

Internet-Delivered Dialectical Behavior Therapy Skills Training for Suicidal and Heavy  
Drinkers

Chelsey Rochelle Wilks

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Reading Committee:

Marsha M. Linehan, Chair

Mary Larimer

Kevin King

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University of Washington

**Abstract**

Internet-Delivered Dialectical Behavior Therapy Skills Training for Suicidal and Heavy Drinkers

Chelsey Rochelle Wilks

Chair of the Supervisory Committee

Professor Marsha M. Linehan

Department of Psychology

Alcohol use is considered to be a significant risk factor among those who die by suicide, especially among those who drink to regulate their emotions. Unfortunately, there is a dearth of treatment outcome research for individuals presenting with both suicide ideation and problem drinking. Moreover, treatments that target this population must be maximally effective and

widely disseminable. The application of technology has been increasingly utilized as an efficacious and acceptable way to rapidly disseminate evidence-based treatment. However, these methods are used infrequently for individuals deemed too high risk for Internet-delivered treatment. Dialectical Behavior Therapy (DBT) skills training is an effective intervention for behaviors associated with emotion dysregulation including addictive and suicidal behaviors. DBT skills use has been identified as the active ingredient for treatment effectiveness; thus, a skills training intervention delivered via the Internet has the capacity to be a potent and efficient method of treatment delivery. This project sought to evaluate the usability, feasibility, acceptability, and preliminary efficacy of an Internet-delivered DBT skills training intervention compared to a waitlist control. Participants ( $N = 59$ ) were randomized to receive the treatment immediately or after an 8-week waiting period. Primary outcomes were suicide ideation, alcohol use, and emotion dysregulation and secondary outcomes were reasons for living, alcohol related consequences, DBT skills use, and depression. Participants on average saw a significant reduction in all primary and secondary outcomes over the four-month study period. Individuals who were randomized to receive iDBT-ST first had faster reductions in suicide ideation and alcohol consumption. These preliminary results suggest that iDBT-ST may be a viable and accessible resource for high-risk and underserved populations.

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## Introduction

Suicide is a significant public health problem. In the United States, Suicide has been ranked among the top four causes of death for individuals aged 10 to 54, and as the tenth leading cause across all ages [Centers for Disease Control and Prevention (CDC), 2016]. U.S. suicide mortality surged to a 30-year high in 2014, and was the only leading cause of death to have increased significantly from 2011 to 2012. While an estimated one million adults attempt suicide and nine million report thinking about suicide each year (CDC, 2016), these figures may be an underestimation of the true scope of suicidal behavior, given that disclosure can often be inhibited by associated stigma (e.g., Czyz, Horwitz, Eisenberg, Kramer, & King, 2013; Downs, 2012).

While suicide is increasing in prevalence, it remains a low base-rate phenomenon. Consequently, attempts to accurately predict suicide are difficult if not impossible (e.g. Franklin, et al., 2016; Klonsky, May, & Saffer, 2016). Regardless, the stakes are high. Each day, thousands of mental health professionals are tasked with determining whether suicidal patients are at risk for imminent suicide, and if so, what should be done to manage their suicidality. To complicate matters, not everyone who endorses a significant degree of suicide ideation act on their suicidal urges. Epidemiological surveys have revealed that only approximately 29% of ideators follow through with a suicide attempt in their lifetimes (Nock et. al, 2008a), and while lifetime prevalence of suicide ideation has been estimated at roughly 9%, global estimates of suicide attempts hover around 3% (Nock, 2008b). In other words, only a subset of those who ideate about suicide enact an actual attempt. As a result, suicide researchers have narrowed their focus to identify factors that uniquely predict suicide attempts among suicide ideators (see Nock, Kessler, & Franklin, 2016). Along those lines, chronic alcohol use and abuse has been identified as a uniquely salient risk factor for suicide among suicide ideators, making ideators who also meet criteria for an alcohol use disorder (AUD) among one of the most at-risk populations for

suicide (Han, Compton, Gfoerer, & McKeon, 2015; Kelly, Lynch, Donovan, & Clark, 2001; Nock et al., 2010; O'Brien, Becker, Spirito, Simon, & Prinstien, 2014).

### **Alcohol and Suicide**

An empirical review of published studies reported that approximately 40% of suicides are preceded by acute alcohol intoxication (Cherpitel, Borges, & Wilcox, 2004). Among individuals physically dependent on alcohol, risk for suicide is 60-120 times greater than it is for non-clinical populations (Murphy and Wetzel, 1990), and simply meeting criteria for an AUD increases one's lifetime risk for suicide to 7% (Brady, 2006). Moreover, suicidal thoughts have been associated with greater severity of alcohol use, as indicated by such factors as younger age of drinking onset, heavier drinking patterns, more alcohol related problems, and longer duration of problematic drinking (see Sher, 2005).

Acute alcohol intoxication is also strongly related to suicide attempts and deaths. Among alcohol involved suicide decedents, blood alcohol concentrations (BAC) are often at a level that far exceeds the legal limit for driving in the U.S. (i.e. .08; Bedford, O'Farrell, & Howell, 2006; Cherpitel, Borges, Wilcox, 2004; Kaplan et al., 2013). Furthermore, intoxication oriented drinking (e.g. heavy episodic drinking; HED) is thought to be even more strongly related to suicide ideation and unplanned attempts than habitual and chronic alcohol use (Borges, Walters, & Kessler, 2000). One plausible explanation for this strong relationship is that intoxicated people are likely to attempt suicide with more lethal methods including firearms (Brent, Perper, & Allman, 1987; Branas, Richmond, Have, & Wiebe, 2011), hangings, and poisonings (Conner Bagge, Goldston, & Ilgen., 2014).

Population trends in alcohol consumption have been shown to parallel that of suicide rates. Wasserman and Varnik (1998) examined suicide rates in the former USSR from 1984-1990. During this period, policies such as substantial price hikes on alcohol were enforced to restrict consumption levels. Predictably, overall alcohol consumption decreased, but less

predictably, suicide rates simultaneously fell from 32% to 19% for men and women respectively. Moreover, suicide rates in the U.S. during the 1970s and 1990s were 8% higher in states where individuals aged 18-20 were legally allowed to drink, than in states where the drinking age was 21 (Birckmayer & Hemenway, 1999). Importantly, the relationship between alcohol consumption and suicide has shown variation in strength across time and region (Norström & Ramstedt, 2005). For instance, suicide has been found to correlate with per capita alcohol consumption in Northern but not Southern Europe, and with spirits but not beer consumption in Canada, Sweden, and the U.S., but not Norway (Razvodovsky, 2009). In other words, the link between alcohol and suicide is undergirded by variations in drinking patterns and beverage preference across and within cultures. A more complete understanding of this link thus requires a consideration of relevant factors over and above individual consumption level.

### **Exploring the relationship between alcohol and suicide**

The relationship between alcohol and suicide is complex; nonetheless, research has consistently pointed to emotion dysregulation as a common link among those who engage in both heavy drinking as well as suicidal behavior (Conner et al., 2009; Nordström, Schalling & Asberg, 1995; Brown, Comtois & Linehan, 2002). Emotion dysregulation is defined as maladaptive ways of responding to emotions (regardless of their intensity/reactivity), including avoidant responses, difficulties controlling behaviors in the face of emotional distress, and deficits in the functional use of emotions as information (Gratz & Roemer, 2004). AUDs are associated with heightened levels of emotion dysregulation (Fox, Axelrod, Paliwal, Sleeper, & Sinha, 2007), as well as difficulties engaging in goal directed behaviors when distressed, and limited access to effective emotion regulation strategies (Gratz & Tull, 2010). Urgency dimension, or the tendency to act impulsively in response to negative emotional states, has been identified as the one of the best predictors of heavy drinking (Anestis, Selby, & Joiner, 2007; Fischer, Anderson, & Smith, 2004). In addition, lacking emotion regulation strategies

significantly predicted current suicidal ideation (Rajappa, Gallagher, & Miranda, 2012), posttreatment levels of alcohol use (Berking, Margraf, Ebert, Wupperman, Hofmann, & Junghanns, 2011) and may increase risk for relapse in situations involving negative emotion (Bandura, Caprara, Barbaranelli, Gerbino, & Pastorelli, 2003). Thus, suicide ideation and alcohol misuse are theorized to function as problem solving behaviors employed in lieu of effective strategies to cope with intense negative emotions (Linehan, 1993a; Schneidman, 1993; Slee, Garnefski, Spinhoven, & Arensman, 2008; Slee, Spinhoven, Garnefski, & Arensman, 2008). The inability to generate alternative solutions, which may be consequent to alcohol abuse, is in turn associated with suicide attempts (Hawton, Haigh, Simkin, & Fagg, 1995).

Narrowing the scope further, research has identified “coping drinking motives” in young adults as a unique predictor of future heavy and problematic drinking (Cooper, 1994; Cooper, Frone, Russell, & Mudar, 1995; Goldstein & Flett, 2009). Furthermore, risk for suicide is thought to be particularly high for individuals who drink to reduce negative affect (Gonzalez, Bradizza, & Collins, 2004). Taken together, those who drink alcohol to regulate their emotions tend to exhibit disordered drinking patterns that extend beyond young adulthood, which in turn increases risk for suicide.

Unfortunately, alcohol use as an emotion regulation strategy is a poisoned chalice. While alcohol may stimulate the reduction of negative affect at low doses, the opposite occurs at higher doses where alcohol acts as a depressant on the central nervous system (see Hufford, 2001). Owing to the former property, the use of alcohol has been theorized as a way to “self-medicate” persistent low mood. For individuals with stable negative mood states, alcohol may be used to engender short-term relief, albeit at a long-term cost. Indeed, there is considerable evidence on “the self-medication hypothesis,” which theorizes that alcohol or other substance use functions to regulate negative emotional states related to mood or anxiety disorders (Bolton, Robinson, & Sareen, 2009; Quitkin, Rifkin, Kaplan, & Klein, 1972). However, while acute alcohol use offers

immediate relief from distressing emotions, these effects are reversed as individuals continue to drink alcohol in higher doses (Jahng, Solhan, Tomko, Wood, Piasecki, & Trull, 2011; Pihl & Smith, 1983). Therefore, among those with a long history of disordered drinking, heavy drinking is both the cause and solution to pervasive low mood and general emotion dysregulation.

**Biological Vulnerability.** As mentioned above, a central theme among individuals who engage in both suicidal behavior and elevated drinking levels is a general tendency to experience negative affect. Along those lines, alcoholic suicide attempters are more likely to have co-occurring mood or anxiety disorders than alcoholics who had not attempted suicide (Driessen, Veltrup, Weber, John, Wetterling, & Dilling, 1998; Chignon, Cortes, Martin, & Chabannes, 1997). In addition, alcohol dependent individuals with a history of suicide attempts were found to be significantly more likely than those without prior attempts to have first degree family members with suicidal behavior (Preuss et al., 2001; Preuss et al., 2003). Indeed, those who engage in alcohol misuse and suicidal behavior may share a common genetic predisposition, specifically within the serotonergic system (e.g. 5-HTTLPR-S-allele and TPH gene; see Gorwood, Batel, Adès, Hamon, & Boni, 2000; Mann et al., 1999; Nielsen et al., 1998; Preuss et al., 2001). Serotonin dysfunction has been strongly associated with emotion dysregulation (Hairiri & Holmes, 2006) and violence (Davidson, Putnam, & Larson, 2000) across the lifespan. This is suggestive of a biological vulnerability that may predispose individuals to suicidal behavior and alcohol misuse.

**Environmental Factors.** In addition to a potential biological predisposition toward suicide and heavy drinking, there is considerable evidence suggesting that these behaviors occur in response to significant environmental disruption. Specifically, individuals who engage in suicidal and dysfunctional drinking behaviors are characterized by interpersonal difficulties, poor social support, low self-worth, and hopelessness. In particular, it has been proposed that low self-worth and hopelessness among disordered drinkers may be related to suicide through a

process of negative life events (Kendall, 1983; Lester, 2000). Negative life events (e.g. unemployment and/or divorce) has also been identified as a key distinguishing factor between suicidal and non-suicidal alcoholics (Pirkola et al., 2000; Preuss et al., 2003). In fact, proximal interpersonal disruption has been shown to predict suicide among alcohol abusers (Conner, Beautrais, & Conwell, 2003; Murphy, Armstrong, Hermele, Fischer, & Clendenin, 1979), and conversely, social support to buffer suicidal thoughts among those with alcohol problems (Lamis, Ballard, May, & Dvorak, 2016). While it is difficult to determine whether alcohol misuse is a cause or distress-alleviating response to environmental disruption, it remains highly plausible that alcohol misuse contributes to, and may exacerbate or perpetuate, negative environmental outcomes (e.g. arriving to work late after a night of heavy drinking).

Figure 1 provides a model for how environmental and biological factors transact and lead to increased risk for suicide among individuals who misuse alcohol.

### **Alcohol and Suicide Summary**

While there is a strong association between alcohol and suicide, uncertainty remains about how alcohol affects suicidal behavior (and vice versa). Nonetheless, emotion dysregulation appears to be strongly associated with both suicidal behavior and chronic alcohol use. Furthermore, risk for suicide is particularly high among those who engage in acute heavy drinking that functions to reduce persistent negative mood states.

### **Treatment use for suicidal and heavy episodic drinkers**

**The treatment gap.** Before summarizing the literature of treatment use for individuals who engage in suicidal or problematic drinking behavior, it is important to highlight the lack of available treatment in general. The treatment gap refers to the proportion of individuals with psychological disorders who are not receiving treatment compared to the proportion of individuals who actually receive psychological services (Kohn, Saxena, Levav, & Saraceno, 2004). It is estimated that while more than a quarter (26.2%) of U.S. adults meet criteria for a

psychiatric disorder in a 12-month period (Kessler, Chiu, Demler, & Walters 2005b), approximately 60% do not receive any treatment (Wang, Lane, Olfson, Pincus, Wells, & Kessler, 2005). In other words, the reach of psychological interventions have bypassed the majority, ranging in the millions, of those requiring care. Taken together, the high need for services along with low help receipt indicates the existence of a substantial treatment gap in the deliverance of psychological care.

**The treatment gap for suicidal and heavy episodic drinkers.** If there is a gap for treatment need and treatment availability in general, there is a chasm for treatment need and availability for suicidal and heavy episodic drinkers. In a multi-country survey of treatment seeking behavior and barriers to treatment among suicidal individuals, Bruffaerts et al. (2011) found that 76.9% of all respondents had not been in contact with any mental health care providers in the past year, and was particularly low for individuals with suicide ideation only (e.g. 19.4% for ideators only, 31.5% for planned attempters, 41.6% for unplanned attempters). With regard to barriers experienced when enrolling in treatment, the majority expressed that they had a low perceived need for treatment (see Table 1). Such barriers to treatment can have fatal consequences, as demonstrated by Luoma, Martin, & Pearson's (2002) finding that 81% of suicide decedents were not in contact with any mental health providers in the month prior to death.

