Mapping Aspects of Psychotherapy in Dialectical Behavior Therapy

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Study Protocol and Data Analytic Plan

1. Brief Description of Protocol

1.1 Protocol Overview

The aim of this study is to compare the effects of DBT emotion regulation skills training (DBT-ER), DBT interpersonal effectiveness skills training (DBT-IE), and an evidence-based interpersonal process (IP) support group developed by Dr. Constantino on emotional functioning and on BPD-related outcomes. These targets will be assessed using innovative laboratory-based assessment methods. This study uses an NIH Phase III randomized clinical trial to parse the link between elements of DBT skills training modules to specific mechanisms of action. Participants are adults with 4+ BPD criteria and recent, recurrent self-injurious behaviors (*N* = 81). The interventions under study are:

- An orientation meeting plus 6-week DBT-ER skills training group,
- An orientation meeting plus 6-week DBT-IE skills training group, and
- An orientation meeting plus 6-week IP support group

Theorized mechanisms and outcomes will be assessed via self-report and laboratory assessment at baseline (week 0-1), mid-treatment (week 3-4), and post-treatment (week 6-7), and follow-up questionnaires will be administered (week 13-14).

Participants were randomized via the Redcap randomization module[1], stratified by reported emotion regulation difficulties (above/below 106.87,) the lower end of the cutoff in previous research,[2] and gender.

1.2 Methods Summary

Self-report measures will be assessed at baseline, mid-treatment (week 3-4), post-treatment (week 6-7), and follow-up (week 13-14). Primary (namely BPD symptoms on the Borderline Symptom List, BSL,[3] emotion dysregulation on the Difficulties in Emotion Regulation Scale, DERS, [4]) and Secondary (DBT skills use on the DBT-WCCL, [5]) self-report p\outcomes are indicated below, although additional measures will also be included. Laboratory-based paradigms will be assessed at baseline, mid-treatment, and post-treatment.

1.2.1 Deliberate Emotion Regulation Laboratory Paradigm

Standardized scripts will be used to assess deliberate emotion regulation, based on past work [6]. Scripts are approximately 4 sentences, written in second-person ranging 45-50 seconds in length, used in past research with BPD samples ([7]; [6]). We first evaluate baseline responses with a recorded neutral mood induction script (selected randomly of 3 standard scripts). Participants continue to sit for another 90-120s after each script ([7]; [6]), while physiological measures (skin conductance, heart rate variability) are recorded. Participants then listen to 2 recorded negative scripts (randomly selected from 6 total scripts that elicit comparable negative valence/arousal in BPD samples). Per past research [8, 9], participants are instructed to either *maintain* (i.e., respond as they normally would) or *decrease* (i.e., adopt a third-person, detached view) their emotions while listening to the negative scripts. Instruction order is counterbalanced.

1.2.2 Automatic Emotion Regulation Laboratory Paradigm

To evaluate "automatic emotion regulation", we will use an established paradigm used in BPD samples.[93] Startle eye-blink is assessed, and participants wear headphones throughout. Participants are presented with negative and neutral images (primarily social from the IAPS[160] used in BPD samples[81]), with some images presented twice, permitting an examination of Repeated vs. Novel images, consistent with past work in BPD.[93] A subset of images in each Valence (Neutral, Negative) and Stimulus Type (Novel vs. Repeated) were accompanied by a startle-eliciting probe (105 dB sound pressure level white noise 50ms long). Unique images matched for valence/arousal will be counterbalanced and used at each lab session. EMG will be used to assess startle amplitude, permitting an examination of affect-modulated startle.

2. Data Analytic Plan

2.1 Preliminary Analyses

Preliminary analyses will examine descriptive data to examine distributional properties of each variable. Transformations (e.g., log transformations) will be applied for variables not meeting normality assumptions. Alternative models (e.g., Poisson or negative binomial) will be used for variables that are not sufficiently normalized by these transformations, as appropriate. Extreme outliers will be considered and adjusted if necessary.

