

The DBT Coach Mobile Application as an Adjunct to Treatment for Suicidal and Self-Injuring Individuals With Borderline Personality Disorder: A Preliminary Evaluation and Challenges to Client Utilization

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Acquisition and generalization of specific behavioral skills is a key component of dialectical behavior therapy (DBT) for individuals with borderline personality disorder (BPD). We examined the feasibility, acceptability, usability, and immediate effects of the DBT Coach, a mobile phone application (app) designed specifically to augment skills generalization through interactive coaching in DBT skills. In this pilot study, we provided the DBT Coach installed on a mobile device as an adjunct to 6 months of standard DBT, among a sample of 16 individuals with BPD and a recent history of attempted suicide and/or nonsuicidal self-injury (NSSI). Results indicate good acceptability and usability of the DBT Coach with considerable between-person variability in the frequency of app use and a median use of only 11.5 times over the course of treatment and a 3-month follow-up period. Using a hierarchical linear modeling approach, analyses indicated the DBT Coach reduced subjective distress and urges to self-harm following app use. However, use of the DBT Coach was not related to any treatment outcomes, except for reductions in NSSI. This study is the first to examine the use of mobile technology as an adjunct in DBT and highlights some potential challenges in incorporating apps into treatment. Implications for future research and clinical utility are discussed.

Keywords: mobile technology, dialectical behavior therapy, borderline personality disorder, suicidal behavior

Dialectical behavior therapy (DBT; Linehan, 1993) is a well-researched psychosocial treatment that has been found to be effective for treating borderline personality disorder (BPD) and associated problems. To date, over 20 published randomized controlled trials support DBT's efficacy across a number of behavioral problems; the majority of these studies have examined BPD specifically with suicidal behaviors as a primary outcome (see Rizvi, Steffel, & Carson-Wong, 2013 for a review). Dialectical behavior

therapy is a comprehensive, multimodal treatment based on a combined capability (skills) deficit and motivational model of BPD. This model states that (a) chronically suicidal individuals with BPD lack important interpersonal, emotion regulation, and distress tolerance skills, and (b) personal and environmental factors often both block and/or inhibit the use of behavioral skills that BPD individuals do have. Standard outpatient DBT includes four treatment modes: individual psychotherapy, skills training, psychotherapist consultation team, and phone consultation.

The fundamental principle behind phone (or text or e-mail) consultation is that suicidal individuals with severe skills deficits need explicit help in generalizing skills that they learn in psychotherapy to their daily lives, and especially during states of high distress. Empirical research has supported the relative importance of skills practice in DBT. Two studies (Lindenboim, Comtois, & Linehan, 2007; Stepp et al., 2008) have indicated that self-reported practice of skills increases as length of time in treatment increases. Another study has indicated that DBT skills use mediates primary treatment outcomes (Neacsiu, Rizvi, & Linehan, 2010). A recent component analysis supported the efficacy of the skills training component of DBT relative to DBT with a nonskills based activities group (Linehan et al., 2015). Taken together, it is quite possible that increased use of skills could lead to greater improvement in clinical outcomes and thus efforts should be made to support skills acquisition and generalization.

One mechanism for skills acquisition and generalization is mobile technology. Mobile technology is a burgeoning field and provides a multitude of opportunities for psychotherapy research and practice. As of April 2015, 64% of adults in the United States

This article was published Online First August 15, 2016.

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This project was supported by Grant SRG-0-126-11 awarded to Shireen L. Rizvi from the American Foundation for Suicide Prevention. The content is solely the responsibility of the authors and does not necessarily represent the official views of the American Foundation for Suicide Prevention. We acknowledge the following people who helped make this project possible; David Carroll, Linda A. Dimeff, Melanie Harned, Marsha M. Linehan, and colleagues at Behavioral Tech and BTECH Research. The research staff and study therapists include Kristen Roman, Jenna Blewis, Alexandra Hittman, Lauren Bonavita, Pedro Oliveira, Amanda Carson Wong, David Eddie, Sara Geisser, and Jessica Yu. Rizvi provides workshops and consultation on DBT for Behavioral Tech, LLC.

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own a smartphone (Smith, McGeenley, Duggan, Rainie, & Keeter, 2015). Given the high prevalence of smartphone use, the myriad of indispensable functions performed by smartphones, and the fact that most people carry their mobile phones at all times and have immediate access to them, mobile technology is likely to exert great influence on clinical practice now and in the future. At present, there is very little known about the use of smartphone applications (apps) within evidence-based treatments and there is a dearth of research on this topic. This is especially concerning given the ubiquity of smartphone apps purported to alleviate symptoms of psychological disorders. Widespread accessibility without research is problematic; apps may have no effect on the symptoms they are designed to treat, or worse yet, their use may be detrimental. Thus, it is extremely important to empirically evaluate the effects of apps on mental health outcomes.