Regarding alcohol use, it is estimated that nearly 80% of individuals with an AUD never enroll in psychological treatment (Kohn, Saxena, Levav, & Saraceno, 2004). That being said, those with AUDs report similar barriers to treatment as suicidal individuals. In an early study on the subject, Cunningham and colleagues (1993) surveyed individuals diagnosed with an AUD both engaged and not engaged in treatment. The researchers found that participants not enrolled in treatment did not perceive their drinking to be a problem and wanted to handle the problem on their own. Furthermore, survey respondents rated "not wanting to be labeled an alcoholic" as

being most influential in their reason for not seeking treatment. Cryer and colleagues (1999) found that alcohol users are frequent users of medical services (e.g. emergency rooms), but underuse preventative services. Finally, those with an AUD with co-occurring mood or anxiety disorders report more barriers to treatment in general, such as cost and a perceived unmet need for treatment (Kauffman, Chen, Crum, & Mojtabai, 2014).

Very little research has examined barriers to treatment among suicidal alcoholics. In a rare study with this population, among AUD suicide attempters, treatment use did not significantly change after their attempt; specifically, only 6% had any psychotherapy prior to their attempt, and only 9% had treatment after their attempts, with treatment for addiction being the most common type of treatment (Suominen, Isometsa, Henriksson, Ostamo, & Lonnqvist, 1999). There are three major takeaways from this study: for one, suicidal alcoholics report remarkably low treatment rates; second, hospitalization after a suicide attempt did not alter treatment utilization, and finally, this study highlights the general lack of treatment availability for those presenting with both suicidal behavior and an AUD.

Table 1 presents the top barriers among suicidal as well as alcoholic individuals that had not been in treatment at the time of their respective interviews. For both groups, self-reliance, or the belief that they can handle the problem on their own, was considered the major reason for not seeking treatment. Individuals with AUDs also highly endorsed that their “problem” would get better on its own, as well as a belief that their drinking behavior was not severe. In general, barriers to treatment among suicidal and alcohol using individuals are similar, both citing attitudinal and logistical factors interfering with their ability to seek and enroll in treatment. This literature suggests that the similarities and differences between suicidal and alcohol misusing populations are quite similar, and that very little research has been conducted on treatment seeking behaviors among individuals who engage in both of these behaviors.

**Informal help seeking.** Treatment seeking is commonly characterized by an individual's *acknowledgement or awareness* of a problem that would benefit from intervention. If suicidal heavy episodic drinkers deny they have a problem, why would they engage any treatment? Among both suicidal and alcohol abusing populations, self-reliance, or the ability that one can handle the problem on one's own, is the prevailing reason why these individuals do not actively seek professional psychological treatment. A possible explanation for wanting to solve a suicidal ideation or heavy drinking on one's own is a due to an external and/or internal negative perception of the problems, or stigma. In particular, stigma around mental health issues in general is a known contributor to reticence of seeking help (Corrigan, Druss, & Perlick, 2014). Stigma around suicidality and alcohol use is particularly strong, inducing a sense of shame to individuals contemplating suicide or drinking to manage emotional distress (Calear, Batterham, & Christensen, 2014; Room, 2005). Early studies of stigma and mental health reported strikingly negative attitudes toward individuals with mental disorders (Wahl, 1999). Individuals may also experience self-stigma, or the endorsement of stigmatized beliefs toward oneself (e.g. Mittal, Sullivan, Chekuri, Allee, & Corrigan 2012). While Corrigan (2004) has argued that both public and self-stigma affect an individual's decision to seek treatment, more recent research has established self-stigma as a unique inhibitor of help seeking behavior (Vogel, Wade, & Haake, 2006; Vogel, Wade, & Hackler, 2007). In this way, suicidal drinkers may perceive themselves as weak or inadequate, and it is the shame associated with their thoughts and/or behaviors that keeps them from treatment (Luoma, Kohlenberg, Hayes, Bunting, & Rye, 2008; Tangey & Fischer, 1995).

Given societal views of both suicide and heavy drinking, the treatment-seeking paradigm may need some shifting. Along those lines, people who are coping with negative emotions using alcohol and/or suicide ideation may seek help, but in atypical sources. For example, Seward & Harris (2016) found that higher suicide risk among young adults was associated with greater

willingness to seek help through informal sources (e.g. social networking sites and anonymous forums) as opposed to formal sources. Among problem drinkers, help-seeking usually begins (and sometimes ends) with friends and family (Simpson & Tucker, 2002). In addition, college-aged heavy drinkers were more likely to seek out informal treatment avenues (e.g. talking with a friend) as well as anonymous treatment sources (e.g. Internet forums) over formal treatment avenues (e.g. alcohol treatment; Hunt & Eisenberg, 2010).

It should be noted that one's preference toward informal forms of help might be due to lack of an intervention that can effectively target both suicidal behavior and alcohol use disorders. There has not been one randomized controlled trial (RCT) targeting adults with an AUD and history of suicidal thoughts. Furthermore, as treatments targeting alcohol use alone are likely ill-equipped to manage co-occurring suicide ideation, many treatment providers are legally and/or ethically obligated to exclude individuals deemed at risk for suicide (Conner, Bagge, Goldston, & Ilgen, 2014; Mishara & Weisstub, 2005).

In summary, the treatment gap faced by suicidal individuals with co-occurring AUD constitutes a critical but under-researched problem in mental health care. To address low service receipt in this target population, effective interventions must be matched with delivery methods that are attuned to preferred help-seeking modalities. Innovations in technology offer potential non-traditional pathways for treatment-seekers to access needed services with minimal deterrence from social and attitudinal barriers. It is toward this new paradigm of treatment delivery that the next section seeks to expand.

### **Technology to reduce treatment gap**

Over the decades, significant progress has been made in the development and evaluation of psychological interventions for a multitude of disorders including addictive behavior [e.g. Cognitive Behavior Therapy (CBT); Beck, 2011] and suicide [e.g. Dialectical Behavior Therapy (DBT); Linehan, 1993a]. When compared to non-active controls, CBT for addictive behavior

had larger effect sizes (Magill & Ray, 2009). In addition, moderate effect sizes for suicidal and self-harm behaviors have been obtained in trials of DBT for Borderline Personality Disorder (BPD; Kliem, Kroger, & Kosfelder, 2010).

The existence of effective treatments however, while necessary, is insufficient as a standalone condition for the successful delivery of care. Subsequent to their development, evidence-based treatments (EBTs) require a tremendous amount of resources to be disseminated and implemented as intended. Implementation may be constrained by the lack of adequately trained clinicians, tremendous costs of transitioning an EBT from a research lab to community practice, and substantial logistical and financial burden associated with maintaining fidelity to the original treatment model. For the consumer, therapy may be cost prohibitive, often entail considerable wait times, and stigma (Wright et al., 2009; Lyons, Hopley, & Horrocks, 2009; Turner, Beidel, Spaulding, & Brown, 1996). A more effective strategy to alleviate low help receipt may consist in delivering the EBT directly to the consumer.

Technology-delivered treatments or interventions have emerged as a potential solution to reducing the treatment gap. One example is with web-based interventions, which incorporate software that automates many aspects of psychotherapy. Web-based or computerized interventions (CI) can eliminate or minimize the need for mental health providers. Compared to face-to-face therapy, computational technology is relatively inexpensive. In the United Kingdom, the National Institute for Health and Care Excellence (NICE) has estimated savings of \$2,000 to \$16,000 per client (National Institute for Health and Care Excellence, 2002; Stuhlmiller & Tolchard, 2009). Further, CIs can reach individuals that are presently outside the boundaries of traditional psychotherapy, and the Internet is growing faster than effective training in EBTs (i.e. worldwide internet usage up 832.5% from 2000-2015; Internet World Stats, 2015). Finally, treatments delivered via technological devices can be more easily updated and amended when compared to re-training treatment providers.

For the consumer, technology-delivered treatments offer an anonymous, on-demand, and convenient avenue for help. An early study investigating the use of the Internet as a method of self-help found that roughly 80% of Internet users sought healthcare information online (Eisenberg, et al., 1998). Among suicidal individuals, Gould and colleagues (2002) identified that one out of ten adolescents used the Internet for assistance with suicidal ideation, a proportion that is certain to have increased since the Internet has become even more widely used and accessible in recent years. Finally, sensitive and vital information such as drug use or suicidal thoughts appear to be more frequently disclosed on computer platforms than to a person (Classen & Larkin, 2005; Gilat & Shahar, 2009), due perhaps to the increased anonymity afforded by the Internet as a medium of communication.

**Review of computerized interventions.** To date, there have been 11 meta-analyses of web-based, Internet-delivered, or computerized treatments evaluating the overall efficacy of over 150 unique RCTs for a variety of mental disorders (Andersson & Cuijpers, 2009; Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010; Barth, et al., 2013; Cheng & Dizon, 2012; Cuijpers et al., 2009; Motter et al., 2016; Reger & Gahm, 2009; Richards & Richardson, 2012; Spek et al., 2007; Wilks, Zeive, & Lessing, 2016). Computerized interventions produce large effect sizes when targeting anxiety disorders (Andrews et al., 2010; Cuijpers et al., 2009; Reger & Gahm, 2009) and medium effect sizes for depression (Richards & Richardson, 2012). Overall, CTs produce a medium effect (Barak, Hen, Boniel-Nissim, & Shapira, 2008). The vast majority of interventions have been designed based on CBT and address mostly mood or anxiety disorders with very little clinical complexity. Individuals presenting with more complex behaviors or co-occurring disorders, including co-occurring substance use, are yet to be targeted by CT. Specifically, one meta-analysis found that over 90% of RCTs of cCBT excluded individuals at risk for suicide, and 74% excluded individuals engaging in addictive behavior (Wilks, Zieve, & Lessing, 2016).

**Web-based interventions for alcohol use.** With regard to alcohol use, there have been two systematic reviews (Khadjesari, et al., 2011; White et al., 2010) and three meta-analyses (Barak et al., 2008; Riper et al., 2011; Rooke, Thorsteinsson, Karpin, Copeland, & Allsop, 2010) on Internet and/or technological delivered interventions for alcohol use examining efficacy outcomes in a total of 45 unique studies. Internet-delivered interventions that target alcohol use can be categorized as brief intervention (lasting one hour or less in total) or long interventions (lasting several sessions over several weeks). Brief interventions consist of various forms of personalized feedback (PFB) that provide participants with information on self-reported current levels of drinking, set in comparison against safe drinking limits only. This was often accompanied with normative feedback, associated health risk, guidelines for calculating consumption units, and support services. These feedback interventions, which are grounded in motivational (Miller & Rollnick, 1991) and social learning theory (Bandura, 1977), introduce information discrepant to participant beliefs about drinking behaviors (e.g. quantity and frequency consumed) such as risk factors (e.g. tolerance), and normative comparisons (e.g. amount consumed in relation to peers). Long interventions generally include computerized versions of evidence-based approaches for reducing addictive behavior in face-to-face settings, such as motivational interviewing strategies, designed to gauge and increase participants' level of motivation to change their drinking behavior. These interventions also often include self-monitoring exercises such as daily diaries or drinking logs, as well as evidence-based strategies for behavioral change including contingency management, drink refusal strategies, and community reinforcement.

In general, CTs for alcohol use have yielded small to medium effect sizes in reducing consumption quantity and frequency, with longer interventions producing larger effects than brief ones. Strengths of online/web-based interventions, as reviewed in the above meta-studies, include consistent trends in the reduction of problematic drinking behavior. Further, many of

these interventions function with little to no therapeutic support, a condition ideal for widespread dissemination. That being said, outcomes other than drinking were absent from the surveyed literature, making problematic the generalization of positive findings to alcohol users with co-occurring disorders. Moreover, moderators of treatment effectiveness (or ineffectiveness) could not be identified as none of the reviews reported on such potential candidates as the proportion of individuals meeting criteria for co-occurring diagnoses, or measures of daily stressors.

**Web-based interventions for suicide.** To date, two RCTs for Internet-delivered interventions have explicitly examined suicide behaviors, specifically ideation (Christensen, Farrer, Batterham, Mackinnon, Griffiths, & 2013; van Spijker, et al., 2012). In van Spijker's study, a six-week CBT intervention for depression was evaluated against a waitlist control. The intervention showed a significant improvement in suicidal thoughts compared to the waitlist, albeit with a small effect size ( $d = 0.28$ ). Participants were excluded if they scored higher than a 26 on Beck's scale for suicide ideation, scored higher than a 40 on the Beck's Depression Inventory, and/or having more than "moderate suicidal thoughts." As van Spijker and others noted, the trial may have yielded stronger results had higher risk individuals been included. Christensen et al. (2013) compared a web-based CBT program against a suicide hotline. This study also excluded people who were in "high distress or acutely suicidal." While there were significant decreases in suicidal ideation, the web-based program did not outperform the hotline.

In an uncontrolled effectiveness trial of a brief, fully automated CBT course delivered over the Internet to depressed primary health care patients with suicidal ideation, Watts et al. (2012) observed a significant reduction in suicidal ideation from pre to post intervention. Based on these findings, Watts and colleagues concluded that it is unjustified to exclude suicidal individuals from computerized treatment research trials or computerized psychotherapy programs. While there is as yet insufficient evidence to make definitive claims about the suitability of CT for suicidal clients, the very paucity of data presents a barrier to research

necessary for its production. In a review of web-based suicide prevention programs, Lai et al. (2014) commented on the lack of rigorous studies on web-based treatment for suicide in general. Of those that have been published at the time of the review ( $N = 15$ ), most merely described and evaluated the interventions without directly testing the efficacy of measurable outcomes.

### **Designing an intervention for suicidal heavy drinkers**

Given the role of emotion dysregulation in heavy drinkers who are suicidal, interventions that target drinking alone may be lacking in components necessary for effective treatment of co-occurring HED and suicidality (e.g. Conner et al., 2014). Problems manifesting outside periods of acute alcohol intoxication, such as interpersonal stress and depression (Simon et al., 2001), are likely to require redress in those experiencing concurrent suicidality and drinking problems. Furthermore, evidence suggests that suicidal individuals who engage in problematic drinking are likely to be out of touch with the current mental health infrastructure (e.g. Cornelius, Clark, Salloum, Bukstein, & Kelly, 2014; Suominen et al., 1999). These various factors point to a need for new and innovative approaches in improving treatment engagement within this population. Specifically, two recommendations can be distilled from the review above: 1) treatment should manage both suicidal thoughts and problematic drinking by targeting emotion dysregulation and 2) an Internet-delivered intervention may be useful. First, given that both suicidal thoughts and heavy drinking appear to function to regulate emotions, a treatment for this population should teach participants skillful behavior that can supplant ineffective emotion regulation strategies. Second, while there has yet to be a published RCT evaluating the efficacy of any treatment for suicidal heavy episodic drinkers, there is strong evidence to suggest that this population may be more amenable to an Internet-delivered intervention that can be accessed in the privacy of one's home.

