

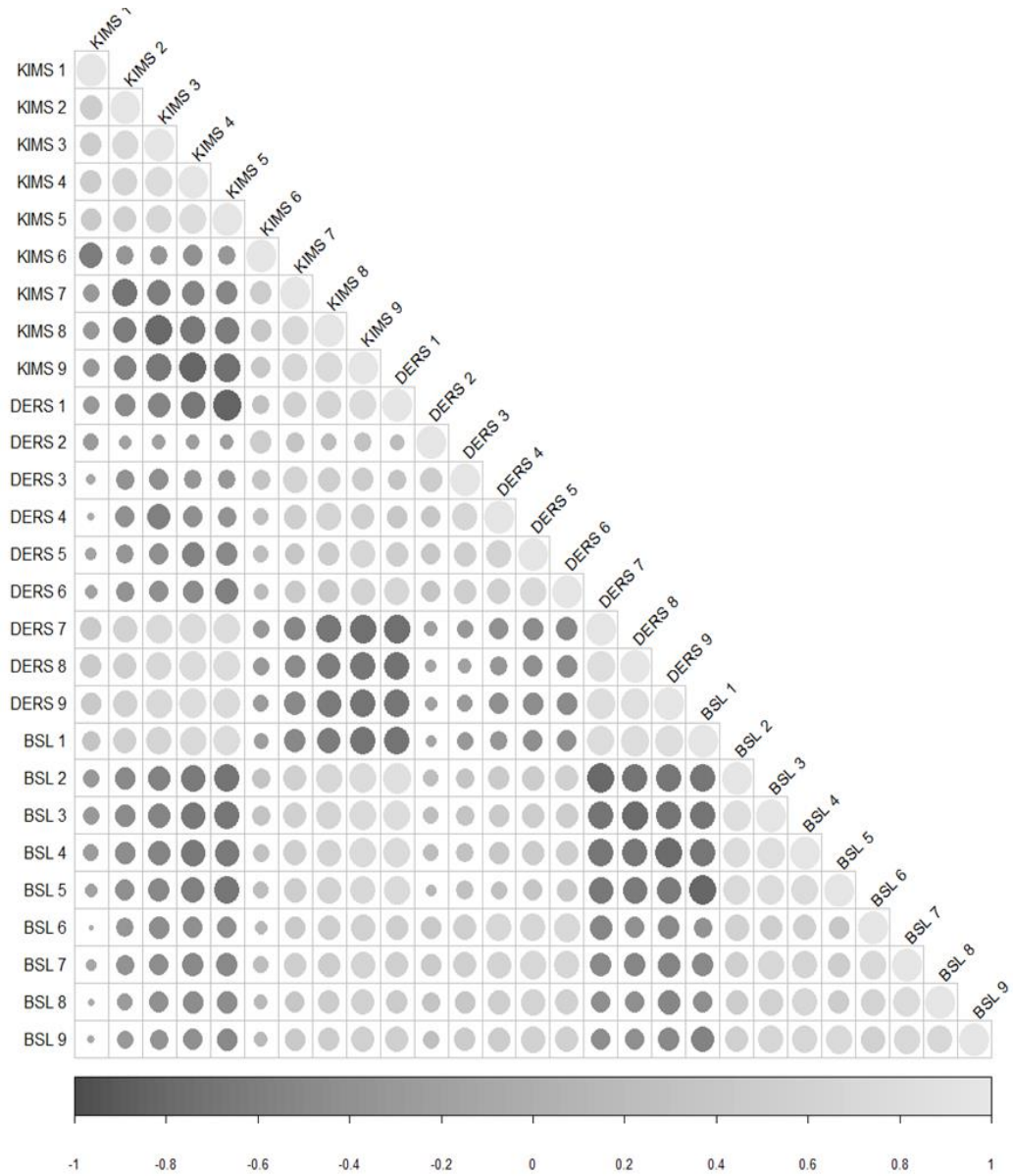
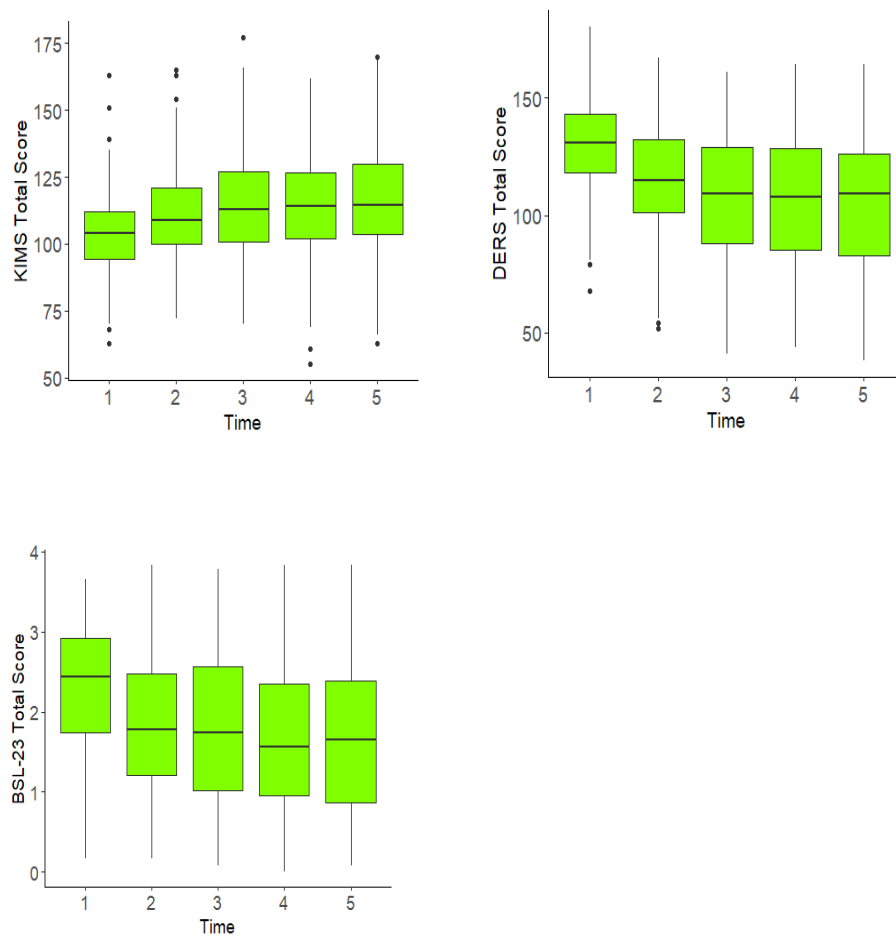