The skills coaching component of DBT may be particularly well-suited to mobile technology translation due to the concrete nature of DBT skills and the theoretical importance of on-demand coaching in DBT. A mobile app could provide in-the-moment guidance in identifying the appropriate skill and step-by-step instruction in skills use when distressing problems arise in daily life. Relative to phone coaching, a mobile app may increase the immediacy of coaching and reduce barriers to accessing skills coaching such as social avoidance. Despite the availability of phone coaching in comprehensive DBT, not all individuals engage in and benefit from phone coaching. Accessing a mobile app for skills coaching may be more acceptable and/or feasible in a broader range of situations than contacting one's psychotherapist or referring to the DBT skills worksheets. A mobile platform for skills coaching thus has the potential to increase the extent to which suicidal individuals with BPD engage with an important treatment component. Furthermore, increased options for on-demand skills coaching may reduce clinician burden.

The DBT Coach is a smartphone application that provides interactive, on-demand coaching in DBT skills. The DBT Coach was developed as an adjunct to standard DBT with the explicit purpose of encouraging and facilitating the use of skills in individuals with BPD. Initial pilot work (Rizvi et al., 2011) with an early version of the DBT Coach was promising. Even with the limited capability to coach in only one skill (the emotion regulation skill of opposite action), the DBT Coach was associated with a decrease in emotional intensity after each DBT coaching session, as well as a decrease in depression and general distress over the course of the 2-week trial period. Since that study, the DBT Coach was expanded to include most of the DBT skills from all four modules (Linehan, 2015). The present study is the first to examine the DBT Coach in this expanded form.

We could find only one app similar to the DBT Coach that has been the basis of some empirical research. The Prolonged Exposure (PE) Coach is designed to facilitate implementation of the treatment components of PE treatment for posttraumatic stress disorder (Reger et al., 2013), including completion of in vivo and imaginal exposure homework assignments and skills practice such as breathing retraining. A study on clinician perceptions of the prospect of using the PE Coach in conjunction with PE prior to the app's availability revealed generally favorable perceptions of the app, including beliefs that it could augment the existing components of PE, was not overly complex, and was in line with their own values and their patients' values (Kuhn et al., 2014). A year after the PE Coach became available in 2012, a

survey of Veterans Affairs clinicians trained in PE suggested that half used the PE Coach with at least one client, clinician perceptions were generally favorable, and the majority of clinicians intended to use the app, suggesting rapid dissemination among this sample of clinicians (Kuhn et al., 2015). Furthermore, a case study of two clients for whom the PE Coach was integrated into 4 of 8 PE sessions suggested that clients viewed the PE Coach positively and preferred sessions with the app (Reger, Skopp, Edwards-Stewart, & Lemus, 2015). However, to date, there have been no published studies on the extent to which clients use the PE Coach and whether it facilitates treatment as intended. To our knowledge, there have been no studies examining acceptability, usage, and effects of other apps integrated into psychological treatment.

The purpose of the current pilot study was to test initial feasibility, acceptability, and immediate effects of the DBT Coach when integrated into a standard DBT program for suicidal individuals with BPD. We were interested in determining usage patterns of the DBT Coach and whether use of the app was related to decreases in distress and suicidal urges both in-the-moment of use as well as over the course of treatment. Furthermore, we aimed to determine if specific demographic or psychopathology factors predicted higher use of the app. These results would further speak to the feasibility of incorporating the DBT Coach into standard DBT.

Method

Participants

Participants were 16 adults who met criteria for BPD and a recent history of repeated nonsuicidal self-injury (NSSI) and/or suicide attempts who sought comprehensive DBT at a DBT clinic housed at a large, mid-Atlantic university. Recent history of NSSI and/or suicide attempts was defined as at least one instance of either NSSI or attempted suicide in the 6 months prior to pretreatment assessment and a second within the last 5 years. To participate in the study, individuals had to live within 1-hr commuting distance of the clinic, consent to video recordings of assessments and psychotherapy sessions, and could not concurrently receive other treatment with the exception of psychiatric medication management, nor have prior participation in 6 months or more of comprehensive DBT. Exclusion criteria were IQ below 70, non-English speaking, primary psychotic disorder, current substance withdrawal requiring medical management, or life-threatening eating disorder.

The majority of participants (75%) were women. The mean age was 27.50 ($SD = 7.71$; range = 19–49). The majority of participants were White ($n = 11$), with two non-White Hispanic, two multiracial, and one Black participant. All had attained at least some college education; 4 participants were employed part- or full-time, 6 participants were unemployed, and 6 participants were students. Most participants were single, never married (69%). The most common comorbid disorders present at pretreatment were generalized anxiety disorder (63%), social anxiety disorder (50%), major depressive disorder (44%), and posttraumatic stress disorder (25%). Participants reported significant psychosocial impairment, with a mean global assessment of functioning (GAF; American Psychiatric Association, 2000) score of 45.94 ($SD = 8.92$, range = 31–65). Eighty-two percent of the sample had attempted suicide

(mean number of lifetime attempts = 8.7, *Mdn* = 2), and 94% had engaged in nonsuicidal self-injury (mean number of lifetime NSSI acts = 797, *SD* = 1952, range = 2–7,500, *Mdn* = 60).