### **Selecting an Appropriate Intervention**

Dialectical behavior therapy (DBT; Linehan, 1993a; Linehan 2014) is a behavioral treatment that was developed specifically for complex, high-risk, and multi-diagnostic individuals. DBT is considered a transdiagnostic treatment that is specifically designed to target dysfunctional behaviors associated with *pervasive* emotion dysregulation. Pervasive emotion dysregulation is theorized to develop from an increased vulnerability to high emotionality combined with an inability to regulate intense emotional responses (Linehan, Bohus, & Lynch, 2007). Therefore, DBT works by simultaneously increasing emotion regulation capabilities and decreasing destructive behaviors that function to reduce distress in the short term.

Multiple reviews have identified DBT as having produced the strongest evidence for reducing suicidal behaviors (for a review, see Ward-Ciesielski & Linehan, 2014). Further, DBT is the one of the only treatments that has been evaluated among adults presenting with both addictive and suicidal behavior (Linehan et al., 1999; Linehan et al., 2002; van den Bosch, Verheul, Schippers, & van den Brink, 2002), and may be particularly potent for addictive behavior as demonstrated by Harned and colleagues' (2008) finding that alcohol and other substance use comprised the psychological disorders most responsive to DBT. These promising results suggest that infrastructures and procedures to manage both suicidal and addictive behavior concurrently are included within the DBT framework. However, waiting lists for DBT are often prohibitively long even where available due to the comprehensive inclusion of 1) individual therapy, 2) group skills training, 3) phone coaching, and 4) therapist consultation team. The single component of DBT skills use alone, nonetheless, has been evidenced as an active factor of treatment effectiveness (Neacsiu, Rizvi, & Linehan, 2010). As such, a DBT skills intervention may serve as a potent and efficient package for treatment delivery, with promise in reducing scarcity-associated costs and attrition rates.

The potential efficacy of DBT skills training as a standalone treatment receives support from a comprehensive body of evidence. Skills training alone has demonstrated efficacy for a

myriad of clinical features, including such diagnoses as BPD (Soler et al., 2009), depression (Lynch et al., 2003), binge eating disorder (Safer, Telch, & Agras, 2001; Telch, Agras, & Linehan, 2001), attention deficit hyperactivity disorder (Hirvikoski et al., 2011), oppositional defiance in adolescents (Nelson-Gray et al., 2006), impulsive aggression in correctional settings (Shelton et al., 2009), and for incarcerated women (Bradley & Follingstad, 2003), as well as couples with emotional difficulties (Fruzzetti & Iverson, 2006). Notably, when DBT skills were added to a brief alcohol intervention for college students [i.e. Brief alcohol screening intervention for college students (BASICS); Larimer & Crouse, 2007], individuals randomized to the DBT + BASICS condition saw faster reductions in depression, anxiety, and emotion dysregulation than those receiving BASICS alone (Whiteside, 2011). Finally, in a recently completed NIMH-funded component analysis of DBT, skills training alone was shown to be effective at reducing suicidal behaviors (Linehan et al., 2015). These findings provide initial support for the therapeutic value of DBT skills in addressing co-occurring suicidality and alcohol misuse.

One aspect of DBT skills training that makes it particularly amenable to computerization is that it is a protocolled and inherently modular. As previously mentioned, the bulk of Internet-delivered and computerized therapy has been modeled off CBT, which is also highly structured, protocolled, and modular. In this context, modularity is used to separate the functions of a treatment into independent sections such that each section contains everything necessary to carry out one specific aspect of the desired treatment. Using DBT skills training as an example, DBT contains four *modules*: mindfulness, emotion regulation, distress tolerance, and interpersonal effectiveness. In this way, each module serves a specific function and can be added or subtracted based on the theoretical and empirical needs of a clinical population. In addition, within each module, there are specific skills that work together to target aspects of the larger function. For example, within the module of emotion regulation is the skill of “check the

facts,” (based on cognitive modification principles; e.g. Meichenbaum, 1979c), which guides clients through determining whether an emotional response is justified or unjustified. In addition, different emotion regulation skills are recommended based on the justification of an emotional response. Specifically, if an emotional response is unjustified, it is recommended the client act opposite to her emotion urge (e.g. “Opposite Action”), and if an emotional response is justified, it is recommended that the client solve the problem that is eliciting the emotional response (e.g. “Problem Solving”). Taken together, DBT skills training incorporates a variety of skills, each with a specific function, and the skills training package can be logically transposed into a computational program in which a user’s response leads to a specific recommendation.

Given the absence of an exact model of an Internet-delivered DBT skills training intervention for a complex and high-risk population, it was necessary to look outside the suicide or alcohol literature and find a plausible model that could be easily adapted. An Internet-delivered DBT skills training for emotion dysregulation by Lungu (2014) provides just such a model for an intervention for individuals who present with suicide ideation and heavy episodic drinking. Lungu developed and pilot tested a computerized, trans-diagnostic (DBT) skills training programs to treat emotion dysregulation in individuals with mood and anxiety disorders. Participants with high emotion dysregulation (being above a threshold on a measure of emotion dysregulation, DERS – Difficulties in Emotion Regulation; Gratz & Roemer, 2004), and who met criteria for a mood and/or anxiety disorder ( $N = 34$ ) received an 8 week online DBT skills intervention plus two months of follow-up assessment. Individuals enrolled in the study saw significant reductions in emotion dysregulation, anxiety, depression, general distress, as well as increases in mindfulness and skills practice (Lungu, 2014).

Three important points of difference about this pilot study are worth emphasizing. First, Lungu specifically excluded individuals at risk for suicide. Second, Lungu’s emphasis on limited therapist contact may not be feasible with a high-risk and complex sample. And third,

the intervention did not target addictive behavior, but rather emotion dysregulation more broadly. Nonetheless, Lungu's intervention provides a solid starting point for further research investigation to determine the scope of Internet-delivered DBT skills training interventions and their impact for individuals presenting with suicidal thoughts and problematic drinking.

### **Summary**

Alcohol use is considered to be a significant risk factor of suicide mortality, especially among those who drink to regulate their emotions. Unfortunately, there is a dearth of treatment outcome research for suicidal heavy drinkers. Furthermore, treatments that target this population must be maximally effective and widely disseminable. The application of technology has been increasingly utilized as an efficacious and acceptable way to rapidly disseminate evidence-based treatment. However, these methods are used infrequently for individuals deemed too high risk for computerized treatment. Dialectical Behavior Therapy (DBT) skills training is an effective intervention for behaviors associated with emotion dysregulation including addictive and suicidal behaviors. Moreover, DBT skills use has been identified as the active ingredient for treatment effectiveness. A skills training intervention delivered via the Internet thus has the capacity to be a potent and efficient method of treatment delivery. The goal of this research is to establish a proof of concept for developing and evaluating a potentially efficacious and acceptable intervention for heavy episodic drinkers who are suicidal. Specifically, we describe a randomized controlled pilot trial of a computerized DBT skills training intervention for suicidal individuals who engage in heavy episodic drinking (HED) to regulate emotions.

### **Current Study**

The current study was designed to evaluate the effectiveness of an Internet-delivered DBT skills training intervention (iDBT-ST) for individuals who endorse suicide ideation and drink alcohol to regulate their emotions. A pilot randomized, controlled trial was conducted comparing this Internet-delivered DBT skills-based intervention to a waitlist control.

## **Target Sample**

The focus of this study was on suicidal individuals who drink alcohol to regulation their emotions. Therefore, the population was identified by including participants who endorsed suicide ideation in the past four weeks, engaged in heavy episodic drinking twice in the past four weeks, and scored above a predetermined cutoff on the Difficulties in Emotion Regulation Scale (Chapman, Gratz, & Brown, 2006). To increase the generalizability of the findings to other alcohol using and suicidal samples, inclusion and exclusion criteria were kept to a minimum (e.g. not U.S. resident, not English speaking).

## **Specific Aims**

**Aim 1.** To conduct a randomized controlled pilot trial of iDBT-ST vs. a Wait-list control (WL). This pilot trial is not intended to demonstrate that iDBT-ST works better than other interventions in improving clinical indices but rather to determine whether further revisions of the iDBT-ST intervention are needed and will inform the design of a subsequent full-scale RCT.

**Aim 1a.** To determine the feasibility of recruiting clients, administering the treatment, and retaining clients in the treatment.

**Aim 1b.** To evaluate the safety of the treatment with respect to potential adverse events.

**Aim 1c.** To assess the feasibility of the research methodology (e.g., reliability of the measures used; feasibility of random assignment to treatment; appropriateness of the control condition).

**Aim 1d.** To evaluate the feasibility of using an enhanced wait-list control group in this line of research and changes over time among individuals in such a comparison group.

## **Methods**

### **Participants**

Participants were 59 adults currently residing in the United States who volunteered to participate in an online pilot trial for heavy drinkers and suicidality. Of 398 individuals who called or emailed expressing interest, 142 completed the screening process, and 91 were considered eligible and sent informed consents. Sixty eligible participants returned the consents and were randomized into the waitlist ( $n = 29$ ) and immediate-treatment ( $n = 31$ ) groups. One person randomized to the immediate treatment group (iDBT-ST) did not complete any of the assessments, leaving 59 people included in the analyses.

The focus of this study was on suicidal individuals who consume alcohol in order to regulate their emotions. To that end, individuals were recruited who endorsed suicidal ideation in the past 30-days, engaged in two episodes of heavy episodic drinking (defined as reporting consumption of 4 standard drinks for women and 5 drinks for men over a 2 hour period at least twice in the past month) in the past 30-days, and endorsed high emotion dysregulation. The 16-item Difficulties of Emotion Regulation scale (DERS) and a threshold of 46 was used to identify individuals high in emotion dysregulation. To increase the generalizability of the findings to other suicidal samples, inclusion and exclusion criteria were kept to a minimum. Participants were excluded if they (a) were enrolled in psychology treatment, (b) were diagnosed with Bipolar I or a psychotic disorder and were unwilling to receive medication management, (c) could not understand verbal or written English, and (d) did not have access to a computer with Internet. The inclusion/exclusion criteria (Table 2) were chosen for clinical relevance, feasibility, to allow for maximum generalizability, and to accommodate the computerized nature of the intervention. Additional criteria for eligibility included current residence in the United States, 18 years or older, willingness to stay on the same dosage of psychotropic medications while enrolled in the study, and to pause or withhold seeking external therapeutic services during the two-month active-treatment phase.

Participant (41 Females, 18 Males) ages ranged from 18 to 60 years ( $M = 37.71$ ,  $SD = 10.71$ ). Of those who consented to our demographic survey ( $n = 56$ ), 82% ( $n = 46$ ) identified as White/Caucasian, 14% ( $n = 8$ ) identified as Black/African-American, and 4% ( $n = 2$ ) as Asian. Approximately 59% ( $n = 33$ ) have completed high school, GEDs, some college or vocational training beyond high school; 38% ( $n = 21$ ) reported having earned a bachelor's degree or higher, and 4% ( $n = 2$ ) did not graduate high school. The majority of participants (63%,  $n = 35$ ) reported being single, and 20% ( $n = 11$ ) were either separated, divorced, or widowed, and a small proportion of participants (18%,  $n = 10$ ) were married. Income level among those who chose to disclose ( $n = 54$ ) was generally low, with median reported past-year earnings falling at the minimum wage level of \$15,000 to \$19,999; the lowest range (less than \$5,000) was also the most frequently endorsed ( $n = 12$ ). Demographic and clinical characteristics of eligible and randomized participants at phone screening are summarized in Tables 3-6.

### **Recruitment**

Call-for-participant ads containing a brief description of the study were distributed through a variety of online recruiting platforms (Volunteer and Job sections on Craigslist and ClassifiedAds.com, BRTC Clinical Trials page, Reddit DBT Self-help subreddit) and a local newspaper based in Seattle (Stranger). The online and newspaper ads had the tagline, “are you suicidal and drink alcohol to cope?” and interested participants were directed to contact the study line for further information.

### **Assessment**

The assessment domains were selected based on the aims of the study. Therefore, assessment domains included demographic information, suicidal ideation, emotion regulation, alcohol use (severity and quantity and frequency), skills use, acceptability, and feasibility (see Table 9). Additionally, measures to prompt assessment and documentation of suicide risk were included.

## **Screening.**

**Demographic information.** Demographic information was collected using the Demographic Data Schedule – Short Version (DDS; Linehan, 1982) which obtains a selection of demographic data including age, sex, ethnicity, marital status, income, educational level, and occupation. High concurrent validity was established comparing DDS responses to hospital chart data for a sample of psychiatric inpatients (Linehan, 1982).

**Treatment history.** Information related to participants' current and past treatment use including hospitalizations, as well as medication use were obtained using the Treatment History Interview (Linehan & Heard, 1987).

**Heavy episodic drinking.** Binge or heavy episodic drinking was assessed using a single item from the NIAAA recommended questions (NIAAA, 2003). The specific question assessed for the frequency participants consumed 4 (for women) or 5 (for men) standard alcoholic beverages in a 2 hour period in the past 30-days.

**Emotion dysregulation.** Emotion dysregulation was assessed using the 16-item version of the Difficulty in Emotion Regulation Scale (DERS-16; Bjureberg, et al., 2016). The DERS-16 has excellent internal consistency. Good test-retest reliability, and good convergent and discriminant validity. In addition, the DERS-16 retains similar convergent and discriminant validity when compared to the original 39-item DERS (Gratz & Roemer 2004).

**Suicide ideation.** Suicide ideation was assessed using the Suicide Behavior Questionnaire-Revised (SBQ-R; Osman, Bagge, Gutierrez, Konick, Kopper, Barrior; 2001). The SBQ-R has been found to differentiate suicidal from nonsuicidal individuals.

**Drinking Motives.** Individuals were assessed about their reasons for drinking using the Drinking Motives Questionnaire-Revised (DMQ; Cooper, 1992). The DMQ is a 15-item self-report measure of the relative frequency of drinking for three conceptually and empirically

distinct motives (i.e., enhancement, social, and coping). Each reason is rated on a 5-point Likert scale from 1 (never/almost never) to 5 (always/almost always).

### **Primary Outcomes.**

***Alcohol use.*** Two primary methods were used to assess alcohol use throughout the study. First, we used the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993), which is a 10-item self-administered measure to specifically designed to identify hazardous and harmful alcohol consumption. Questions 1-3 assess drinking consumption, questions 4-6 assessment drinking behavior/dependence, and questions 7-10 assess alcohol related problems. The period was set for drinking behavior in the last 30-days. Each question was scored 0 to 4; with maximum possibly score of 40. The AUDIT cutoff scores yield a sensitivity scores that range from 0.90 to 0.80 and an average specificity score of 0.80 (Allen et al., 1997). Reinert and Allen (2007) calculated a median reliability of the AUDIT of 0.83 across 18 studies.