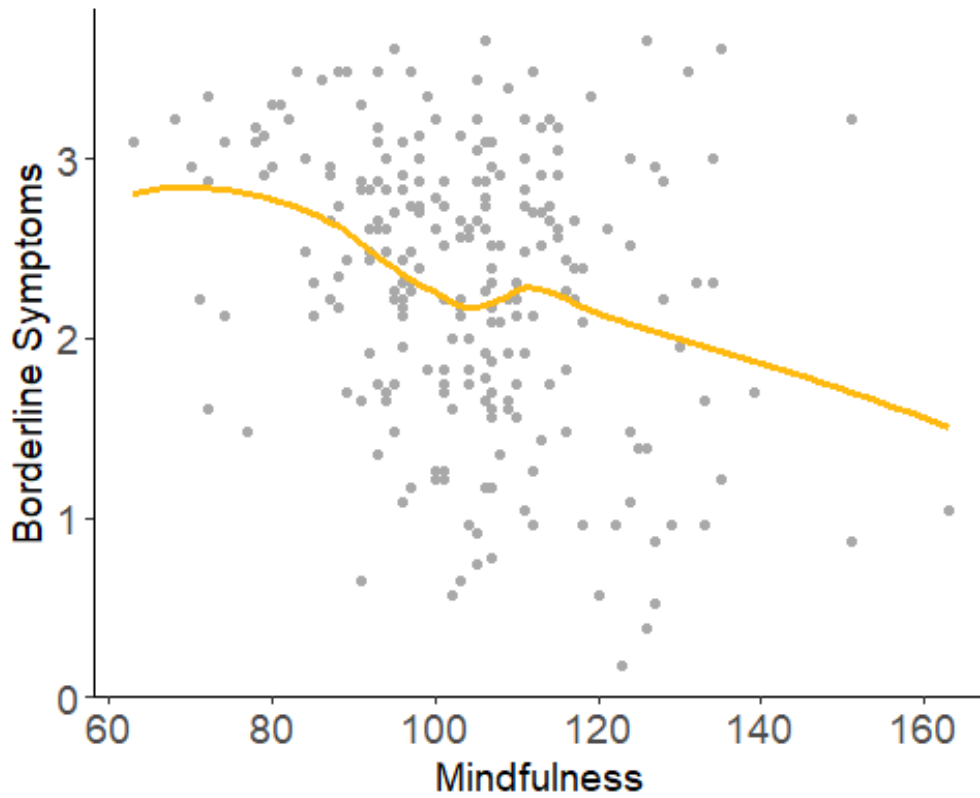
Figure 5. Time series boxplot showing variance and outliers for mindfulness, emotion regulation difficulties, and BPD symptoms.



Hypotheses 1A-1B

Findings supported Hypothesis 1A ($\mu_{2obs} = -0.43$; $Z_{obs} = -5.27$, $P_{obs} = 0.01 < 0.05$) that BPD symptoms at baseline are a monotone non-increasing function of mindfulness at baseline. Figure 6 depicts the scatterplot and LOESS regression function. The PPMC was estimated to be -0.29, indicating that roughly 67% of the monotone trend observed is due to linearity (the remaining 33%, to nonlinearity).

Figure 6. The association between mindfulness and BPD symptoms at baseline.



Findings also supported Hypothesis 1B ($\mu_{2obs} = 0.66$; $Z_{obs} = 8.51$, $P_{obs} < 0.001$) that BPD symptoms at baseline are a monotone non-decreasing function of emotion regulation at baseline. Figure 7 depicts the scatterplot and LOESS regression function. The PPMC was estimated to be 0.48, indicating that roughly 30% of the monotone trend observed is due to linearity (the remaining 70%, to nonlinearity).

Figure 7. The association between emotion regulation difficulties and BPD symptoms at baseline.