Measures

Diagnostic interviews. At pretreatment assessment, psychological diagnoses defined by the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.; *DSM-IV-TR*; APA, 2000) were evaluated using the Structured Clinical Interview for *DSM-IV* Axis I and Axis II Disorders (SCID-I; First, Gibbon, Spitzer, & Williams, 1995; and SCID-II; First, Gibbon, Spitzer, Williams, & Benjamin, 1997). The SCID is a semistructured interview widely used for assessing all five axes of the *DSM-IV* with good reliability (Segal, Hersen, & Van Hasselt, 1994; Williams et al., 1992).

Psychopathology. Severity of psychopathology was indexed with three measures: GAF assessed via the SCID-I, the General Severity Index (GSI) on the Brief Symptom Inventory (BSI; Derogatis, 1993), and emotion dysregulation measured by the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). The GSI is a widely used global index of 53 self-reported psychological symptoms rated from 0 (*not at all*) to 4 (*extremely*). The DERS is a widely used, 36-item self-report of how often participants experience difficulties regulating their emotions using a 5-point scale; 1 (*never*) and 5 (*almost always*).

Suicide and self-harm behaviors. The Self-Injurious Thoughts and Behaviors Interview, long form (SITBI; Nock, Holmberg, Photos, & Michel, 2007), a semistructured interview, was used to assess counts of NSSI and suicide attempts at pretreatment, mid- and posttreatment, and 3-month follow-up. The SITBI has been found to have strong psychometric properties (Nock et al., 2007).

Skills use. The DBT Ways of Coping Checklist (DBT-WCCL; Neacsiu, Rizvi, Vitaliano, Lynch, & Linehan, 2010), a self-report

measure of frequency of coping responses, was used to assess frequency of DBT skills use during the past month. The DBT-WCCL consists of a 38-item subscale of DBT skills described in layperson terms (DBT-SS). Previous examination of the DBT-SS found excellent internal consistency and test-retest reliability (Neacsiu et al., 2010).

Technology and DBT Coach expectations. At pretreatment, participants rated their comfort using technological devices and expectations for the DBT Coach on a face-valid measure. After reading the following description, “The DBT Coach app is designed to provide immediate, interactive coaching on DBT skills. The app helps clients figure out on their own what skills to use in particular situations and how to practice them,” clients rated on a 5-point Likert scale how often they anticipated using the app (*less than once a month*, *once a month*, *once a week*, *daily* and *multiple times per day*) and how helpful they expected the app to be, from 1 (*not at all helpful*) to 5 (*very helpful*). Participants also indicated whether they anticipated that the app, phone coaching with their psychotherapist, or both would be most useful between sessions.

Acceptability and usability of DBT Coach. At midtreatment, posttreatment and follow-up, participants rated ease of use, appearance, overall functionality, and acceptability of the DBT Coach on a 16-item questionnaire with face validity. Sample items include “How helpful has the DBT Coach been to you in your treatment so far?” and “How easy is the DBT Coach material to understand?”

DBT Coach data. Data were collected every time participants initiated the DBT Coach. Distress and urges to self-harm were assessed with forced choice ratings on a horizontal slide bar ranging from 0 to 10 in response to the questions: “How distressed are you at this moment?” and “How strong are your urges to harm yourself?” at the start and end of each app use. Participants also rated post-Coach helpfulness, on a scale ranging from 0 to 5, in response to “How helpful was this coaching session?” (see Figure 1).

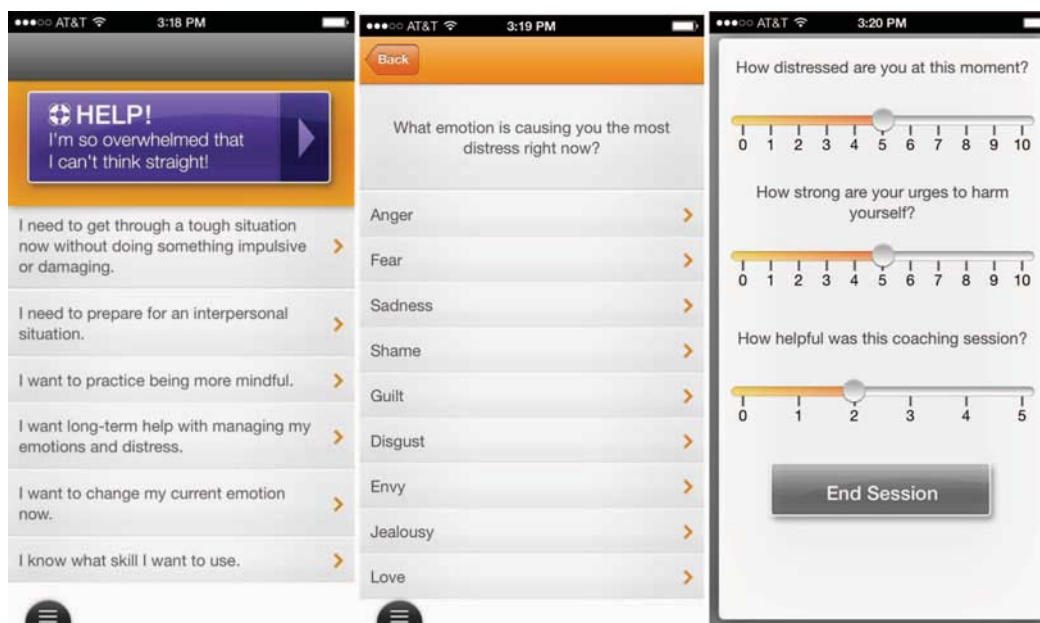


Figure 1. Sample screenshots of the DBT Coach app. See the online article for the color version of this figure.