Alcohol quantity and frequency was also assessed using a self-administered web-based version of the Timeline Followback (TLFB; Rueger, Trela, Palmeri, & King, 2012). The TLFB has been shown to be a psychometrically valid instrument for obtaining retrospective daily estimates of alcohol consumption (Sobell & Sobell, 1992). Research has demonstrated that the self-administered web-based version of the TLFB is strongly correlated ( $r = 0.83$  to  $0.93$ ) to the interview versions of the TLFB. The following variables were derived from the TLFB: total standard drinks consumed during a thirty day period (total drinks), number of dangerous drinking days (defined as consuming more than 3 for women or 4 for men standard drinks in a day), and number of safe drinking weeks (defined as not having a dangerous drinking day and not exceeding 7 standard drinks in a week for women or 14 standard drinks in a week for men).

***Suicidal ideation.*** During the outcome assessment portion of the study, suicidal ideation was assessed using the Scale for Suicidal Ideation (SSI; Beck, Kovacs, & Weissman, 1979).

The SSI is a 19-item self-report assessment that addresses domains related to suicidal ideation including the intensity and frequency of suicidal thoughts, attitudes toward suicidal thoughts, planning and preparation for a suicide attempt, and discussing thoughts of suicide with others. Each item is scored from 0-2, with higher total scores indicating higher suicide ideation. Individuals answering a 0 on questions 4, “desire to make an active suicide attempt is none” and 5 “would take precautions to save my life,” do not answer the subsequent 14 questions. The SSI has demonstrated moderate internal consistency ( $\alpha = 0.84-0.89$ ) and high interrater reliability ( $r = 0.83-0.98$ ) (Beck, Brown, & Steer, 1997; Beck, Kovacs, & Weissman, 1979).

***Emotion dysregulation.*** Throughout the five waves of assessments, emotion dysregulation was assessed using the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). The DERS a 39-item self-report measure that assesses individuals’ typical levels of emotion dysregulation across six domains: non-acceptance of negative emotions, inability to engage in goal-directed behaviors when experiencing negative emotions, difficulties controlling impulsive behaviors when experiencing negative emotions, lack of emotional awareness, and lack of emotional clarity. The DERS has been found to have high internal consistency ( $\alpha = 0.93$ ), good test-retest reliability ( $r = 0.88$ ), and adequate construct and predictive validity.

### **Secondary Outcomes.**

***Reasons for living.*** Throughout all assessment waves, participants answered questions from the Reasons for Living Inventory (RFL; Linehan, Goodstein, Nielsen, & Chiles, 1983). The RFL is a 48-item self-report measure designed to assess a range of potential reasons for not attempting or dying by suicide. Respondents answer using a 6-point Likert scale, ranging from (1) extremely unimportant to (6) extremely important. There are six distinct subscales: Survival and Coping Beliefs, Responsibility to Family, Child Concerns, Fear of Suicide, Fear of Social Disapproval, and Moral Objections (Linehan et al., 1983; Osman et al., 1993). The number of

items for each scale ranges from 3 to 24. Subscale and total scores are divided by the number of items, therefore scores range from 1 to 6. The RFL total score has strong reliability ( $\alpha = 0.89$ ; Osman et al., 1993) and has demonstrated strong validity with other measures of suicide (Osman et al., 1999).

***Alcohol problems.*** The Short Inventory of Problems (SIP) is a 15-item self-report measure of alcohol-related problems (Miller, Tonigan, & Longabaugh, 1995). Participants indicate how often each of the consequences occurred during the past month on a scale of 0–3. The overall problem severity score was used in analyses. The SIP demonstrates good internal consistency (Cronbach’s alpha 0.95; Kenna et al., 2005) and test–retest reliability ( $r = 0.89$ ; Miller et al., 1995).

***Skills use.*** Skills use was assessed using the DBT Ways of Coping Checklist (DBT-WCCL; Neacsiu, Rizvi, Vitaliano, Lynch, & Linehan, 2010). The DBT-WCCL is a 59-item self-report measure that assesses different methods of coping with stress and 2) weekly assessment of skills use from a self-administered web-based diary card. The DBT-WCCL has strong psychometric properties and does not include the names of the specific skills within the items. Therefore, it is a general measure of coping strategies used by participants. Participants rate the extent to which they have used the skill to cope with stressful events on a scale from 0 (never used) to 3 (regularly used). The measure produces two subscale mean scores: functional coping (i.e., using DBT skills) and dysfunctional coping. The DBT skills use subscale was used in the longitudinal analyses.

***Depression.*** Participants’ level of depression was assessed using the Patient Health Questionnaire-9 (PHQ-9; Kroenke, Spitzer, & Williams, 2002). The PHQ-9 is a 9-item self-report measure of depression with high internal consistency ( $\alpha = .89$ ) good test-retest reliability ( $\rho I = .84$ ). Scores at or above a 10 on the PHQ-9 have a sensitivity of 88% and a specificity of 88% for major depression (Kroenke & Spitzer, 2002; Spitzer, Kroenke, Williams, 1999).

***Suicide risk assessment.*** The University of Washington Risk Assessment Protocol (UWRAP; Linehan, Comtois, & Ward-Ciesielski, 2012) is an assessment protocol which includes 1) assessment of suicide and self-injury risk pre- and post-assessment, 2) strategies to decrease distress and related suicidal and self-injurious urges, 3) strategies to improve mood, and 4) procedures for when to increase the level of response (e.g., escorting the participant to the hospital). The UWRAP was completed each time a subject completed an assessment over the phone and if they answered weekly suicide questions in a manner that prompted a follow-up call. Assessors and therapists were extensively trained in how to use this protocol prior to conducting phone interviews.

***Acceptability.*** Acceptability was assessed using a variety of methods.

***Expectancy of outcomes.*** Prior to enrolling in active treatment, participants responded to questions about how effective they believed the treatment would be using the Credibility/Expectancies Questionnaire (CEQ; Devilly & Borkovec, 2000). The CEQ is a 7-item measure with two subscales specifically designed to assess one's expectancy of outcome as well as the credibility of the intervention. The CEQ has adequate internal consistency ( $\alpha = 0.84$ ).

***Treatment satisfaction.*** At the end of treatment, participants filled out the Client Satisfaction Inventory-Short Form (CSI-SF; McMurtry & Hudson, 2000). The CSI-SF is a 9-item self-report measure that assesses one's satisfaction with the program as well as interest in continued use. The CSI-SF has high internal consistency ( $\alpha = 0.89$ ) and strong validity.

***Therapeutic Alliance.*** At the end of treatment, the participants' perceived alliance with the online skills training program was assessed using the California Psychotherapeutic Alliance Scale (CALPAS-P; Gaston, 1991). The CALPAS-P is a 24-item measure designed to assess four alliance dimensions: Patient commitment, Patient working capacity, Therapist understanding and involvement, and Working strategy consensus. The CALPAS-P has adequate internal consistency ranging from 0.43-0.73 for each subscale and is 0.83 for the total score.

*Intervention Use.* Treatment engagement was examined by analyzing the amount of time spent on each session, as well as adherence with treatment modes such as homework and diary card completion.

*Perceived usefulness.* Participants were asked about the usefulness of each session on a 7-point Likert scale after each session and at the end of each session. Higher scores indicate higher perceived usefulness.

*Urge to quit.* Participants were assessed on their urge to stop using the intervention at the beginning of each session from a 0-5 scale, with higher scores indicating a higher urge to quit the intervention.

## **Intervention**

**iDBT-ST.** The structure of the iDBT-ST intervention was consistent with the general structure of standard DBT skills training. It includes a welcome, orientation, and commitment from the treatment developers. Consistent with in-person skills training, participants also identified goals to reduce alcohol use, suicidal thoughts, and increase emotion regulation capabilities.

Participants were also oriented to the logistics of iDBT-ST including the number of sessions, duration and frequency of sessions, the function of homework, and participant expectations.

Each session began with a 2-5 minute mindfulness practice and ended with a homework assignment followed by troubleshooting. The final session concluded with a congratulatory statement and encouragement to continued skills use.

**iDBT-ST treatment session structure and components.** After session 1, each session began with an overview of the material to be covered, followed by a brief mindfulness practice, a review of the homework from the last session with feedback, and troubleshooting barriers to practice if homework was not completed. After homework review, each session included teaching of new skills, often accompanied by a video vignette of Dr. Linehan, in session practice of the new skills to the extent possible, assignment of the new homework, and finally,

troubleshooting what could get in the way to get the assignment completed for the following week.

***Mindfulness practice.*** Each session started with a brief mindfulness practice (2 to 4 minutes). The mindfulness practices included all aspects of DBT mindfulness such as observing, describing, and participating.

***Homework review and feedback.*** After the brief mindfulness practice, participants were assessed on whether they completed the homework assignment from the previous week. For those who completed the homework, they were prompted to type how they implemented the skill and if they found the skill to be effective. Finally, a positive response if followed by praise and encouragement. If participants endorsed that they did not complete their homework, they were prompted to complete a “missing links analysis,” which functioned to troubleshoot barriers to homework completion. Participants were assessed whether a) they knew there was homework, b) they wanted to do the homework, c) if the thought to do homework entered their mind, and d) if so, what prevented them from doing the homework right away. Individuals endorsing an aspect of the missing links analysis were directed to a set of strategies to help them complete homework in the subsequent week.

***Teaching new skills.*** Each session included 2-3 new skills. Each new skill was first introduced via a video segment between 3-7 minutes. After the video, participants would be directed to a “Key Point” page in which they were presented with the salient aspects from the video. Finally, participants would engage in the skill through an interactive and guided practice.

***Mindfulness Skills.*** Sessions 1 and 2 were specifically designed to teach mindfulness skills. The mindfulness skills are considered foundational skills aimed at increasing attentional control through intentional and non-judgmental awareness of the present experience. These sessions engage learners in the intentional practice of observing, describing, and participating in reality non-judgmentally, in the moment, and with skillful effectiveness. Session 1 included

mindfulness what skills (i.e. observe, describe, and participate) and session 2 included mindfulness how skills (i.e. nonjudgmentally, one-mindfully, and effectively).

*Addiction Skills.* Sessions 3 and 4 were designed to target problematic drinking. Because this intervention was targeting alcohol use, a new skill was developed specifically for problematic drinking: “Dialectical Drinking.” The skill of dialectical drinking describes the abstinence violation effect (see Figure 2), goal setting, pros and cons of their current drinking behavior and changing their drinking behavior, as well as an assessment of motivation and confidence to follow-through on their drinking goal. Dialectical drinking incorporates aspects of motivational interviewing (Miller & Rollnick, 1991) and harm reduction (Marlatt, Larimer, Baer, & Quigley, 1993) as a way to reinforce goal directed behavior as it relates to drinking. See Table 7 for evidence-based strategies incorporated into dialectical drinking and other DBT addictions skills. Session 3 included the skills of dialectical drinking and clear mind. Clear mind included a set of strategies to help participants get into “clear mind” as opposed to addict mind, or clean mind. Finally, session 4 included the skills of community reinforcement and burning bridges. Together, these skills are designed to help participants identify the positive relationships and activities that can reinforce their drinking goal as well as avoid relationships and activities that would reinforce drinking behavior. In addition, the skill of burning bridges teaches strategies to help manage cravings for addictive behavior. For all addiction skills, a greater emphasis was placed on harm reduction rather than abstinence. Therefore, any verbiage about “stopping addictive behavior” was modified to “working toward your drinking goal.”

*Emotion Regulation Skills.* Sessions 5-7 were specifically designed to help participants change their emotions as well as become less vulnerable to negative emotional states. Session 5 was designed to help participants understand their emotions by increasing their capacity to change emotions through awareness and insight. The main skills taught in session 5 are functions of emotions and model for describing emotions. In Session 6, participants learn how to

manage and reduce unwanted emotions. The skills taught in session six are ‘Check the Facts,’ which helps individuals figure out when their emotional reaction fits the actual facts, ‘Opposite Action,’ which is acting opposite to one’s emotion urge for when acting on an emotion does not fit the facts or is not effective, and ‘Problem Solving,’ for when the solving the problem will reduce the emotional state. Finally, session 7 is designed to help participants build resilience to experiencing intense negative emotions. The skills taught in session 7 are Building Mastery, which helps participants build a sense of competence as well as Cope Ahead, which is designed to help participants manage anticipated distress through the use of imaginal rehearsal.

*Distress Tolerance Skills.* The final session (session 8) includes a set of distress tolerance skills designed to help participants manage crises and intense negative emotions without making things worse. Participants learn about the skills of TIP (temperature, intense exercise, paced breathing) to help them reduce acute negative emotions as well as the skill of Wise Mind ACCEPTS, which offers a variety of methods to distract from a situations eliciting acute negative affect, but cannot be solved immediately. See Table 8 for a synopsis of the sessions, the accompanied skills, and their function.

*Homework assignment.* At the end of the session, participants are given a homework assignment that reiterates the skills they have just learned. The function of the homework assignment is to help individuals generalize new skillful behavior to their environment. Therefore, participants are given the specific homework assignment for that week, and it is emphasized to have realistic expectations about the pace of learning new skills. Finally, participants are given a set of strategies to help them reduce anticipated urges to quit and stop practicing. Following completing of the intervention, participants were sent a fillable PDF of their corresponding DBT worksheet.

*In between session skills practice and mindfulness prompts.* Participants were instructed to practice the new skillful behavior throughout the week. This was facilitated using

email and/or text message prompts encouraging participants to both practice the skills they had just learned as well as take a moment to be mindful. Behavioral prompts are known to increase the frequency of engaging in a specific behavior. Text messaging interventions have been found to be efficacious in the field of behavioral health (Cole-Lewis & Kershaw, 2010; Fogg & Adler, 2009). iDBT-ST included daily messages delivered via text or email message encouraging participants to practice the skills assigned for homework and offering specific suggestions for practice.

***Daily diary card.*** Each day, participants were sent an email or text message with a link to a diary card. Participants were prompted to input their urges to die, harm self, and use drugs or alcohol, as well as ratings on various emotions.

***Technical set-up for iDBT-ST.*** There were several components in order for iDBT-ST to function. The videos teaching the DBT skills with the DBT treatment developer were professionally recorded, edited, and uploaded on the video streaming server vimeo.com ([www.vimeo.com](http://www.vimeo.com)). The daily and weekly assessment components were administered via Qualtrics.com. Finally, the iDBT-ST sessions were developed using an e-Learning course development software called Articulate Storyline ([www.articulate.com](http://www.articulate.com)) and then hosted in the Articulate Online Learning Management System (LMS). Users would login to access the iDBT-ST content through the Articulate Online LMS that would in turn link them to assessments and provide a platform to display videos hosted on Vimeo.com.