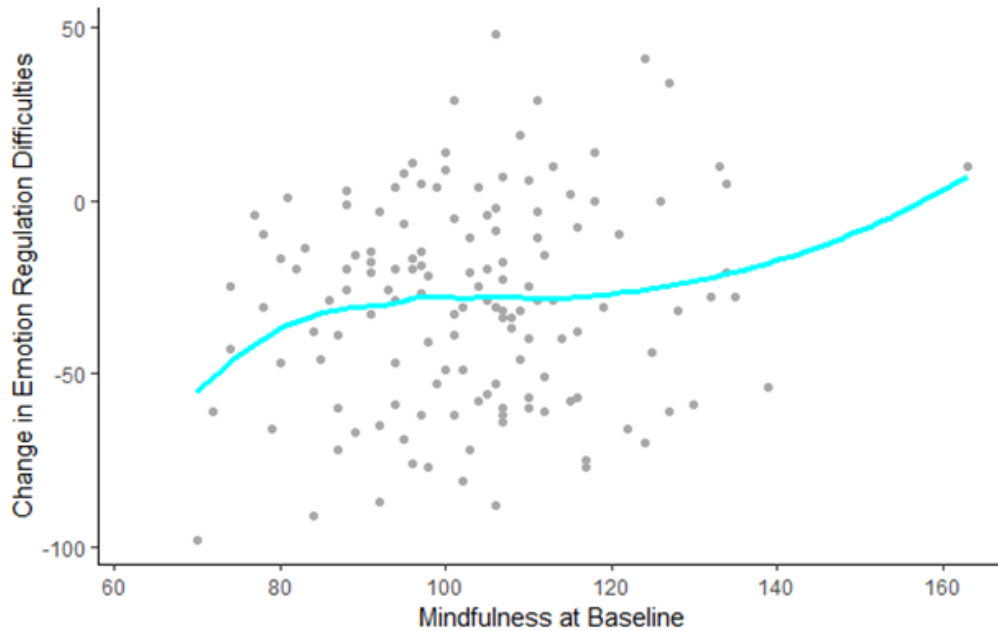


Characterizing Change, Both in and Between, Mindfulness, Emotion Regulation, and BPD Symptoms

Hypotheses 2A-2B

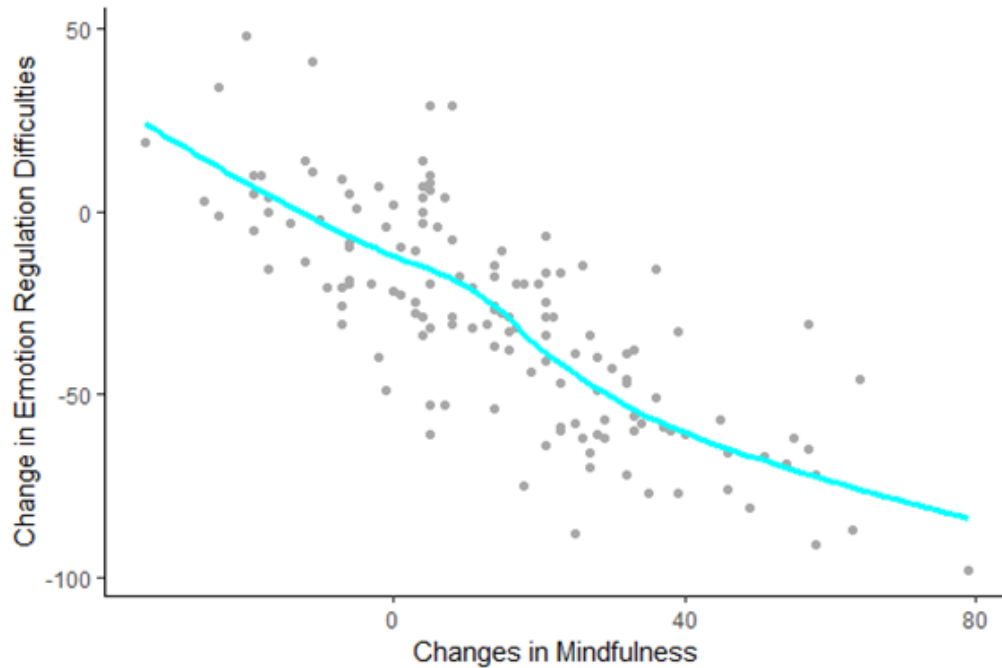
Findings supported Hypothesis 2A ($\mu_{2obs} = 0.23$; $Z_{obs} = 1.78$, $P_{obs} = 0.04 < 0.05$) that changes in emotion regulation difficulties between baseline and 24 months were a monotone non-decreasing function of mindfulness at baseline. Figure 8 depicts the scatterplot and LOESS regression function. The PPMC was estimated to be -0.15, indicating that roughly 65% of the monotone trend observed is due to linearity (the remaining 35%, to nonlinearity).

Figure 8. The relationship between mindfulness at baseline and changes in emotion regulation between baseline and 24 months.



Findings also supported Hypothesis 2B ($\mu_{2obs} = 0.93$; $Z_{obs} = -55.57$, $P_{obs} < 0.001$) that changes in emotion regulation between baseline and 24-months is a monotone non-increasing function of changes in mindfulness between baseline and 24-months. Figure 9 depicts the scatterplot and LOESS regression function. The PPMC was estimated to be 0.78, indicating that roughly 84% of the monotone trend observed is due to linearity (the remaining 16%, to nonlinearity).

Figure 9. The relationship between changes in mindfulness and emotion regulation between baseline and 24-months.



Investigating the Temporal Ordering of Changes in BPD Symptoms, Mindfulness, and Emotion Regulation

Hypothesis 3

Contingency Table 3 contains estimates of P_{ij} , the proportion of cases for which the first change in mindfulness occurred at month i , and, in emotion regulation, at month j ; while Table 4 shows the direction of the first change in each of the two series.