Procedure

Study procedures were approved by the institutional review board. Participants were individuals from the community seeking DBT treatment at their own initiation or by referral from local agencies and clinicians. Interested persons completed a brief screening assessment over the telephone. Next, participants came to the clinic where they provided written informed consent and completed interviews assessing eligibility, psychological diagnoses, and baseline measures (pretreatment assessment). Treatment entailed 6 months of comprehensive DBT consisting of weekly individual psychotherapy, weekly group skills training and as needed telephone coaching. Study psychotherapists were advanced graduate students who participated in a weekly consultation team and weekly supervision with a DBT expert. Participants completed assessments at 3 months (midtreatment), at the end of 6 months of DBT (posttreatment), and 3 months posttreatment (follow-up).

The DBT Coach was available to participants for the duration of treatment as well as a 3-month follow-up period when they were no longer in treatment at the DBT clinic. Within 1 week of beginning skills group, the DBT Coach was installed on the participant's own mobile device for those who owned an iPhone or iPod Touch ($n = 7$), or provided to participants on an iPod Touch loaned to them by the study ($n = 9$). A research assistant demonstrated how to use the app for coaching, how to complete the pre- and post-Coach assessment questions, and how to transmit data electronically. While in treatment, clients were encouraged to use the app by their individual psychotherapist and group leaders, and app data were transmitted weekly during skills group. This transmission occurred via a button in the app's settings menu that a user could click to send data. These data would then be downloaded into a cloud file that the research staff could access and convert to a Microsoft Excel file. During the follow-up period, participants were prompted by the research assistant via text message every 2 to 3 weeks to electronically transmit data by clicking on the "Send Data" button.

DBT Coach application. The DBT Coach is a mobile technology application that includes content from all four modules of Linehan's (2015) revised skills manual (i.e., mindfulness, distress tolerance, emotion regulation and interpersonal effectiveness skills). Participants accessed the app by tapping an icon on the home screen of an iPhone or iPod Touch. The initial screen assessed pre-Coach distress and urges to harm oneself on a 0 to 10 horizontal slide scale. Clients then tapped a button reading "Begin Session." On the next screen, clients viewed a menu listing five problem categories for which they may have been seeking coaching, as well as the option to directly select the skill they wanted to use (see Figure 1). Based on their selection from this menu, the Coach used iterative branching to guide clients to the skill most likely to be relevant to their particular situation at that moment. If a client was unwilling to try the suggested skill, or tried and reported that the skill did not help, he or she was provided further coaching before being redirected to either the main menu or given the option to end the session. At session end, clients rated post-Coach distress, urge to harm themselves, and the helpfulness of the session.

Data Analysis

Prior to conducting primary analyses, DBT Coach session data that appeared to be invalid (i.e., sessions longer than 2 hr, shorter than 20 s, or incomplete due to missing post-Coach ratings) were removed. Next, usage patterns were analyzed by participant and treatment phase. Due to the non-normal distribution of the app use frequency (see below), Spearman's rank-order correlation was used to identify any significant relationships between frequency of use and demographic and baseline psychopathology variables. Because of the longitudinal nature of our design (resulting in a multilevel data structure where repeated measures are nested within individuals), hierarchical linear modeling (HLM; Bryk & Raudenbush, 1992; HLM 6.1 software) was used to assess whether DBT Coach use frequency predicted changes in measures of psychopathology, suicidal behavior, or self-reported skills use over the course of treatment. Specifically, scores on outcome measures were entered as the dependent variable, app use and time were entered as predictor variables at level one (repeated-observations model), and baseline scores on the measures were entered as a predictor variable at Level 2 (person-level model).

Similarly, because of the multilevel nature of the data (repeated [pre-post Coach] measures nested within individuals), we used HLM to examine the efficacy of the app for reducing participants' levels of distress and urges to self-harm. This approach allowed for comparison of differences between pre- and post-Coach ratings of each session while accounting for within-person variability in outcomes. For each outcome (distress and urges to self-harm), we ran two models: first, a fully unconditional model (in which no level one variables were entered). For the second model, we added time of the rating (pre- or post-Coach) as a level one predictor variable, in which a negative slope for time indicates that distress/urges decreased from pre-to-post session rating. Comparison of the two models allowed us to determine the proportion of variance explained by the additional variable (time), which is an index of effect size.

Results

Of 16 participants who began the study and received the app, 4 participants (25%) dropped out of treatment (noted by asterisks in Figure 2). Three of these individuals terminated prior to midtreatment and one terminated in the fifth month of treatment. Two dropouts completed the interview portion (but not self-report measures) of the posttreatment assessment, one individual did not complete any assessments subsequent to terminating treatment, and one individual completed all subsequent assessments.