**Waitlist Control.** Individuals randomized to the waitlist control condition received weekly questionnaires assessing the frequency, intensity, and seriousness of their suicide ideation as well as the frequency and quantity of alcohol consumption. Those endorsing high levels of suicide ideation were called by individuals trained in suicide risk assessment. After 8-weeks, those randomized to waitlist would be given access to the intervention.

## **Study Procedures**

**Assessors.** Screening assessments were conducted by the principal investigator and bachelor's level or undergraduate research assistants. All assessors were trained extensively in the assessment and management of suicide risk, and were given direct supervision during phone interviews with participants. Weekly surveys, as well as monthly assessments conducted at baseline, 4-weeks, 8-weeks, 12-weeks, and 16-weeks, were administered directly to participants through the online survey hosting platform "Qualtrics.com," in order to maintain the consistency of assessments and integrity of research data collected. Figure 3 shows the timeline of study procedures and assessments administered.

**Phone screening.** Interested individuals contacted the research office via telephone or email. Callers were provided with information about the study and what participation would entail. Individuals still interested underwent a phone screening to determine their eligibility according the aforementioned criteria. Those expressing continued interest then responded to questions about their demographic characteristics, current suicidal ideation, heavy episodic drinking, and mental health treatment history during the previous year. The schedule of assessments and domains assessed at each time point are included in Table 9.

**Weekly assessments.** Regardless of treatment condition, participants received weekly assessments on variables of suicide ideation and alcohol consumption. There were three questions related to suicide: 1) one question related to the frequency of suicidal thoughts in the past week, 2) one question related to the intensity of suicidal thoughts in the past week, 3) one question on how seriously one was thinking about suicide, and 4) one question on the current urge for suicide. Participants also answered two questions about their drinking, specifically how often during the past week they consumed alcohol, and how much alcohol did they consume in a given setting.

For individuals in treatment, participants were assessed about their urges to quit treatment (from 0 low to 5 high). Also, participants were asked to endorse which skills they practiced

during the previous week. Finally, participants were asked to self-assess how much they engaged in the treatment activities from the previous week (from 0%-100%).

**Monthly Assessments.** Each month, participants in each condition were sent an assessment battery that they completed online and assessed them on a variety of outcomes including suicide, alcohol consumption, and emotion dysregulation.

**Payment.** As compensation for their participation and as an incentive to complete all monthly assessments, participants received payments following each assessment. At the conclusion of the baseline assessment, participants received \$15, for the one-month assessment, participants received \$20, for the two-month assessment, participants received \$25, and the three- and four-week assessments, participants received \$30 each. Thus, participants could receive up to \$120 by completing all assessment interviews.

**Telephone screening.** Interested individuals contacted the University of Washington's Behavioral Research and Therapy Clinics (BRTC) and were screened on the phone by one of the study's research assistants. The phone screening served as a preliminary screening tool in determining participant eligibility. Individuals were provided with a general overview of the screening process, including information about the type of questions they would be asked and about their rights as participants. Individuals were asked about whether they were receiving outpatient treatment, whether they were taking psychiatric medication, whether they could freely discontinue treatment (e.g., whether they were court-ordered to treatment), about any current and/or past suicidality, and about their interest in the 4-month trial. Interested participants were screened for eligibility via a semi-structured interview conducted over the phone. The time to administer phone screens ranged from 40-120 min ( $M = 70.49$ ,  $SD = 41.25$ ), and were administered by trained undergrad and post-bac research interns, and were either pre-scheduled or conducted during the first call of contact depending on caller preference. By contrast, those

ineligible for continued screening, either due to rejection based on inclusion/exclusion criteria or to self-withdrawal, were offered a treatment referral list. See Figure 4 for participant flow.

## **Protocols**

**Suicide risk assessment and management.** Several steps were taken to protect participants against risks associated with their participation in the study. First, participants were fully informed of the range of items and the most sensitive and personal items in the consent form and were informed that they were free not to answer any questions they did not wish to answer and could refuse to participate or withdraw from the study at any time. They were encouraged to talk with the investigator in the event that they experienced distress or discomfort as a result of their participation.

*Phone screening suicide risk protocol.* To address participant suicide risk, an assessment for monitoring the current suicide risk of participants (i.e., the University of Washington Risk Assessment Protocol; Linehan, Comtois, & Ward-Ceileiski, 2013) involved ratings of stress and suicidality both before and after participation in each assessment session of the study. The UWRAP asks participants to rate the a) current level of stress, 2) urge to harm themselves, 3) intent to kill themselves, and 4) desire to use drugs or alcohol. These ratings are made on a scale of one to seven and an increase of more than two points or any value over a four is considered sufficient for further assessment. In the rare events when further assessment was warranted, the principal investigator took over the phone call to further assess imminent risk and a licensed, doctoral-level psychologist (usually Dr. Linehan) was contacted for consultation and follow-up. The follow-up interview, among other things, assesses the presence of a plan, access to means, and the likelihood of being interrupted by others. While this was not necessary during the trial, in the event that a participant was determined to be at high risk based on this interview and the clinical judgment of Dr. Linehan, a safety plan would have been developed with the cooperation of the participant and the principal investigator.

Even for those participants who did not report an increase in their levels of stress or suicidality, the procedures were expected to potentially cause stress or contribute to a negative mood. Thus, all participants were offered mood-improvement activities at the end of their participation. These activities were determined collaboratively with the participant at the start of the interview and reviewed again at the end. The most common mood-improvement activities were taking a walk, watching a movie, calling a friend or family member, or eating a meal after the interview ended.

***Weekly suicide risk protocol.*** Throughout the 16-week trial period, weekly questionnaires assessing suicide risk were emailed to all participants. They included questions on: 1) frequency of suicidal urges in the past week, 2) intensity of suicidal urges in the past week, 3) seriousness of acting out on suicidal urges in the past week, and 4) current suicidal urge, all using a 5-point Likert scale. Participants endorsing a rating of three or higher on any item or a 2-point increase from the previous week would be called and assessed for suicide risk. Additionally, the number for the National Suicide Prevention Lifeline was situated next to prompts on suicidality received by all participants.

The principal investigator was on call to intervene by phone at any time. In the event that a participant was determined to be at high risk based on this interview and the clinical judgment of the last author, a safety plan was to be developed with the cooperation of the participant and the principal investigator. If a participant was unavailable by phone, a non-judgmental “caring email” was sent, which expressed concern and encouraged participants to reach out to a suicide hotline or textline provided in the email.

After communicating with a suicidal participant whether during the phone screening process or throughout the active study, the University of Washington Risk Assessment and Management Protocol (UWRAMP; Linehan, Comtois, & Ward-Ceileiski, 2013) was also completed. Further, a trained clinician with expertise in suicidal behavior, ordinarily Dr.

Linehan, was always on call should any emergency arise that research staff and the principal investigator were not equipped to handle.

**Drop-out.** Participants were considered to have dropped out once they stopped completing online sessions (e.g., did not log into to articulate.com for three weeks in a row). Participants who did not complete sessions, but who completed subsequent sessions (e.g., missed sessions 2 and 3 but completed sessions 4-8) were not considered drop outs. If someone indicated that s/he wanted to stop receiving sessions, we assessed whether they wanted to continue receiving paid monthly assessments. We considered individuals who either wanted to stop receiving sessions or stopped completing sessions, but completed paid monthly assessments as treatment drops, and those who stopped completing sessions and assessments as study drops.

**Medications.** Current psychiatric medication was not an exclusionary criterion. That is, participants were accepted into the study regardless of whether they were taking psychiatric medications. However, participants agreed not to change or stop their medication use throughout the duration of the study.

**Unanticipated problems and adverse events.** The Office for Human Research Protections (OHRP) of the United States Department of Health and Human Services has published guidance for reviewing and reporting unanticipated problems and adverse events (2007) to help protect human research subjects from avoidable harms and unnecessary burdens. This guidance defines unanticipated problems based on 3 criteria including 1) they are unexpected given the research procedures and the subject population being studied, 2) they are related or possibly related to participation in research procedures, and 3) the research places subjects at a greater risk of harm than anticipated previously. It further defines adverse events in general as unfavorable physical and psychological occurrences temporally associated with the subjects' research participation. According to OHRP, not all adverse events are unanticipated

and must be reported separately; the key is whether a particular adverse event meets the three criteria of unanticipated problems as described above.

### **Data Management and Analysis**

**Randomization and matching.** In order to account for potential covariates that may spuriously affect analytic results, participants were matched on three variables to control for any differences resulting from disproportional randomization into the intervention conditions. These three variables were biological sex (male, female), degree of suicide ideation (above 7 on SBQ-R or at or below 7 on SBQ-R), and degree of disordered drinking (above 16 on the AUDIT or at or below 16 on AUDIT). Following receipt of signed informed consent, matching data for all participants were entered into a computerized system that utilized the minimization randomization algorithm to ensure equal numbers of participants at each level of the matching variable. This strategy for randomization to condition was developed specifically for studies in which the number of matching criteria is large in relation to the number of participants being randomized. The randomization algorithm was implemented by entering matching criteria information into a computerized program specifically designed for minimization randomization (MinimPy). MinimPy is an open source desktop application for managing the whole process of minimization. MinimPy program is written using Python programming language. Following entry of the matching criteria values, the program randomly assigned each participant into one of the intervention conditions. Participants were randomized using a 1:1 ratio, such that equal numbers of participants were assigned to the experimental condition (iDBT-ST;  $n = 31$ ) as to the control condition (Waitlist;  $n = 29$ ).

**Power analyses.** This study was not powered to test hypotheses. Rather, the primary purpose of the data analyses is to use repeated observation data to describe in a preliminary manner the effects of the iDBT-ST protocol treatment over time (including the maintenance of treatment effects at the 16-week follow-up). The results will be used to determine whether the

iDBT-ST program shows promise as an effective intervention for heavy episodic drinkers who are suicidal and, if so, to justify the need for additional research on this treatment in a larger sample.

**Data management.** Data was collected using direct entry of surveys using the online survey tool, Qualtrics.com. All computerized survey information was stored in a de-identified state and identifiable information housed in a separate area of the server.

Confidentiality was carefully protected. Data were only identified with a code number, generated for study purposes only. This code number was linked to identifiers for the length of time necessary to complete the study. Only the principal investigator and necessary research assistants had access to the linking information that was stored on a secure server that is password protected and requires special authorization to access.

**Missing data.** Missing at random (MAR) assumes that the probability of missing data depends on observed data, but not on missing data (Schafer & Graham, 2002). Given that clinical trials commonly experience attrition when participants improve as well as when their symptoms deteriorate (i.e., missing data may be related to observed data), it is reasonable to assume the data was missing at random versus missing completely at random (MCAR). The last case of missing data is missing not at random (MNAR), in which the distribution of missing data does depend on missing values (e.g., a participant lapsed on alcohol and no longer wanted to participate in the study). When the data are MAR, and the parameters that account for the mechanism of the missing data are distinct from parameters measured and included in the model, the missing data is said to be “ignorable” (Laird, 1988; Rubin, 1976; Schafer & Graham, 2002).

**Confounding variables.** Potential confounding variables were determined both theoretically and analytically. Two theoretical confounding variables were identified: medication use at baseline (yes/no) and contact regarding suicide risk (yes/no). Because the use of psychotropic medication was not an exclusionary criterion, and we did not randomize based

on medication use, it is likely that any treatment gains could be attributable to psychotropic medication. In addition, regardless of condition assignment, participants were called if they endorsed high intensity or frequency of suicidal thoughts in order to conduct a suicide risk assessment. Given the inherent therapeutic aspect of weekly check-ins, therapist contact was included as an a priori potential confound for all models. Therapist contact was defined as both meeting the threshold of requiring a suicide call and answering the phone.

Analytic confounding variables were determined by examining chi-square and *t*-test comparisons of each demographic and baseline clinical characteristic. These analyses were conducted to identify any significant differences between the two conditions. Any significant comparison was treated as another potential confounding variable. These potential confounding variables were included in the longitudinal analyses as covariates to determine whether they were a significant predictor of the outcome variable. If a main effect of a confounding variable was both significant and improved model fit (by comparing quasi information criteria), this confounding factor was added as a covariate in the analyses. If there was no significant main effect for the confounding variable, it was left out of the final model. For all outcome measures (e.g., SSI, AUDIT, TLFB, DERS, etc), the critical significance value was set to 0.05, two-tailed. Therefore, the confounding factor was considered to have a significant main effect if its corresponding *p*-value was 0.05 or less.

**Longitudinal Analyses.** Intervention effects were evaluated by examining changes in the primary (alcohol use severity, alcohol use quantity, suicide ideation, and emotion dysregulation) and secondary (alcohol related consequences, reasons for living, skills use, and depression) outcomes as a function of treatment condition using generalized estimating equations (GEE; Liang & Zeger, 1986; Zeger & Liang, 1986). Gardiner, Luo, and Roman (2009) summarized the conceptual similarities and differences between random effects modeling and GEE, and concluded that GEE models are particularly useful in estimating population average

models. Some have argued that when investigating population-level averages, GEE models (in comparison to multilevel models) provide a more useful approximation of reality (Hubbard, et al., 2010). Given the focus on this study is to evaluate the average effect of covariate on the response in a population, GEE was chosen as the primary analytic method for all longitudinal analyses.

GEE is an extension of the generalized linear model (GLM), which incorporates a correlation structure. GEE can accommodate both auto-correlated (observations nested within persons) and non-normal data. GEE was chosen as an analytic technique because 1) it can model population-level estimates, 2) GEE models have an inherent over-dispersion term, 3) GEE provides robust estimation of regression coefficients and standard errors, and 4) GEE is flexible in its ability to model non-normal responses such as binary and count outcomes (e.g. negative binomial) (Hubbard et al., 2010; Norton, Bieler, Ennett, & Zarkin, 1996). Another benefit of GEE is the way that the model handles missing data; GEE allows for randomly missing observations, which increases power of the analyses. Specifically, only missing observations are treated as missing, rather than implementing a listwise deletion that ignores all data for any participant with a missing data point. Thus, analyses are conducted using all available data for a given time point. However, while GEE can accommodate correlation, GEE treats the correlation as a nuisance variable (i.e., as a covariate). In addition, GEE does not assume independence of outcomes, and it uses a quasi-likelihood analysis in which only the relationship between the mean and variance must be specified in the form of a variance function (Zeger & Liang, 1986).

In order to evaluate model fit in GEE, the Quasi likelihood Criterion (QIC) statistic is used. The QIC (e.g. Hardin & Hilbe, 2003) is analogous to the Akaike's Information Criterion (AIC) statistic for comparing models fit with likelihood-based methods. Because GEE is not a likelihood-based method, the AIC statistic is not available. QIC is an acceptable method to

identify a working correlation structure for a given model; however, Hardin and Hilbe (2003) recommend the use of QIC only to choose among otherwise equally suitable structures. The QIC statistic can also be used to compare GEE models to one another—thus, serving the function for model fitting. Models do not need to be nested in order to use QIC to compare them.