Table 4. The point of first change on mindfulness and emotion regulation for complete cases on each variable.

Time of change	3 months N (%)	6 months N (%)	9 months N (%)	12 months N (%)	15 months N (%)	18 months N (%)	21 months N (%)	Total M N (%)
3 months	7 (6.1%)	1 (0.9%)	2 (1.7%)	4 (3.5%)	3 (2.6%)	4 (3.5%)	1 (0.9%)	22 (19.2%)
6 months	6 (5.2%)	8 (7.0%)	4 (3.5%)	1 (0.9%)	3 (2.6%)	0 (0.0%)	1 (0.9%)	23 (20.1%)
9 months	2 (1.7%)	4 (3.5%)	2 (1.7%)	0 (0.0%)	4 (3.5%)	2 (1.7%)	2 (2.6%)	16 (14.7%)
12 months	2 (1.7%)	2 (1.7%)	6 (5.2%)	4 (3.5%)	0 (0.0%)	1 (0.9%)	1 (0.9%)	16 (13.9%)
15 months	3 (2.6%)	1 (0.9%)	1 (0.9%)	0 (0.0%)	5 (4.3%)	1 (0.9%)	0 (0.0%)	11 (9.6%)
18 months	3 (2.6%)	2 (1.7%)	3 (2.6%)	3 (2.6%)	1 (0.9%)	2 (1.7%)	1 (0.9%)	15 (13.0%)
21 months	0 (0.0%)	5 (4.3%)	0 (0.0%)	0 (0.0%)	2 (1.7%)	1 (0.9%)	2 (2.6%)	10 (9.5%)
Total ED	23 (19.9%)	23 (20.0%)	18 (15.6%)	12 (10.5%)	18 (15.6%)	11 (9.6%)	8 (8.8%)	113 (100.0%)

Note: M = Mindfulness; ED = Emotion Regulation Difficulties

Table 5. The direction of first change for complete cases on mindfulness and emotion regulation.

Direction of change	ED change = Neg	ED change = Pos	
M change = Neg	14 (12.2%)	12 (10.4%)	26 (22.6%)
M change = Pos	74 (64.3%)	15 (13.0%)	89 (77.3%)
	88 (76.5%)	27 (23.4%)	

Note: M = Mindfulness; ED = Emotion Regulation Difficulties

Of 113 complete cases, for 32.4%, the first change in mindfulness occurred prior to the first change in emotion regulation, for 40.7%, emotion regulation prior to mindfulness, and for 26.9%, the first change in mindfulness occurred during the same time period as that of emotion regulation. Accordingly, $P_{M \rightarrow E} = .324$, and the null hypothesis of Hypothesis 3 was retained. Results indicate that 66.0% of the first changes in emotion regulation occurred during the first 12 months of the study, while 34% occurred during the subsequent 12 months. Similarly, 67.9% of the first change in mindfulness occurred during the first 12 months, and 32.1% during the subsequent 12 months. Finally, 47.8% of the total first changes occurred during initial 12 months of the study, with 52.2% occurring over the subsequent 12 months

Hypothesis 4 and Exploratory Analysis

Two models were tested. Model 1 was developed to examine the longitudinal relationship between mindfulness and emotion regulation over 12 months, without the potential confounding effect of BPD symptoms. Model 2 introduced BPD symptoms to examine mediational action between mindfulness, emotion regulation, and BPD symptoms.

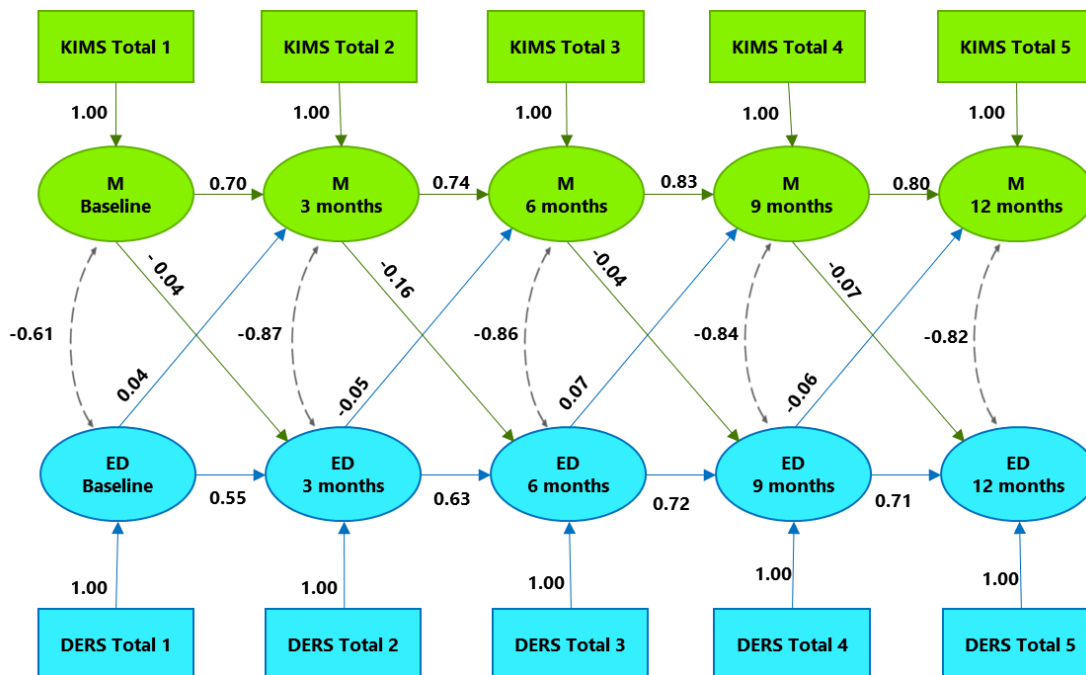
Mindfulness and emotion regulation. In the case of Model 1 (mindfulness and emotion regulation alone), the standard cross-lagged model with modifications³ was found to account for the data well (RMSEA = .015; $\chi^2 = 29.50$; $df = 28$; number of standardized residuals exceeding 2 in absolute value = 4 [4/55 = 7.3%]). This model, with estimated parameters, is depicted in Figure 10, and manifests four notable empirical features. Firstly, for both mindfulness and emotion regulation, the autoregressive coefficients were large and positive, implying that, within each series, there was a high degree of consistency in the rank orderings of individuals throughout 12 months. Secondly, for both mindfulness and emotion regulation, the autoregressive coefficient linking baseline and 3 months was smaller than the other coefficients within each series. The implication of this finding is that, agreement in the rank ordering of individuals with respect to the changes they made over 12 months (captured by coefficients linking latent