Participants indicated high levels of comfort with technology in general. Prior to receiving the app, over half of participants expected the DBT Coach to be more desirable than phone coaching with one's psychotherapist and nearly a third of participants anticipated coaching via the app to be more helpful than phone coaching with one's psychotherapist. On average, participants expected to use the Coach once weekly (see Table 1).

In terms of DBT Coach acceptability and usability, there were clear positive notes and negative notes (see Table 2). Specifically, participants generally found the app easy to understand and use. Participants endorsed agreement that the DBT Coach is helpful to the treatment of suicidal and self-harming individuals, and found it moderately helpful in their own treatment. At midtreatment and

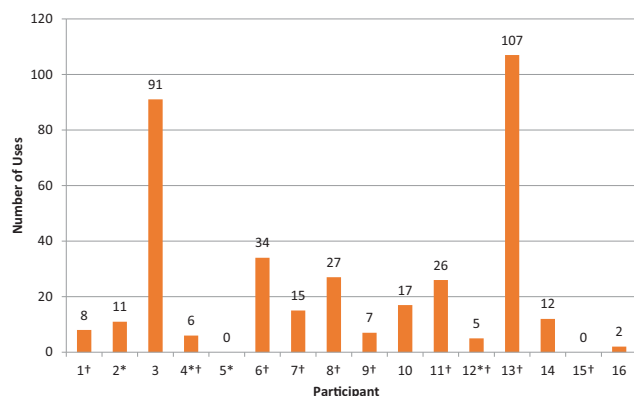


Figure 2. Frequency of DBT Coach uses by participant. Asterisks indicate that the participant dropped out of the study prior to the completion of treatment. Daggers indicate that the participant used a borrowed iPod touch to access the DBT Coach app. See the online article for the color version of this figure.

posttreatment, over 90% of participants reported that they would use the app if it were available for use outside of this study. However, participants provided relatively low ratings regarding how enjoyable and interesting they found the app to be.

Of 477 total DBT Coach sessions, 79 sessions were determined to be invalid and removed before analysis. Thirty-two sessions were removed because they were exited without providing end-of-session ratings, and 31 sessions were removed because the length of time between the pre- and post-Coach ratings indicated invalid data. Furthermore, one participant's Coach data (16 sessions) were excluded from analyses because each post-Coach rating across all sessions was the default answer choice, indicating invalid responding. The final dataset consisted of 368 valid sessions. In terms of pre-Coach distress, valid ($M = 4.62$, $SD = 2.68$) and invalid ($M = 4.39$, $SD = 2.41$) sessions did not significantly differ, $t(445) = 0.70$, $p = .48$. There was also no difference between valid ($M = 1.75$, $SD = 2.67$) and invalid ($M = 2.23$,

$SD = 2.49$) entries on pre-Coach self-harm urges, $t(445) = -1.47$, $p = .14$.

Fifteen of 16 clients used the Coach, though one participant's data were considered invalid for analysis purposes (see previous text) and thus are not included. Among those who used the app, the frequency of usage varied substantially by participant, ranging from two to 107 uses, with a median of 11.5 uses over the course of the 9-month trial (6 months of treatment plus 3-month follow-up; see Figure 2). There was no difference in frequency of use between participants with their own iPhone and those with a borrowed iPod Touch, $t(14) = 0.08$, $p = .94$. Overall, participants used the app more frequently at the beginning of treatment and use decreased over time: 187 sessions occurred in the first half of treatment, 108 sessions in the second half, and 70 sessions during the follow-up phase (three sessions could not be categorized due to miscoding of the date by the application). The demographic variables of age, gender, race/ethnicity, and education level were not significantly associated with app use. Further, none of the measures of baseline psychopathology (GAF, GSI, or DERS) correlated with app use. Although history of suicide attempts was not related to frequency of app use, history of NSSI (both lifetime and in the 1 year prior to the study) was correlated with frequency of app use across all participants. Specifically, greater frequency of lifetime NSSI, $r_s(16) = .506$, $p < .05$, and greater frequency of NSSI episodes in the last year, $r_s(16) = .645$, $p < .01$, were associated with greater use of the app.

We further assessed whether frequency of DBT Coach use predicted changes in measures of psychopathology, suicidal behavior, or self-reported skills use over the course of treatment using HLM (model explained above in analysis plan). DBT Coach use was not a significant predictor of change in any measures of psychopathology, suicide attempts, or self-reported skills. Frequency of use was a significant predictor of changes in NSSI, $B = -2.49$, $SE = 0.56$, $t(38) = -4.43$, $p < .001$, such that increased DBT Coach use predicted a greater reduction in the number of instances of NSSI over the course of treatment, explaining an additional 26.41% of the within-person variability.