All analyses were conducted using an intent to treat (ITT) framework, in which all randomized and available participants were included in the analyses. Given that all enrolled participants were able to enroll in the treatment, either immediately or after an 8-week waiting period, analyses were conducted using all assessment waves with the effect of time only (baseline to 4-month), in order to examine change over time for the entire sample. A set of analyses were also conducted using the first three assessment waves (baseline to 2-month), in order to compare immediate treatment to no treatment. Finally, a set of analyses were conducted with time, condition, and time by condition over all five assessment waves.

For continuous outcomes (e.g. AUDIT, DERS, etc), the distribution was set to normal. For outcomes with a preponderance of zeros (e.g. TLFB outcomes), a negative binomial (NB) distribution with a log function was used. The negative binomial model is an extension of the poisson distribution, however, it allows for the means and variances to be different (Atkins, Baldwin, Zheng, Gallop, & Neighbors, 2013). Using the NB approach, the resulting coefficients are exponentiated and interpreted as risk-ratios (RR). Risk ratios are similar to odds ratios in that the value of 1 signifies no difference. Values above or below one are interpreted as a percentage increase or decrease in the rate of the outcome.

**Effect size.** In reviewing the literature related to effect sizes in treatment outcome studies, Feingold (2009) concluded that treatment effect sizes for longitudinal analyses are best obtained by using pretreatment raw scores, rather than change scores. In this way, bias estimates are minimized when estimating the treatment effect from longitudinal results. The resulting equation from which effect sizes were determined is:

$$Effect\ size = \frac{\beta * time}{SD_{raw}}$$

where  $\beta$  is the estimated coefficient of the difference in slope for each condition (i.e., iDBT-ST slope, waitlist slope),  $SD_{raw}$  is the pooled standard deviation between conditions at pretreatment, and time is the number of time points included in the analysis (time equals three or five, depending the analyses). The resulting effect size is interpreted using Cohen's specifications (1988), where 0.20 is a small effect size, 0.50 is a medium effect size, and 0.80 is a large effect size.

In order to examine within group effect size for each group when they were enrolled in treatment, the following equation was implemented:

$$d = \left| \frac{M_1 - M_2}{SD_{pooled}} \right|$$

where  $M_1$  is the baseline mean score,  $M_2$  is the follow-up mean score (using data from all available participants who completed that follow-up assessment point), and  $SD_{pooled}$  is the pooled standard deviation between time points.

Cohen's  $d$  is best suited to continuous outcomes in longitudinal analyses. For count outcomes, relative risk ratios were calculated (McGough & Faraone, 2009). Relative risk (RR) ratios are an indicator of the proportion of participants in one condition who improve or engage in a behavior relative to the proportion of participants in the other condition who do so as well. Thus, the equation from which RRs are computed is,

$$RR = \frac{Probability\ of\ improvement\ in\ condition\ 1}{Probability\ of\ improvement\ in\ condition\ 2}$$

RR ratios range from 0 to infinity. Using all available data, a RR of 1 would indicate that the outcome does not differ between the two groups. An increasingly larger RR, on the other hand, indicates that the experimental condition (i.e., iDBT-ST) has a greater probability than the control condition (i.e., waitlist) of improvement or engagement in the outcome behavior while an

RR below 1 indicates that the control condition (i.e., waitlist) has a greater probability than the experimental (i.e., iDBT-ST) of engagement or improvement.

**Clinically significant change.** Clinically significant change refers to improvement or deterioration in individual functioning meaningful for participants who undergo treatment interventions (Bauer, Lambert, & Nielsen, 2004). In reviewing methods for assessing clinically significant change, Bauer, Lambert, & Nielsen (2004) concluded that the Jacobson and Truax (1991) approach is the easiest method while producing similar results to more complex methods. Therefore, the authors recommend Jacobson and Truax’s approach for use in outcome studies and research on clinically significant change.

Jacobson and Truax’s (1991) two-step approach involves determining (1) if scores at  $T_m$  (where  $m$ =months elapsed,  $m>0$ ) meet criteria for normal functioning, and (2) if reliable change has occurred between  $T_0$  and  $T_m$ . Participants may be classified as “Recovered” if both obtains, “Improved” if only condition (2) obtains, or “Unchanged/deteriorated” if neither criterion was met.

The first step entails establishing a cut-off score for each outcome of interest that approximates the threshold point at which scores depart from the clinical/dysfunctional to non-clinical/functional range. A change toward normal functioning can be operationalized as a process that brings scores (a) outside the clinical range, (b) within the non-clinical range, or (c) closer to the mean of the non-clinical population than that of the clinical population. As such, in the absence of standardized cutoffs, either of the following three methods may be employed (higher scores indicate improvement,  $M_c$  and  $M_n$  represent means of clinical and non-clinical distributions, and  $s_c$  and  $s_n$  represent their respective standard deviations):

$$\text{cutoff } a = M_{clin} + 2s_{clin}$$

$$\text{cutoff } b = M_{norm} - 2s_{norm}$$

$$\text{cutoff } c = \frac{s_{norm}M_{clin} + s_{clin}M_{norm}}{s_{norm} + s_{clin}}$$

$a$  places the cutoff at two standard deviations above the mean of the clinical sample;  $b$  at two standard deviations below the normative distribution;  $c$  is a weighted mid-point between the means of the two distributions. Given that clinical and normative distributions showed some degree of overlapping across all outcomes of interest, cutoff  $c$  was computed in all cases where normative data are available, as cutoffs  $a$  and  $b$  are likely to lacking respectively in sensitivity and specificity for scales with overlapping distributions. Where normative data are unavailable, the cutoff was computed using  $a$ .

In the second step, Reliable Change Index (RCI) is computed to determine if the observed change reflects more than spurious fluctuations generated by the imprecision of a measure. This criterion also serves as a guard against false positives where overlapping clinical and non-clinical distributions may inflate chances of scores crossing the cutoff. The RCI for each participant is calculated by standardizing the difference between their scores at  $T_0$  and  $T_m$  ( $x_m$  and  $x_0$ ) by the standard error of difference ( $S_{diff}$ ), a function of the standard error of measurement ( $SE_m$ ).  $SE_m$  is an estimate of the measure's precision derived from  $r$ , a reliability index substituted with Cronbach's  $\alpha$  in this study, and standard deviation observed at baseline ( $s_0$ ):

$$RCI = \frac{x_m - x_0}{S_{diff}} \quad , \quad S_{diff} = \sqrt{2 (SE_m)^2} \quad , \quad SE_m = (s_0 \sqrt{1 - r})$$

Where  $RCI > 1.96$ , change can be said to have reliably occurred ( $p < .05$ ). Participants whose scores at  $T_m$  yield  $RCI > 1.96$  and exceed the cutoff are classified as "Recovered" at  $T_m$ . Those whose scores at  $T_m$  yield  $RCI < 1.96$  but fall below the cutoff are classified as "Improved". If neither criterion obtains, the participant is classified as "Unchanged/deteriorated".

Clinical significance analyses were performed on primary non-count outcome variables (AUDIT, SSI, DERS) and secondary outcome variables (SIP, DBT-WCCL, RFL, PHQ-9) at every monthly time-point subsequent to, and against baseline ( $T_0$ ). To examine the clinical meaningfulness of intervention effects, clinical significance of changes at mid-treatment ( $T_1$  for

iDBT, T<sub>3</sub> for waitlist) and post-treatment (T<sub>2</sub> iDBT, T<sub>4</sub> for waitlist) were also analyzed. Mann-Whitney *U* analyses were conducted between conditions to compare differences in the proportion of participants ranked to either of the three change categories at each monthly time point and treatment phase.

## Results

Three hundred and ninety eight individuals initially expressed interest in participating in the study. Of those, 142 were screened over the phone for study eligibility (see Figure 4). Ninety one individuals met inclusion/exclusion criteria and were sent informed consents via email (80) or mail (11). Of these individuals, 60 returned their informed consent and were randomized (65.93%). One participant did not complete any of the monthly assessments and were excluded from all longitudinal analyses. This resulted in an intent-to-treat sample of 59 participants.

Participants who met study inclusion, but did not return a signed informed consent ( $n = 31$ ) were more likely to be male ( $p < .05$ ). In addition, those who did not return their informed consent endorsed a greater percentage of daily HED (41.9% versus 21.7%) as well as lower psychotropic medication use (45.2% versus 53.3%); however, both variables were not statistically significant (Tables 3 & 4).

Nearly half (53.3%) of consenting participants reported having been psychiatric hospitalized in their lifetime. Many of the participants (46.7%) endorsed receiving psychological treatment in the last year, while a vast majority (88.3%) had received psychotherapy sometime in their lifetime. With regard to clinical characteristics, the average AUDIT score for consenting participants was 24.85 ( $SD = 8.46$ ), which places the sample at the highest risk level according to cutoffs (Allen, Litten, Fertig, & Babor, 1997). In addition, the consenting participants were more likely to endorse drinking for coping motives ( $M = 16.70$ ,  $SD = 2.83$ ) compared to social motives

( $M = 12.20$ ,  $SD = 4.36$ ), or enhancement motives ( $M = 14.22$ ,  $SD = 4.02$ ). The average DERS-16 score for consenting participants was 63.45 ( $SD = 8.94$ ), which was slightly less than three standard deviations from a normative mean (Bjureberg, et al. 2016). Finally, the average SBQ-R score for consenting participants was 12.13 ( $SD = 2.47$ ), which is also considerably higher than the cutoff of a psychiatric population ( $\geq 8$ ; Osman et al., 2001). There were no significant differences on any clinical characteristic between individuals who returned their informed consent to those who did not. In addition, there were no differences on these variables between conditions.

Of note, a comparison of demographic variables of randomized participants in each condition revealed a statistically significant difference on marital state between conditions. Specifically, nearly 30% of individuals randomized to waitlist were married compared to 3.4% of those randomized to receive iDBT-ST immediately ( $p < .001$ ). As a result, this variable was evaluated as a potential confounding factor in the longitudinal outcome analyses described below.

### **Missing Data**

All observations were included at any time point giving a potential of 295 from 59 individuals. In these analyses, 259 observations were retained across all waves, or 87.80% of all possible observations. In order to determine whether the data was MAR, a series of analyses were conducted comparing study drop (measured by a dichotomous study drop variable) to any variables of interest including baseline dependent variables and demographic variables. Comparing individuals who were loss to follow-up ( $n = 7$ ) to those who did not drop from the study ( $n = 53$ ), there were no significant between group differences on AUDIT scores,  $t(51)=0.25$ ,  $p = 0.81$ , average drinks consumed per day in the past thirty days,  $t(51)=-0.29$ ,  $p = 0.78$ , nor were there differences in SSI scores  $t(52)=1.49$ ,  $p = 0.18$ , or DERS scores at baseline,  $t(52)=0.44$ ,  $p = 0.44$ . In addition, a series of chi-square, fisher's exact tests, and independent

measure t-tests were conducted comparing study drops to non-drop on demographic variables. There were no significant between group differences on any demographic variables of interest including biological sex  $\chi^2 (1) = 0.71, p = .41$ , racial background, (fisher exact test;  $p = 1.00$ ), annual income (fisher exact test;  $p = 1.00$ ), or marital status  $\chi^2 (1) = 0.67, p = .59$ . See Table 10 for an evaluation of drop status on primary outcomes.

### **Matching Results**

Participants were randomized to one of the two conditions using the matching procedure described above. This procedure led to equal distribution of important characteristics between the two groups (see Table 11). Of the 60 randomized participants, 31 were randomly assigned to receive iDBT-ST immediately and 29 were randomly assigned to the 8-week waiting period. Of those randomized to start iDBT-ST immediately, 67.7% were female versus 72.41% female in waitlist. Twenty-seven (87.10%) iDBT-ST participants had high AUDIT scores versus 25 (86.21%) of the individuals in waitlist. The vast majority (96.77%) of iDBT-ST participants had high SBQ-R scores compared to 29 (100%) of participants in waitlist (Table 11).

### **Study Implementation**

**Recruitment effectiveness.** In order to determine what recruitment methods resulted in potential participants contacting the research office, during the phone screening interview callers were asked how they heard about the study. Table 12 summarizes the recruitment methods that were reported. A sizeable majority of screened individuals reported learning about the study via online advertisements on Craigslist (64.6% of participants). Individuals who heard about the study from Craigslist were also the largest proportion among those who were invited (90.1%), enrolled (90%), and retained (95.8%). Other mediums for recruitment was Reddit (3.3% of those enrolled) and a referral source (5% of those enrolled).

**Unanticipated problems and adverse events.** From its inception, this was considered a high risk study, and as a result, much attention was put onto attending to the safety of

participants. Subsequently, there were no unanticipated problems or adverse events that occurred throughout the entire data collection period.

**Intervention fidelity and feasibility.** While the majority of participants experienced little to no problems with the intervention platform, 27 (45%) participants contacted study staff with a variety of technical and/or access issues. Most commonly, participants experienced technical problems with the Articulate program ( $n = 16$ ), accessibility barriers ( $n = 13$ ), and/or connectivity issues (i.e. slow Internet speed) ( $n = 4$ ). Furthermore, five individuals reported multiple issues (e.g. connectivity issues and problems logging into the program). The technical problems included inability to begin or move past session contents and freezing. Most problems were resolved after participants updated their browser or Adobe flash. Accessibility barriers were issues that interfered with participants ability to access and use the computerized program, and included being jailed ( $n = 2$ ), computer/phone theft ( $n = 4$ ), homelessness ( $n = 3$ ), and/or moving ( $n = 2$ ). The technical and access problems were a considerable barrier to treatment completion. In fact, among individuals who dropped from treatment and provided a reason ( $n = 21$ ), 52% cited technical problems, 33% cited access problems, and 9% cited connectivity problems.

### **Longitudinal Outcome Analyses**

**Confounding factors analyses.** Before conducting any longitudinal analyses, a variety of confounding factors were explored. Confounding factors, as described above, were theoretically derived (e.g. medication use and therapist contact) or determined based on chi-square analyses of baseline demographic and clinical characteristics. Chi-square analyses of baseline demographic and clinical characteristics yielded one confounding variable in addition to the a priori confounds: marital status (married versus not married). Thus, medication use, therapist contact, and marital status were explored by including them into the outcome model to determine whether it explained a significant portion of the variance.

Medication use and marital status did not explain significant variance for any outcome measure and, as a result, they were not added into any outcome analyses presented below. However, therapist contact was found to have be a significant main effect for the dependent variable of RFL and was included as a covariate in the final models.