³ Removal of equality constraints over a) cross-lag regression parameters; and b) cross-series correlations of disturbance terms, and the addition of correlations between the error terms of KIMS[baseline] and KIMS[3 months] and DERS[3 months] and DERS[12 months].

variables from three months onwards), was higher than the agreement in the rank ordering of their baseline and three months levels. Thirdly, the fact that the cross-lag regression coefficients were modest in magnitude, indicated that it was neither the case that mindfulness explained change in emotion regulation, nor that emotion regulation explained change in mindfulness. Fourthly, although neither variable accounted for the change in the other, change in emotion regulation was still strongly associated with change in mindfulness. In fact, the degree of association between the *change* in mindfulness and emotion regulation (even at the smallest point of difference; i.e., baseline and 12-months) was significantly greater than the degree of association between the two variables at baseline ($r = (-0.61, -0.82)$, $Z_{obs} = -5.12$, $P_{obs} < 0.001$; 95% CI = -0.30 - -0.23) (Hittner et al., 2003; Zou, 2007).

Direct and indirect effects are outlined in Table 5. As would be expected in light of the modest cross-lag regression coefficients, most mediation occurred within series (e.g., at 9 months, $M1 \rightarrow M4 = .42$ and $M2 \rightarrow M4 = .6$ whereas $M1 \rightarrow E4 = -.12$ and $M2 \rightarrow E4 = -.14$).

Figure 10. Model 1, the two-variable, five-wave, cross lagged panel model, showing the longitudinal relationship between mindfulness and emotion regulation difficulties over treatment.



Note: M = Mindfulness; ED = Emotion Regulation Difficulties; Regression coefficients presented are standardized; disturbance correlations are indicated by dashed arrows.

Figure 11. Model 1: direct and indirect effects (standardized regression coefficients).