Table 1
Participants' Technology Expectations

Selected technology expectation item	Pretreatment	
	<i>N</i>	<i>M</i> (<i>SD</i>)
In general, how comfortable are you using technology, such as computers, the internet, smart phones, and tablet devices (e.g., iPads)? 1 = not at all comfortable, 5 = very comfortable	16	4.44 (.81)
How often do you think you will use the DBT Coach app during your six months of treatment? 1 = less than once a month, 3 = once a week, 5 = multiple times per day	16	3.63 (.81)
How helpful do you think the DBT Coach app will be? 1 = not at all helpful, 5 = very helpful	16	3.56 (.63)
Does using the DBT Coach app sound more or less desirable than calling your individual therapist for phone coaching?	16	56% = more desirable 25% = less desirable 19% = no difference
Which do you think would be more helpful overall between sessions?	16	31% = DBT Coach 38% = phone coaching 31% = no difference

Note. DBT = dialectical behavior therapy.

Table 2
DBT Coach Usability and Acceptability

Selected acceptability/Usability items	Mid-treatment		Posttreatment	
	<i>N</i>	<i>M</i> (<i>SD</i>)	<i>N</i>	<i>M</i> (<i>SD</i>)
How much have you enjoyed the DBT Coach? 1 = <i>not enjoyable</i> , 5 = <i>extremely enjoyable</i>	12	2.58 (.90)	13	2.08 (.954)
How helpful has the DBT Coach been in your treatment so far? 1 = <i>not helpful</i> , 5 = <i>extremely helpful</i>	12	2.50 (.80)	13	2.46 (.88)
How helpful do you imagine the DBT Coach to be to treatment of individuals with suicidal and self-harm behaviors? 1 = <i>not helpful</i> , 5 = <i>extremely helpful</i>	12	3.08 (1.08)	13	3.23 (.93)
How well does the DBT Coach hold your interest? 1 = <i>doesn't hold my interest</i> , 5 = <i>completely holds my interest</i>	12	3.08 (1.08)	13	2.46 (1.13)
How easy is the DBT Coach material to understand? 1 = <i>very difficult</i> , 5 = <i>very easy</i>	12	4.17 (.84)	13	4.00 (1.00)
How informative is the feedback you receive from the DBT Coach? 1 = <i>not at all informative</i> , 5 = <i>very informative</i>	12	3.33 (.78)	13	3.08 (1.04)
Overall rating of the DBT Coach in assisting your learning and practice of DBT skills to handle difficult situations? 1 = <i>not helpful</i> , 5 = <i>extremely helpful</i>	12	2.83 (.72)	13	3.08 (1.08)
If the DBT Coach was available for use outside our research would you make use of it on your own initiative?	12	90.90% (yes)	13	92.30% (yes)

Note. DBT = dialectical behavior therapy.

To assess the short-term efficacy of the DBT Coach, we conducted HLM analyses to examine whether participants reported a significant change in their pre to post-Coach distress and self-harm urges (outlined in analysis plan). As predicted, results indicated a significant reduction in participants' distress ratings at the end of DBT Coach sessions; pre-Coach $M = 4.62$ ($SD = 2.67$), post-Coach $M = 3.14$ ($SD = 2.19$), $B = -1.49$, $SE = 0.16$, $t(721) = -9.02$, $p < .001$. The addition of time as a level one variable accounted for an additional 10% of the within-person variability. In addition, HLM analyses revealed a significant reduction in urges to self-harm following app use (although urges were relatively low at both time points); pre-Coach ($M = 1.75$, $SD = 2.67$), post-Coach ($M = 1.13$, $SD = 1.97$), ($B = -0.61$, $SE = 0.15$), $t(721) = -4.10$, $p < .001$. The addition of time as a level one variable explained an additional 2.14% of within-person variability.

Although there was a significant reduction in subjective distress and self-harm urges overall, there was considerable between-participants variation in terms of average change in distress (range = 0.8 to -2.5), urges to self-harm (range = 0.8 to -1.57) and ratings of Coach helpfulness (range = 0 to 3.79; see Table 3). Heavy users of the app reported greater average reduction in distress and urges to self-harm and rated DBT Coach sessions as more helpful. When collapsed across participants, 68% of sessions resulted in reduced distress, 27% of sessions had equivalent pre and post ratings, and 5% of sessions indicated increased distress. With regard to urges to self-injure, 30% of sessions resulted in reduced urges to self-harm, pre and post ratings remained the same in 67% of sessions (the vast majority of which were rated 0), and 3% of sessions resulted in increased urges to self-harm.

Discussion

Despite the surge of smartphone apps designed to alleviate psychological problems, there is a dearth of research on the extent

to which they are used and their overall effectiveness. This study represents one of the first to empirically examine the feasibility, acceptability, usability, and effectiveness of a smartphone app for mental health. Specifically, the DBT Coach is designed to provide interactive coaching in the use of DBT skills to individuals in a DBT treatment program. Among a sample of individuals with BPD and a recent history of suicidal or self-injurious behavior, all but one client accessed the DBT Coach during treatment. The range of use rates was broad; overall, it was not accessed frequently, yet some clients regularly used the DBT Coach. We found that the DBT Coach appears to be effective for reducing distress and self-harm urges in the moment. However, frequency of app use did not correlate with treatment outcomes with the exception of frequency of NSSI episodes. Data from this pilot trial thus provide