**Suicidal ideation (Tables 13 & 17; Figure 5).** Due to the nature of scoring the SSI, there were an elevated number of zeros at each time point. Specifically, at each assessment wave, an increasing number of participants endorsed no suicide ideation, therefore, positively skewing the data (skew = 0.18 [ $SE = .15$ ];  $K = -1.06$  [ $SE = .30$ ])) and violating tests of normality (Shapiro-Wilk = 0.93,  $p < .001$ ). As a result, SSI was analyzed using a NB approach. Although NB distributions are commonly used count dependent variables, there is evidence that they perform well with over-dispersed non-count data (Woodridge, 2002).

In the first set of analyses, GEE analyses revealed a significant main effect of time (RR = 0.87,  $p < .001$ ), indicating that, on average, the likelihood of experiencing suicide ideation decreases 13% at each assessment wave. In the next set of analyses, a model was conducted to examine the differential effects between individuals in the immediate treatment group to the waitlist from baseline to the end of the waiting period (2-month). When condition and its two-way interaction was added the model, the main effect of time was not significant (RR = 0.92,  $p = .07$ ). In addition, there was not a main effect of condition (RR = .96,  $p = .76$ ), indicating that there was no significant differences between the conditions at baseline. Finally there was not a significant difference in the rate of change between conditions (RR = 0.86,  $p = .11$ ). Finally, in order to examine the differential effect of condition from baseline to end of the 4-month study period, time, condition, and the interaction between time and condition were added as predictors over all five-assessment waves. In the final set of GEE analyses, the main effect of time was significant (RR = 0.92,  $p < .01$ ), indicating that the sample reduced their level of suicide ideation over the all the assessment waves. The main effect of condition was not significant ( $p = .80$ ).

However, there was a significant time by condition effect ( $RR = .86, p < .05$ ), indicating that those who were randomized to receive treatment first had faster decreases in their level of suicide ideation.

**Alcohol use severity (Tables 13, 15, & 16; Figure 6).** GEE analyses revealed a significant main effect of time all participants from baseline to 4-month ( $\beta = -1.79, p < .001$ ), indicating that, on average, participants saw a decrease of AUDIT scores nearly 2 points during each assessment wave. The next set of analyses aimed to evaluate the between condition effects on AUDIT scores from baseline to the end of the waiting period (2-month) in order to examine differences in slopes between individuals randomized to the immediate treatment group (iDBT-ST) to individuals randomized to the 8-week waiting period. GEE analyses revealed no significant main effect of time, ( $\beta = -1.16, p = .08$ ), condition ( $\beta = 0.48, p = .98$ ); however, there was a modest trend toward significance on the interaction between time and condition ( $\beta = -2.05, p = .09$ ). For the first three assessment waves, individuals randomized to receive treatment immediately had an average decrease of 3.21 ( $p < .01$ ) on their AUDIT scores compared to an average decrease of 1.16 ( $p = .08$ ) to those randomized to waitlist. Interestingly, individuals randomized to the immediate treatment group continued to see a significant decrease in their AUDIT scores during their follow-up ( $\beta = -1.53, p < .05$ ), while individuals on waitlist did not see a significant change in their scores from their own pre-treatment (month 2) to their post-treatment (month 4) ( $\beta = -1.65, p = .06$ ). Finally, when all time points were included in the analyses, the main effect of time was significant ( $\beta = -1.61, p < .001$ ). However, condition was not significant ( $p = .69$ ), nor was the interaction between time and condition ( $p = .58$ ).

The between group effect size from baseline to 2-month was  $d = -0.73$ , indicating a large effect. Over all five assessment waves, the between group effect size was small ( $d = -0.22$ ). The within group effect for individuals randomized to receive the active treatment immediately was

large ( $d = 0.75$ ). The within group effect size for individuals randomized to the 8-week waiting period was small ( $d = 0.34$ ) during their treatment phase.

**Alcohol use frequency and quantity (Tables 14 & 17; Figures 7-9).**

**Alcohol quantity.** For the dependent variable of total standard drinks consumed over the past 30 days (total drinks), GEE analyses with a NB distribution revealed a significant effect of time over the five assessment waves ( $RR = 0.87, p < .001$ ), indicating an average decrease of 13% of alcohol consumption for each assessment wave. In the second analysis which compared the slopes of each condition over the first three assessment waves. There was no significant main effect of time ( $RR = 0.96, p = .46$ ) or condition ( $RR = 0.95, p = .78$ ). There was a significant time by condition interaction ( $RR = 0.77, p = .03$ ), indicating that individuals randomized to the immediate treatment group saw significantly quicker reductions in alcohol consumption than those randomized to waitlist. Specifically, individuals randomized to the waitlist condition had a 1.3 times greater likelihood to engage in alcohol consumption than those randomized to the immediate treatment group. In the final set of analyses, condition level changes were evaluated from baseline to 4-month. The main effect of time was significant ( $RR = 0.91, p < .01$ ). However, condition nor the interaction between condition and time were not significant, indicating that levels of drinking were not significantly different from one another once individuals on the waitlist transitioned to the intervention portion of the intervention. Although, throughout the entire study period, those randomized to the immediate treatment group were 1.09 times less likely to consume alcohol than those on waitlist.

**Number of dangerous drinking days.** In order to parse out dangerous levels of drinking from potentially normative levels of drinking, a series of analyses were conducted to evaluate differential changes over time in the number of dangerous drinking days (defined at 4 drinks or more for women and 5 for men or more drinks in one day). For example, if a woman consumed 7 standard drinks in one day, she would have one “unsafe” drinking day; thus, a participant could

have a minimum of zero dangerous drinking days and a maximum of thirty dangerous drinking days in a given assessment wave.

In the first set of analyses, GEE revealed a significant effect of time ( $RR = 0.84, p < .001$ ), indicating that participants saw a 16% average reduction of dangerous drinking days at each assessment wave. In the next set of analyses, the effect of time, condition, and rate of change for each condition were compared during the first two months of data collection. There was no significant main effect of time ( $RR = 0.92, p = .11$ ), or condition ( $RR = 0.94, p = .78$ ). There was a significant interaction between time and condition ( $RR = 0.72, p < .01$ ), indicating that individuals randomized to receive treatment immediately had quicker reductions in the number of dangerous drinking days than those randomized to waitlist. To emphasize that point, individuals randomized to iDBT-ST had nearly seven less dangerous drinking days, on average, from baseline to 2-months; in comparison, individuals on the waitlist saw had an average of two less dangerous drinking days from baseline to 2-month. In fact, over the first three assessment waves, those randomized to the immediate treatment group were 1.19 times less likely to have dangerous drinking days than those on the waitlist. In the final set of analyses, the effect of condition on the dangerous drinking days was evaluated over all five-assessment waves. The main of time was significant ( $RR = 0.90, p < .01$ ); however, condition was not significant ( $p = .34$ ), nor was the interaction between time and condition ( $p = .22$ ).

***Number of safe drinking weeks.*** In order to further qualify drinking outcomes beyond quantity and frequency, the next series of analyses examined differential changes in the number of weeks deemed to be at a level safe drinking according to NIAAA guidelines. As mentioned above, safe drinking is defined as having no more than four standard drinks in a day and no more than seven standard drinks in a week for women, or no more than five standard drinks in a day and no more than fourteen standard drinks in a week for men. As assessments were conducted monthly, an individual can have a maximum of four and a minimum of zero safe drinking weeks

at a given time point. In the first GEE analysis, there was a significant main effect of time, indicating that on average, the entire sample increased the number of safe drinking weeks by 47% at each assessment wave ( $RR=1.47, p < .001$ ). When the analyses were conducted over all five assessment waves, the effect of time became significant ( $RR = 1.39, p < .01$ ); however, condition was not significant ( $p = .29$ ), nor was the interaction between condition and time ( $p = .45$ ).

**Emotion Dysregulation (Tables 13, 15, & 16; Figure 10).** In the first set of GEE analyses, there was a significant effect of time from baseline to 4-month ( $\beta = -3.37, p < .001$ ), indicating that the population reduced their DERS score on average by 3.37 points at each time point. In the next GEE analysis, the effect of condition assignment was evaluated over the first three time points. There was no main effect of time ( $p = .68$ ), a main effect of condition ( $p = .33$ ), nor an interaction effect between time and condition ( $p = .18$ ). Finally, when the effect of time was expanded to include all five assessment waves, there was a significant effect of time ( $\beta = -3.57, p = .01$ ); however, both condition and the interaction between condition and time was not significant.

The between group effect size was small for the first three time points ( $d = 0.34$ ), but even smaller for all five assessment waves ( $d = 0.20$ ). In addition, the within group effect size for individuals randomized to the active treatment immediately was only slightly larger for those in the immediate treatment group ( $d = 0.42$ ) compared to individuals who waited two months for treatment ( $d = 0.39$ ).

## Secondary Outcomes

**Reasons for living (Tables 13, 15, & 16; Figure 11).** Because the confound variable, therapist contact was a significant main effect on RFL, it was added to all models. All two-way and three-way interaction terms were evaluated and parameters were retained based on model fit. Only the main effect of “contact” improved model fit, and was included in each model. In the

first set of models, GEE analyses revealed a significant main effect of time such that for every time point, the mean RFL score increased .10. In addition, the presence of therapist contact was associated with a lower mean RFL score ( $\beta = -0.53, p < .05$ ), such that those who were contacted endorsed less reasons for living than those did not receive therapist contact. In the next set of analyses, individuals receiving iDBT-ST immediately were compared to those on the waitlist over the first two months. The main effect of time was not significant ( $p = .18$ ), nor was the main effect of condition ( $p = .59$ ). Therapist contact, however, was significant, indicating that individuals who received a phone call from a therapist endorsed less reasons for living than those who did not receive a phone call. Finally, there was no significant time by condition interaction, which suggests that the rate of change between groups was not significantly different from one another. However, individuals randomized to iDBT-ST immediately saw a significant increase in RFL scores from baseline to two-month ( $\beta = 0.23, p < .05$ ), while those on the waitlist did not see a noticeable change in scores from baseline to the end of their waiting period ( $\beta = 0.07, p = .21$ ). Finally, when the effect of time was expanded to cover all five assessment waves, the main effect of time was significant ( $\beta = 0.07, p < .05$ ) as well as the main effect of therapist contact ( $\beta = -0.52, p < .05$ ). However, neither condition nor the interaction between time and condition were significant.

Regarding effect size, the between group effect size for the first three time points was small ( $d = 0.34$ ), but was considerably smaller for the entire study period ( $d = 0.04$ ). Notably, the within group effect size for iDBT-ST during the first three assessment waves was medium ( $d = 0.44$ ), which individuals randomized to waitlist saw a small effect size during the portion of the study in which they had access to the intervention (months 2-4;  $d = 0.13$ ).

**Alcohol related consequences (Tables 13, 15, & 16; Figure 12).** In the first set of analysis, GEE analyses revealed a significant main effect of time; the overall sample reported an average decrease of 1.81 ( $p < .001$ ) in their SIP scores across all five assessment waves (month 0-

4). In the second set of analysis evaluating the differential effects between individuals in the immediate treatment and the waitlist condition during the first three assessment waves (month 0-2), the main effect of time remained significant ( $\beta = -2.48, p < .01$ ) when group condition and its interaction with time were added to the model. However, the result failed to show a significant difference between conditions from month 0-2 ( $\beta = -2.36, p = .41$ ). Further, the difference in the rate of change between conditions was not statistically significant ( $\beta = -0.43, p = .79$ ). In the third set of analysis evaluating the differential effects between the immediate treatment and waitlist condition during all five assessment waves, the main effect of time was also significant ( $\beta = -2.50, p < .001$ ) with group condition and its interaction with time included the model. The results failed to show a significant difference between conditions from month 0-2 ( $\beta = -3.60, p = .21$ ), or a significant difference in the rate of change between conditions ( $\beta = 1.39, p = .08$ ).

The between condition effect size of month 0-2 was small ( $d = -0.06$ ), while the between condition effect size from month 0-4 was medium ( $d = 0.61$ ). For individuals in immediate treatment condition, the pre-treatment (month 0) to post-treatment (month 2) within group effect size was medium ( $d = 0.52$ ). On the other hand, the waitlist pre-treatment (month 2) to post-treatment (month 4) within group effect size was small ( $d = 0.36$ ).

**Skills use (Tables 13, 15, & 16; Figure 13).** The first set of analyses revealed a significant main effect of time ( $\beta = 0.08, p < .001$ ). However, in the second set of analyses, where iDBT-ST was compared to individuals on the waitlist from baseline to 2-month, there was no significant main effect of time ( $p = .47$ ), condition ( $p = .52$ ), nor the rate of change between conditions ( $p = .24$ ). This suggests that the effect of time was mitigated when the number of time points were reduced, and that there was not a significant difference between condition during the first three assessment waves. In fact, individuals randomized to start treatment immediately did not see a significant increase in their skills use when from baseline to their post-treatment ( $\beta = 0.15, p = .10$ ). When the effect of time was expanded to include all five

assessment waves, only the main effect of time was significant ( $\beta = 0.08, p = .02$ ), and not the effect of condition or the interaction between condition and time. In addition, the effect size for this difference between conditions, when pooled across all the first three assessment points, was small ( $d = 0.38$ ), but even smaller for all five assessment waves ( $d = 0.10$ ). For individuals receiving treatment immediately, their pre-post effect size was medium ( $d = 0.44$ ); and finally, when individuals on the waitlist received access to the intervention (months 2-4), they had a medium within group effect ( $d = 0.40$ ).

**Depression (Tables 13, 15, & 16; Figure 14).** In the first set of analysis, GEE analyses revealed a significant main effect of time; the overall sample reported an average decrease of 1.35 ( $p < .001$ ) in their PHQ-9 scores across all five assessment waves (month 0-4). In the next set of analysis evaluating the differential effects between individuals in the immediate treatment and the waitlist condition during the first three assessment waves (month 0-2), the main effect of time remained significant ( $\beta = -1.53, p = .001$ ) when group condition and its interaction with time were added to the model. However, the result failed to show a significant difference between conditions from month 0-2 ( $\beta = -2.40, p = .76$ ). Further, the difference in the rate of change between conditions was not statistically significant ( $\beta = -1.21, p = .21$ ). However, for all five assessment waves, both time ( $p < .001$ ), and condition ( $p < .05$ ) were significant, but not the interaction between time and condition. Nonetheless, during the first three assessment waves, individuals randomized to receive iDBT-ST immediately had an average decrease in their PHQ-9 scores of 2.74 ( $p = .001$ ) as compared to an average decrease of 1.53 ( $p = .001$ ) of those waitlisted. Once the waitlisted individuals were enrolled in treatment (month 2-4), they experienced an average decrease of 1.37 points on their PHQ-9 score ( $p = .09$ ), as opposed to .12 ( $p = .86$ ) of those in the post-treatment follow-up phase.