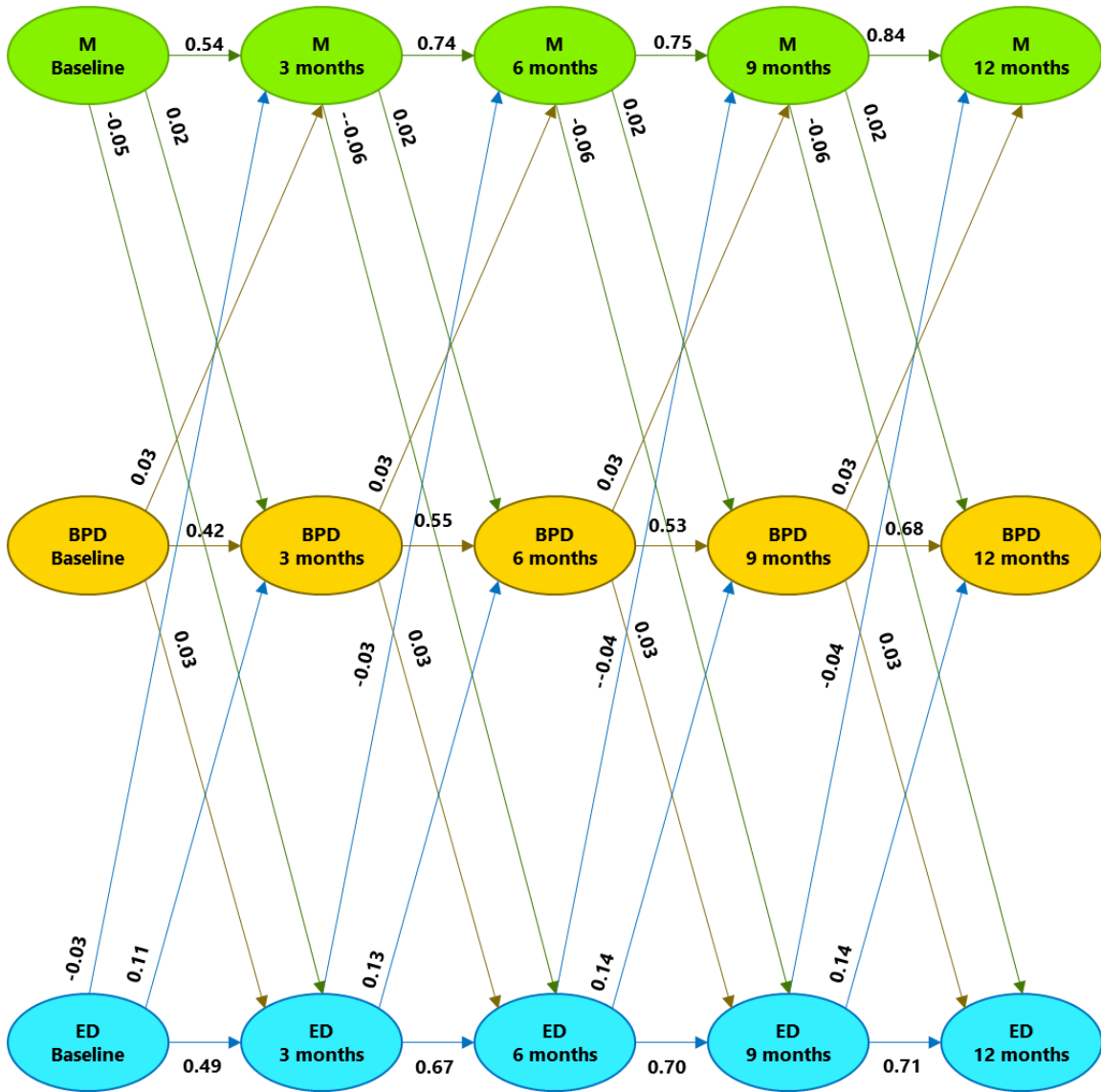
	M1	ED1	M2	ED2	M3	ED3	M4	ED4	M5	ED5
M2	0.70	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ED2	-0.04	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M3	0.52	0.00	0.74	-0.05	0.00	0.00	0.00	0.00	0.00	0.00
ED3	-0.13	0.34	-0.16	0.63	0.00	0.00	0.00	0.00	0.00	0.00
M4	0.42	0.03	0.60	0.01	0.83	0.07	0.00	0.00	0.00	0.00
ED4	-0.12	0.25	-0.14	0.46	-0.04	0.72	0.00	0.00	0.00	0.00
M5	0.34	0.01	0.49	-0.02	0.66	0.01	0.80	-0.06	0.00	0.00
ED5	-0.11	0.17	-0.14	0.32	-0.08	0.51	-0.07	0.71	0.00	0.00

Note: M1, 2, 3, 4, 5 = Mindfulness at baseline, 3, 6, 9, and 12 months respectively; ED1, 2, 3, 4, 5 = Emotion Regulation Difficulties at baseline, 3, 6, 9, and 12 months respectively.

Mindfulness, emotion regulation, and BPD symptoms. The findings for mindfulness, emotion regulation, and BPD symptoms were striking similar to those for mindfulness and emotion regulation, alone, both in terms of the most adequately fitting model (the standard cross-lag model with modifications⁴, yielding RMSEA = .04; $\chi^2 = 96.75$; $df = 70$; number of standardized residuals exceeding 2 in absolute value = 26 [26/120 = 21.6%]), and with regards to the specific empirical patterns revealed (large autoregressive coefficients and disturbance correlations, combined with small cross-lag coefficients). The estimated model is displayed in Figures 11 and 12.

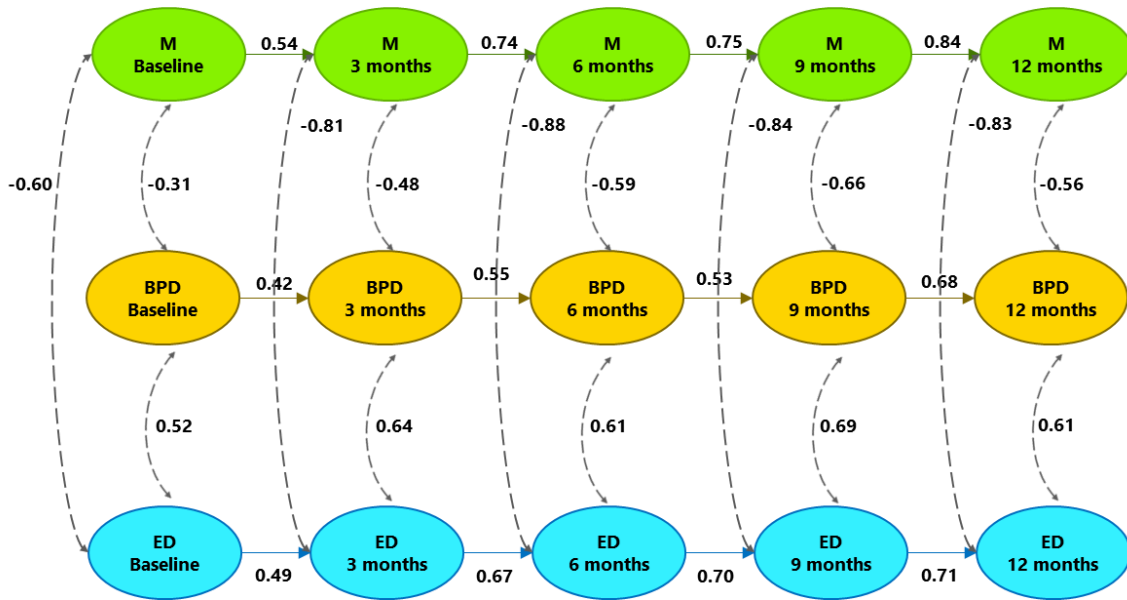
⁴ Removal of equality constraints over a) autoregressive regression parameters; and b) cross-series correlations of disturbance terms, and the addition of correlations between the error terms of Ders[3 months] and Ders[12 months] and bsl[baseline] and bsl[9 months].