Table 3
DBT Coach Use and Ratings by Participant

ID	Number of uses	Helpfulness	Distress change	Urge change
		<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
1	8	1.75 (.71)	-.75 (.71)	-.25 (.71)
2	11	.36 (.67)	-.18 (.40)	.00 (.00)
3	91	3.79 (.69)	-1.99 (1.62)	-1.26 (1.63)
4	6	2.17 (.98)	-.17 (.75)	.17 (.98)
5	0			
6	34	2.65 (1.04)	-1.21 (1.87)	-.21 (2.24)
7	15	2.27 (1.39)	-.53 (1.64)	-.07 (.26)
8	27	2.15 (1.17)	-1.37 (1.67)	-.89 (1.28)
9	7	3.29 (.95)	-2.43 (1.90)	-1.57 (1.62)
10	17	2.82 (.39)	-1.35 (1.06)	-.76 (.90)
11	26	2.12 (1.53)	-1.77 (2.47)	-1.04 (2.14)
12	5	.2 (.71)	.80 (2.39)	.80 (2.39)
13	107	3.25 (1.25)	-1.65 (1.51)	-.30 (.86)
14	12	2.92 (1.16)	-.58 (1.88)	.33 (1.15)
15	0			
16	2	2.5 (.71)	-2.50 (.71)	-1.50 (2.12)

mixed support for the use of a skills coaching app as an adjunct to DBT treatment and highlight some challenges in incorporating an app into treatment.

The immediate effects of the DBT Coach were assessed by asking participants to rate their levels of distress and urges to self-harm upon starting the app and at the end of the coaching session. The data from 368 uses over the course of the study suggest that the DBT Coach was effective at significantly reducing subjective feelings of distress as well as urges to self-harm. These results are notable given that the primary goal of skills coaching in DBT is often to immediately reduce distress and urges to self-harm so that clients refrain from engaging in self-harming and other dysfunctional behaviors and instead engage in more skillful actions. These findings indicate that the app may achieve the same function as telephone coaching. However, data regarding self-harm actions in the context of app use were not collected; thus, it is unclear to what extent using the app prevented episodes of self-harm at the times of engagement. The data indicating that greater frequency of app use was related to greater reduction in NSSI episodes are promising. More research, with larger samples, is necessary to determine if use of the DBT Coach produces reliable reductions in NSSI. It is noteworthy, however, that use of the app was not related to other outcomes. Given the uncontrolled nature of this study, it is not clear what this lack of association reflects. Since the DBT Coach was incorporated as an adjunct to a comprehensive treatment model, it is difficult to parse apart the effects of the app compared to the effects of other aspects of treatment. A study comparing DBT clients who receive access to the app with DBT clients without the app would help to illuminate some of these processes.

Despite the apparent immediate efficacy of the DBT Coach at reducing distress, the median number of uses across the 16-participant sample over the 9-month trial was 11.5 uses which is less than twice per month, on average. Two participants were heavy users of the app (91 and 107 uses) and two participants either did not use the app at all or always provided invalid data. It is unknown whether these usage patterns would extend to larger samples, nor whether this phenomenon is unique to a sample of clients with BPD using the DBT Coach or would be found with other mobile phone apps designed to be adjuncts to treatment in other populations. As the field of mobile technology in treatment expands, more data will become available about utilization rates in order to provide points of comparison. The relatively low frequency of use is especially noteworthy in light of the prediction made by participants themselves that they would use the app weekly, on average. Further, the average frequency of use in this 9-month trial was less than what was found in the 2-week trial of an earlier version of the DBT Coach in which 22 individuals with BPD and substance use disorder used the app an average of 15 times (Rizvi et al., 2011). It is possible that having the app available for a longer period of time reduced the app's novelty factor and it consequently became less enticing to use.

Though not used nearly as heavily as expected or as predicted by participants themselves, similar patterns of phone coaching with individual psychotherapists are typical for clients in DBT, wherein some clients only rarely seek phone coaching and others are frequent users. In addition, pre-Coach distress ratings indicate users sought the app when moderately distressed, which suggests that clients utilized the DBT Coach as a resource during times of need. It is possible that incorporating reminders and notifications

into the app would have increased its use. However, it is unknown whether such reminders would have improved utilization or served as a deterrent. Further research that identifies factors associated with client engagement with technological treatment modules would broaden our understanding of disparate use patterns and help close the gap between available access and actual use.

Taken together, the results from this study imply that it is feasible to incorporate the DBT Coach into treatment and the DBT Coach can be effective at reducing distress and urges to self-harm in the moment. Despite participants' report that the app was easy to navigate, the app provided informative feedback, and that they would make use of the app on their own initiative, overall there were relatively few uses of the app. Some of the obstacles to more frequent use may be represented by the usability questionnaire which suggests that participants were ambivalent about the app's overall helpfulness, how much they enjoyed the app, and how well it held their interest. To further elucidate barriers to use, study psychotherapists were asked to provide comments about their clients' use of the app. A review of these comments suggests that the majority of clients utilized the app to scaffold their learning and practice of skills. Most clients accessed the Coach less frequently over time as they became more knowledgeable in DBT skills, experienced less distress in their daily lives, and attained greater mastery over using skills when distressed. It is important to note that declining use of the app over time might not be problematic. Indeed, less frequent app use may even be expected as treatment progresses, as it may be an indication of client improvement and skills acquisition.