We will consider data missingness. If the data are in fact missing not completely at random, we may only include the ITT sample that also completed at least one of the follow-up timepoints. If data are MAR, we will use Full Information Maximum Likelihood Estimation (FIML),[10]

Preliminary analyses will examine the effectiveness of the lab-based manipulations in the paradigms, to check that the hypothesized emotion induction manipulations operated as expected.

Covariates will be considered per analysis. We will consider including covariates that show associations with the dependent variables (DVs) in analyses[197] particularly if they differ across conditions, including demographic variables, baseline measures of the variables of interest ((and BMI and medication in analyses of physiological variables). Given the small sample size, nonsignificant variables in models may be trimmed from final model reporting.

2.2 Primary Analyses

Given that most of these outcomes will be assessed at Weeks 0 (baseline), 3-4, 6-7, and 13-14, for most primary analyses we will use mixed effects models. We plan to evaluate whether the data are appropriate for use of multilevel models which account for the interdependence of multiple repeated measures within individuals, using full maximum likelihood estimation. Consistent with recommended practices,[11] we will consider a series of models to test how to consider time, levels, and which (if any) random effects to include. If such models do not accurately capture the data, we may resort to single-level regressions. In addition, it is important to consider variability in the group clusters, which is a key strength of using multilevel model analyses to model complex change over time. Given the restraints on sample size imposed by the scope of this proposal, we opted to minimize group-level variability across groups and therapists by retaining the same DBT therapists across the DBT-ER and DBT-IE conditions. Likewise, across all control groups, we will retain the same therapists. We will consider whether to model variability at the level of groups. Alpha will be set to .05 for primary pre-specified outcomes without error correction given the small sample size.

2.2.1 Primary Outcomes

We will examine the effect of condition (DBT-ER, DBT-IE, IP) on (1a) BPD (as measured by the BSL, [3]) and (1b) emotion regulation (as measured by the DERS, [4]). These outcomes were assessed at baseline mid-treatment, post-treatment, and follow-up. We will examine change slopes within each condition and test how these slopes differ.

2.2.2 Secondary Outcomes

We will examine the effect of condition (DBT-ER, DBT-IE, IP) on changes in (2) emotional reactivity and regulation in response to a deliberate emotion regulation paradigm (with Maintain, Decrease, and Neutral instructions) on (2a) self-report on the PANAS negative affect scale[12], (2b) skin conductance, and (2c) high-frequency heart rate variability. Likewise, we will examine the effect of condition (DBT-ER, DBT-IE, IP) on changes in (3) affect-modulated startle (e.g., eyeblink amplitude assessed via EMG to Neutral vs. Negative [repeated and novel] images with associated probes, corrected for startle-only trials). These outcomes will be assessed repeatedly within each baseline, mid-treatment, and post-treatment laboratory session (no follow-up assessment was conducted for these outcomes). As described above, where appropriate we will leverage the repeated measures nature of these data to increase power, but may collapse across levels of data if appropriate to best model variability (e.g., we may create difference scores for startle outcomes across categories; we may aggregate counts of self-injury or attempts post treatment as a single level outcome rather than modeling change via a latent growth curve model if insufficient fluctuation in these outcomes is found). Mixed effects models will test the change across time in self-reported affect, skin conductance, and heart rate variability in the paradigms over treatment, and will compare these time effects across conditions.

2.3 Additional Analyses

Although not included as primary or secondary outcomes, we will also examine the effects of Condition and Time on self-injurious behaviors ([13,14] although these have a low base rate and may not be possible to model in a latent growth curve analysis) and interpersonal targets (e.g., interpersonal bias,[15] interpersonal emotion regulation,[16] and interpersonal problem solving[17,18]). Further, we will consider sex (if adequately powered), emotion dysregulation and interpersonal functioning and diagnosis (especially co-occurring PTSD[145,182]) as moderators of treatment response. Furthermore, although potentially underpowered, we will also consider whether change in interpersonal or emotional targets predict subsequent changes in BPD symptoms on the BSL (and self-injury, if possible) differentially based on Condition.

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