Figure 12. Path model for Model 2, showing the direct effects and autoregressive coefficients.



Note: for clarity, the observed variables are not included in this diagram; however, as mentioned previously, there is one observed variable per latent factor, with a loading set to unity; M = Mindfulness; BPD = BPD symptoms; ED = Emotion Regulation Difficulties.

Figure 13. Large autoregressive and disturbance correlations found in Model 2.



Note: M = Mindfulness; BPD = BPD symptoms; ED = Emotion Regulation Difficulties.

In light of the small cross-lag coefficients and, consequently, the modest indirect effects shown in Table 7, a formal test of the hypothesis that mindfulness mediates the relationship between emotion regulation and BPD symptoms was deemed unnecessary. Nevertheless, to further elucidate this possible relationship, the direct and indirect impacts for each of mindfulness and emotion regulation on BPD symptoms at each time point, as well as the component of the indirect impacts for each variable (mindfulness and emotion regulation) derived from mediational pathways running through the other variable (emotion regulation and mindfulness) to BPD symptoms, are presented in Table 8. The coefficients here indicate that: a) the majority of the total impact of mindfulness on BPD symptoms comes from indirect (mediated) pathways, and these are greatest early on in treatment; b) while in the case of emotion regulation, the proportional contribution to its total impact on BPD symptoms made by indirect (mediated) pathways, increases steadily throughout the treatment period; c) although, at each time point, the total indirect (mediated) impact of mindfulness on BPD symptoms is positive (indicating that, taking all mediated pathways, together, an increase in mindfulness is associated with an increase in BPD symptoms), the contribution made by those pathways running through emotion regulation, is of opposite sign. That is to say, an increase in mindfulness, when mediated by emotion regulation, tends to be associated with lower levels of BPD symptoms; and d) none of the total indirect impact of emotion regulation on BPD symptoms is due to mediational paths running through mindfulness. All told, if the

modest coefficients displayed in Table 8 can be seen as supporting speculations regarding the existence of mediational mechanisms inherent to the impact of mindfulness and emotion regulation on BPD symptoms, these speculations are in favour of emotion regulation mediating the impact of mindfulness on BPD symptoms, and not the other way around.

Table 6. Model 2, direct and indirect effects (standardized regression coefficients).

	M1	E1	M2	E2	M3	E3	M4	E4	M5	E5
M2	0.70	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E2	-0.04	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M3	0.52	0.00	0.74	-0.05	0.00	0.00	0.00	0.00	0.00	0.00
E3	-0.13	0.34	-0.16	0.63	0.00	0.00	0.00	0.00	0.00	0.00
M4	0.42	0.03	0.60	0.01	0.83	0.07	0.00	0.00	0.00	0.00
E4	-0.12	0.25	-0.14	0.46	-0.04	0.72	0.00	0.00	0.00	0.00
M5	0.34	0.01	0.49	-0.02	0.66	0.01	0.80	-0.06	0.00	0.00
E5	-0.11	0.17	-0.14	0.32	-0.08	0.51	-0.07	0.71	0.00	0.00

With regards to emotion regulation difficulties, both the direct and indirect coefficients support the results presented earlier, in that increased emotion regulation difficulties are associated with increased BPD symptoms, but they also indicate that none of the indirect effects are mediated by mindfulness.

Table 7. Highlighting the emotion regulation difficulties (ERD) mediated impacts of mindfulness (M) on BPD symptoms (BPD), and the M mediated impacts of ERD on BPD.

BPD	Mindfulness			Emotion Regulation Difficulties		
	Direct	Indirect	Indirect via ERD	Direct	Indirect	Indirect via M
3 months	0.02	NA	NA	0.11	NA	NA
6 months	0.02	0.15	-0.05	0.13	0.12	0.00
9 months	0.02	0.02	-0.02	0.14	0.27	0.00
12 months	0.02	0.03	-0.05	0.14	0.48	0.00

Discussion

This was the first study to attempt to elucidate the time course of the association between these two key components of DBT, with findings partially supporting the primary hypotheses. The baseline relationships between the three variables were as expected, with higher and lower levels of mindfulness and emotion regulation difficulties respectively predicting lower levels of BPD symptoms. Similarly, findings were also as expected with respect to change, such that both higher levels of mindfulness at baseline, and change in mindfulness between baseline and 24-months, predicted a greater decrease in emotion regulation difficulties between baseline and 24-months. These findings are supported by the extant BPD literature, where mindfulness and emotion regulation have both been found to be associated with BPD symptoms (Axelrod et al., 2011; McMain et al., 2013; Wupperman et al., 2009), as well as extending these results to show that this relationship persists over time. These results also augment findings from the mindfulness and emotion regulation literature, where an established body of research has demonstrated a positive relationship between the two variables (Coffey & Hartman, 2008; Desrosiers et al., 2013; Goldin & Gross, 2010), further indicating that this association holds in the context of treatment.