Regarding specific barriers to app use that were identified by psychotherapists, some clients chose not to utilize the app due to poor fit with their knowledge of DBT skills (e.g., one client expressed discouragement when he initially tried the app and was unfamiliar with the material; others reported they no longer used the app because they already knew the skills). It is possible that there is a "sweet spot" for when clients will make use of a skills coaching app: when clients have little to no familiarity with DBT skills, they may not recognize opportunities to use the app or may be daunted by the prospect of trying new behaviors, and when they have attained greater knowledge and practice of skills, they may have reduced need for the app's step-by-step guidance. Similarly, when distress is too high, clients may not think of using the app or may initiate phone coaching, and when distress is lower, clients may be less motivated to seek help. More research on factors associated with accessing available technologies is necessary in order to determine how to best develop and disseminate an app that clients will make use of whenever it could be helpful. For example, studies that investigate the effects of different timing of app introduction could identify optimal periods for incorporating a mobile adjunct into treatment.

Other barriers to more frequent use were preference for phone coaching, willfulness with regard to skills use, and either not thinking of skills or pessimism about their utility. These comments suggest that barriers to DBT Coach use overlap with general psychotherapy-interfering behaviors and that it may be warranted to target obstacles to app use as a focus of treatment. Moreover, it is possible that client use of an app may be highly influenced by clinician perception of the app and the degree to which the individual psychotherapist incorporates the app into treatment.

Clients provided subjective feedback on the DBT Coach at posttreatment and follow-up in response to an open-ended question on the usability questionnaire that asked: "How could we improve what we've developed so far to make it more useful, helpful and relevant to your treatment?" In their responses, some participants indicated that the app would be improved by expanding the app's functions to make it a "one-stop shop" by including their DBT diary card and skills group homework. In their responses related to improving the app as a skills coach, participants indicated that they wished for the app to be expanded to include all DBT skills, to include more in-depth coaching in how to practice certain skills (e.g., *radical acceptance*), and to expand the mindfulness audio and imagery stimuli and include the ability to voice record (e.g., *mindfulness* and *distress tolerance* guided breathing and meditation). Participants also suggested the app would be improved in ways making it more user friendly, such as a search tool, and by making it more personalized, such as a list of favorite skills and skills to improve on, the ability to track skills practice, and email feedback for certain skills in which users input text during coaching (e.g., interpersonal effectiveness skills and the emotion regulation skill of *cope ahead*). Some clients suggested enabling push notifications to provide them with daily mindfulness exercises and remind clients to practice skills daily as well as check in an hour after using the Coach. This feedback could be used to develop a next version of the app. However, it is unknown from this research whether these additional features would increase frequency of use and/or improve the effects of the app on important outcome variables.

This study has a few limitations that are important to address in future research. Most notably, this was an uncontrolled pilot trial with a small sample which limits the degree to which conclusions can be drawn. Although ratings of distress and urges to self-harm were reduced by using the DBT Coach, it is possible that these changes were due to something other than specific effects of the app (e.g., focused attention on an activity or the effect of time). A controlled trial comparing use of the DBT Coach to a placebo app would help in determining the causal influence of the DBT app as well as provide clearer evidence as to whether use of the app leads to better treatment outcomes. Second, the deletion of DBT Coach sessions that were deemed to be invalid because of length of session or missing post-Coach values, may have introduced a bias. Clients may have exited without entering post-Coach ratings because they found the coaching session unhelpful and were frustrated. Alternatively, they may have exited the app because they were practicing their skills and did not remember to rate their session. It is unknown how only including sessions with valid post-ratings affected the results. Third, participants in this study were all being treated in a research training clinic and were predominantly female and Caucasian; thus it is unclear whether these results would generalize to different populations in different settings. Finally, this study did not examine whether use of the app influenced frequency of coaching phone calls to the therapist. Although the DBT Coach was designed to be an adjunct to standard DBT, it is possible that one effect of the app may be a decreased reliance on telephone calls to therapists. This possibility needs to be examined in future research.

Despite these limitations, this study provides important information about the usability, acceptability, and efficacy of the DBT Coach as a mode for skills generalization when incorporated as an

adjunct to standard DBT for individuals with BPD. Furthermore, this study marks an important advance in the study of behavioral interventions provided via mobile technology. Behavioral psychotherapies have long focused on ensuring that interventions are generalizable to clients' lives as they are lived. Given the ubiquity of mobile phones, mobile applications may be the most obvious and acceptable platform in which to promote generalization. However, research in this area is sorely needed and a focus on the empirical standing of mental health apps is necessary. This research marks an important step in empirically validating mobile applications as adjuncts to mental health treatments.

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Received November 5, 2015

Revision received June 16, 2016

Accepted June 21, 2016 ■