Having found an association, the next step was to attempt to better understand the nature of the relationship. Unexpectedly, changes in mindfulness were not found to precede changes in emotion regulation during treatment, with a larger proportion of participants experiencing their first change in emotion regulation. Furthermore, there was an unexpected third group found in testing this hypothesis, whereby changes in mindfulness and emotion regulation occurred concurrently. Considering the heterogeneity evidenced in BPD presentation (there are 256 ways that an individual can meet the DSM-V criteria for the disorder), one plausible explanation for this finding is that the three groups represent three different categories of participants that could potentially be grouped with regards to another variable. Indeed, a number of studies have attempted to reduce phenomenological heterogeneity within BPD, with exploratory and confirmatory factor analytic work by Clarkin and colleagues (1993) and Sanislow and colleagues (2000; 2002) finding that the DSM criteria can be grouped into three dimensions, disturbed relatedness, behavioral dysregulation, and affective dysregulation; while Bradley and colleagues (2005) have used Q-factor analysis to group

BPD patients into four sub-types (high functioning internalizing, depressive internalizing, histrionic, and angry externalizing). With this in mind, it is possible that an individual's symptomatic presentation (with regards to dimensions or sub-types) at the start of DBT, may predict whether they experience changes in mindfulness first, changes in emotion regulation first, or changes in the two variables concurrently.

Another possibility is that participants entering the study with greater symptom severity at baseline were unable to utilize mindfulness skills until their emotion regulation difficulties had decreased below a certain threshold. It would be valuable for future research to examine this, as it could provide evidence for tailoring the ordering of skills use modules to match the needs of incoming DBT patients.

The examination of the direction and potential mediational roles played by mindfulness and emotional regulation difficulties in the longitudinal trajectory of BPD symptoms also yielded unexpected results. Findings did not suggest that emotion regulation or mindfulness mediated the association of either variable with BPD symptoms. Secondary analyses, however, suggested that emotion regulation mediated the small negative association of mindfulness with changes in BPD symptoms. These findings align with extant literature, where research has shown that emotion regulation mediates the inverse relationship between mindfulness and psychological distress (Coffey & Hartman, 2008; Desrosiers et al., 2013).

The models also yielded further unanticipated findings, with large autoregressive coefficients indicating that individuals retained their rank-order over time, and very large disturbance correlations showing that change in the three variables remained roughly in agreement over 12-months. These findings suggest that either a fourth variable accounted for the changes seen in mindfulness, emotion regulation, and BPD symptoms, or that the treatment may be functioning as a synergistic whole, such that the overall effect of DBT is greater than that of its component parts.

With regards to the possibility of a fourth variable, a couple of possibilities seem theoretically plausible. According to the biosocial developmental theory of BPD, trait impulsivity can be considered focal to the development of BPD (Crowell et al., 2009, 2014). Although often considered and measured as a trait, changes in impulsivity could have driven changes in mindfulness, emotion regulation, and BPD symptoms. Brief,

supplemental analyses to explore this possibility, however, indicated that this was unlikely. Another possible fourth variable includes executive control, defined as the ability to engage in adaptive, goal directed behavior as needed (Miller & Cohen, 2001; Norman & Shallice, 1986). There is evidence that improvements in executive control may account for the association of mindfulness with improved emotion regulation (Teper et al., 2013; Teper & Inzlicht, 2013). Future research might examine the possible mechanistic role of executive control in DBT related outcomes..

Limitations and Future Directions

Some methodological limitations should be considered in future research. First, the measures and the constructs of mindfulness and emotion regulation overlap. More specifically, emotion regulation as operationalized in this study, can be defined as the ability to monitor, accept and understand emotions while engaging in goal directed behaviour to manage emotional reactivity as-needed (i.e., inhibitory control) (Gratz & Roemer, 2004), while mindfulness is most often defined as the ability to be aware of, and attend to the present moment without judgement (Kabat-Zinn et al., 1985). Both constructs include awareness (monitoring) and acceptance of emotional responses, although mindfulness incorporates a broader lens (many elements of the present moment). Future research incorporating more objective measures of mindfulness and emotion regulation (e.g., using neuroimaging or experimental tasks) might further isolate the constructs and would be a useful addition to the literature.

More broadly, it is important to consider that the constructs of mindfulness and emotion regulation are multifaceted, and complex latent constructs. Some research suggests that impulsivity, another core component of BPD, may be a facet of emotion dysregulation (Sebastian et al., 2013). Considering the centrality of emotion regulation and impulsivity to BPD, it would be valuable for future research to dissect the construct of emotion regulation and examine how each component part changes over treatment, as well as the relationship between each of those components and other proposed treatment mechanisms.

Finally, it is important to highlight that this research generalizes to a very specific sample: chronically suicidal, treatment-seeking, individuals with BPD, living in a

Canadian context. It will be important for future studies to examine whether the results of this study apply to other populations for whom DBT is used as a treatment.

Conclusion

Understanding the mechanisms of change in DBT has the potential to elucidate more effective, efficient ways to help BPD patients. Indeed, research into the mechanisms of change in psychotherapeutic interventions has been hailed as the future of psychotherapy research (Kazdin, 2007). Given the high societal and personal costs of BPD, continued efforts to understand key mechanisms of change and improve and streamline treatment are critically needed and will have substantial health impacts.

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