The between condition effect size was medium from month 0-2 ( $d = 0.40$ ) as well as for months 0-4 ( $d = 0.46$ ). For individuals in immediate treatment condition, the pre-treatment

(month 0) to post-treatment (month 2) within group effect size was large ( $d = 0.89$ ). While on the other hand, the waitlist condition pre-treatment (month 2) to post-treatment (month 4) within group effect size was medium ( $d = 0.39$ ).

**Summary of longitudinal outcomes.** All participants on average saw significant improvements in each primary and secondary outcome over the entire 4-month study period. In looking over the first two months, there were no differential rates of change on suicide ideation, alcohol use severity, or emotion dysregulation; however, individuals randomized to iDBT-ST immediately saw quicker reductions in total alcohol consumption and dangerous drinking days. Surprisingly, those randomized to receive iDBT-ST first saw significantly faster reductions in suicide ideation scores when the time variable was expanded to cover all five-assessment waves. There were no between condition differences in reasons for living, alcohol related consequences, DBT-skills use, or depression.

### **Clinical Significant Analyses**

Clinically significant changes were assessed for all primary (AUDIT, SSI, DERS), and secondary (SIP, DBT-WCCL Skill-use Subscale, RFL, PHQ-9) outcomes at each of the four monthly assessment time-points ( $T_1 - T_4$ ). Criteria for the classification of reliable change comprising a normative cutoff and reliable change index (RCI) were formulated prior to analysis to evaluate differences between each participant's scores at  $T_0$  and  $T_x$  on the analyzed measures.

Where standardized norms have not been established for an outcome measure, a cutoff was manually computed following Jacobson and Truax's (1991) specifications, along with an RCI using instrument reliability (Cronbach's  $\alpha$ ), and standard deviation at baseline for that measure. Cutoff  $c$  was computed for all measures with available data on clinical and normative samples as  $a$  and  $b$  would be less sensitive and specific respectively, given that overlap occurred in all these measures. Where data from normative samples are unavailable, cutoff  $a$  was computed using data aggregated from clinical samples.

Participants were classified as “recovered” if their score at  $T_x$  exceeds the stipulated cutoff, and shows reliable change from  $T_0$  yielding an RCI greater than 1.96. If a score at  $T_x$  yields an RCI greater than 1.96 but falls short of the cutoff, the participant was classified as “improved”. If neither criterion obtains, a classification of “deteriorated/unchanged” was assigned. Mann-Whitney  $U$  nonparametric tests were conducted to assess between-condition differences in reliable change classification at  $T_1 - T_4$ . Results for the seven outcomes are displayed by condition and assessment period in Table 18.

**Reliable change in suicidal ideation.** While the SSI is a widely-used measure of suicidal ideation, standardized norms have not been established for this measure. As such, five studies that used the SSI with clinical samples (Beck, Brown, & Steer, 1997; Chioqueta & Stiles, 2006; Desseilles et. al, 2012; Pollock & Williams, 2004; Sokero, Melartin, Rytsala, & Leskela, 2003) and with normative samples (Beck, Brown, & Steer, 1997; Chioqueta & Stiles, 2006; Pollock, & Williams, 2004; Stepakoff, 1998; Sokero, Melartin, Rytsala, & Leskela, 2003; Zhang & Brown, 2007) were consulted to compute a cutoff. Clinical means presented in the five studies ranged from 2.18 to 11.46 ( $SD$  range 2.76-7.95), yielding an overall mean of 8.44 ( $SD = 5.78$ ). Means reported for the five normative samples ranged from 0.16 to 4.84 ( $SD$  range 0.78-5.02), resulting in an overall mean of 0.64 ( $SD = 1.57$ ). Cutoff  $c$  was computed as a weighted midpoint between the two overlapping distributions, resulting in a cutoff of 2.31 for the SSI.

The test of internal consistency reported in the original psychometric publication (Cronbach’s  $\alpha = 0.84$ ; Beck, Brown, & Steer, 1997), as well as standard deviation observed at baseline in the present study ( $SD = 7.68$ ) were used to compute the RCI. Reliable change was designated as a score difference exceeding 8.51. Of all participants whose SSI score at  $T_x$  yielded reliable decrease ( $>8.51$ ) from baseline, those who scored below 2.31 at  $T_x$  were classified as “recovered” at  $T_x$ ; those with higher scores were classified as “improved”. If reliable change has not occurred, a classification of “deteriorated/unchanged” was assigned.

At T<sub>1</sub>, 4.2% of participants in the iDBT condition and 7.7% of WL participants were classified as recovered. By T<sub>2</sub>, recovery rate had approximately tripled to 13.6% in the iDBT group, but remained at 7.7% for WL participants. 22.7% of iDBT participants were classified as showing reliable change (improved or recovered) in this T<sub>2</sub> post-treatment phase, as compared to 17.8% in the WL group awaiting treatment. These rates were approximately doubled at the next assessment phase for both groups, with 41.7% iDBT and 30.8% WL participants showing improvement or recovery at T<sub>3</sub>. While reliable change rates as a whole dipped slightly from T<sub>3</sub> to T<sub>4</sub>, recovery was maintained in both iDBT (25.0% at T<sub>3</sub>, 29.2% at T<sub>4</sub>) and WL (15.4% at T<sub>3</sub>, 19.2% at T<sub>4</sub>) groups. Nonparametric tests revealed no significant between-condition difference in change classification at any of the assessment phases,  $U_{1\text{-month}} = 287.0$  ( $p = .29$ ),  $U_{2\text{-month}} = 290.5$  ( $p = .62$ ),  $U_{3\text{-month}} = 274.0$  ( $p = .39$ ),  $U_{4\text{-month}} = 277.0$  ( $p = .41$ ).

**Reliable change in problematic drinking.** The original development study of the AUDIT presents a cutoff score of 8 that yielded maximal sensitivity and specificity ranging in the mid 0.90's for various indices of problematic drinking (Saunders, Aasland, Babor, De La Fuente, & Grant, 1993). The RCI was computed using the test of internal consistency reported in a psychometric analysis (Cronbach's  $\alpha = 0.84$ ; Hays, Merz, & Nicholas, 1995), along with the standard deviation observed at this study's baseline ( $SD = 8.39$ ). The resulting operational definition for reliable change was a score difference exceeding 9.59. Participants who scored above the 8-point cutoff and showed a reduction greater than 9.59 from baseline to T<sub>x</sub> in AUDIT scores were classified as "recovered" at T<sub>x</sub>. Participants who endorsed a reliable decrease greater than 9.59 but scored 8 or above were classified as "improved." Participants who did not show a score decrease greater than 9.59 were classified as "deteriorated/unchanged".

As reported in Table 18, 12.5% of iDBT participants were classified as improved at T<sub>1</sub> with an additional 4.2% showing recovery, as compared to 7.7% of WL participants showing improvement and none considered recovered while awaiting treatment. For iDBT participants,

reliable change was augmented by a modest improvement during follow-up, with both improvement and recovery maintained at 25% in the final T<sub>4</sub> assessment phase. WL participants ended treatment with 26.9% participants showing reliable change, approximately twice that endorsed prior to treatment at T<sub>2</sub> (10.7%). Nonparametric tests revealed a trend toward significant between-condition difference in change classification at T<sub>2</sub> ( $U_{2-month} = 283.0, p = .07$ ), and at T<sub>4</sub> ( $U_{4-month} = 231.0, p = .07$ ), but no significant difference at T<sub>1</sub> and T<sub>3</sub>,  $U_{1-month} = 283.0 (p = .32)$ ,  $U_{3-month} = 287.0 (p = .54)$ .

**Reliable change in emotion dysregulation.** The DERS is a well-used measure of emotion dysregulation; however, conventional norms have not been established for this measure. Five studies that administered the DERS to clinical samples (Gratz & Chapman, 2007; Gratz & Roemer, 2008; Harrison, Sullivan, Tchanturia, & Treasure, 2009; Tull, Barrett, McMillan, & Roemer, 2007) and to normative samples (Gratz & Chapman, 2007; Gratz & Roemer, 2004; Gratz & Roemer, 2008; Fox, Axelrod, Paliwal, Sleeper, & Sinha, 2007; Harrison, Sullivan, Tchanturia, & Treasure, 2009) were consulted for cutoff computation. Clinical means reported in the five studies ranged from 87.44 to 108.8 ( $SD$  range = 16.16 - 26.54), producing an overall clinical mean of 88.68 ( $SD = 23.47$ ). Means from normative samples ranged from 60.90 to 78.72 ( $SD = 14.46 - 20.86$ ), yielding an overall normative mean of 76.14 ( $SD = 19.60$ ). The cut-off was computed as a weighted midpoint between the two distributions (cutoff  $c$ ) due to the presence of overlap, establishing the cutoff for DERS at 81.84.

For RCI computation, the test of internal consistency reported in the original study (Cronbach's  $\alpha = 0.93$ ; Gratz & Roemer, 2004) was used along with the standard deviation present at baseline ( $SD = 26.47$ ). Reliable change was thus computed as a score difference greater than 19.40. Of participants whose DERS score at T<sub>x</sub> indicate a reliable decrease ( $>19.40$ ) from baseline, those who scored below 81.84 at T<sub>x</sub> were classified as "recovered" at T<sub>x</sub>; those

who scored 81.84 or above were classified as “improved”. Where reliable change has not occurred, a classification of “deteriorated/no change” was assigned.

As indicated in Table 18, while no participants showed recovery at T<sub>1</sub>, 12.5% of participants in the iDBT condition were classified as improved, as opposed to none within the WL group. Proportion of participants showing reliable change was increased at T<sub>2</sub> for both iDBT and WL groups to 27.2% and 14.3% respectively. Recovery was maintained at 4.2% in the iDBT group through the follow-up phases, with 25% of participants maintaining reliable change at T<sub>4</sub>. For the WL group, participants classified as improved or recovered increased from 14.3% at the start of treatment to 27.3% at the final T<sub>4</sub> assessment phase. Nonparametric tests indicated a near-significant difference in change classification at T<sub>1</sub> between iDBT participants at mid-treatment and WL participants awaiting treatment ( $U_{1-month} = 273.0, p = .07$ ), but no significant difference for the remaining assessments ( $U_{2-month} = 269.0, p = .27$ ;  $U_{3-month} = 255.5, p = .11$ ; and  $U_{4-month} = 297.5, p = .71$ ).

**Reliable change in alcohol problems.** For the SIP, while a definitive cutoff has not been established, decile rankings specific to males and females presented in the original development study provided norms derived from a large clinical sample (1389 males, 342 females; Miller, Tonigan, & Longabaugh, 1995). Because normative SIP data from non-clinical samples are absent in the literature, and available clinical data yielded overly strict criteria in the negative ranges ( $a = -2.05$  to  $-4.81$ ; Feinn, Tennen, & Kranzler, 2003; Morse, & Robertson, 2017; Oslin et. al, 2014), the upper bound of the lowest decile score was used as the normative cutoff for this analysis (10 for males, 9 for females). These cutoffs correspond to the lowest ten percent of scores obtained in the test development sample.

The RCI was computed using the Cronbach’s  $\alpha$  reported for the SIP in the original validation study ( $\alpha=0.94$ ; Miller, Tonigan, & Longabaugh, 1995), along with the standard deviation present at baseline ( $SD = 11.39$ ). Reliable change was established as a score difference

exceeding 5.34. Of participants who showed a reliable decrease in SIP scores ( $>5.34$ ) from baseline to  $T_x$ , those who scored below the cutoff (10 for males, 9 for females) at  $T_x$  were classified as “recovered” at  $T_x$ ; those endorsing higher scores were classified as “improved”. Where reliable change has not occurred, a classification of “deteriorated/no change” was assigned.

As reported in Table 18, reliable change rates were modest for both groups at  $T_1$ , with 8.4% of iDBT participants showing improvement or recovery, and 4.2% those in the WL group classified as such. By  $T_2$ , these rates were improved for participants in both conditions, with 9.1% of the iDBT group and 3.6% of WL participants classified as recovered, with an additional 13.6% and 21.4% in each condition classified as improved. For the iDBT group, reliable change was mostly maintained through follow-up, with 20.8% classified as improved or recovered at the final  $T_4$  assessment phase. For the WL group, peak reliable change occurred at the  $T_4$  post-treatment phase, where 38.5% of participants were classified as improved or recovered. Nonparametric tests revealed no significant between-condition differences in change classification at any of the assessment phases,  $U_{1-month} = 297.5$  ( $p = .49$ ) and  $U_{2-month} = 305.5$  ( $p = .95$ ),  $U_{3-month} = 298.5$  ( $p = .72$ ) and  $U_{4-month} = 252.0$  ( $p = .15$ ).

**Reliable change in skills use.** Due to the lack of published studies that have tested the DBT-WCCL skills sub-scale (DSS) on non-clinical samples, and of standardized norms for this measure, cutoff  $a$  was computed using data obtained from clinical samples presented in various studies as suggested by Jacobson and Traux (1991). A total of five studies (Neacsiu, Rizvi, & Linehan, 2010; Neacsiu, Rizvi, Vitaliano, Lynch, & Linehan, 2010; Neacsiu, Rizvi, & Linehan, 2010; Stein, Hearon, Beard, Hsu, & Björgvinsson, 2016; Webb, Beard, Kertz, Hsu, & Björgvinsson, 2016) were consulted. Means for the DSS reported in these publications ( $M$  range 1.39 – 1.54,  $SD$  range 0.46 – 0.51) yielded an overall clinical mean of 1.48 ( $SD = 0.49$ ). At two

standard deviations above the clinical mean, in the direction of greater skills use, cutoff  $a$  for the DSS was established at 2.46.

An RCI for the DSS was computed using the lowest reported Cronbach's  $\alpha$  published in the original psychometric study ( $\alpha=0.92-0.96$ ;  $n = 316$ ; Neacsiu, Rizvi, Vitaliano, Lynch, & Linehan, 2010) along with the standard deviation present at baseline in this study ( $SD = 0.60$ ). Reliable change was defined as a score difference exceeding 0.47. Participants showing reliable change ( $>0.47$ ) from baseline on the DSS were classified as "recovered" if they scored above 2.46, or otherwise as "improved". Where reliable change has not occurred, a classification of "deteriorated/no change" was assigned.

At  $T_1$ , approximately 20% of participants in both groups were classified as improved or recovered on the DSS. For the iDBT group, these rates were improved during the post-treatment follow-up period, with 33.3% of participants maintaining reliable change at  $T_4$ . Change present at post-treatment ( $T_2$  for WL,  $T_4$  for iDBT) appeared slightly more pronounced for participants in the WL group, with 34.6% of WL participants showing reliable change at  $T_4$  as compared to 22.7% of iDBT participants at  $T_2$ . Nonparametric tests indicated no significant between-condition differences in change classification at any of the assessment phases,  $U_{1-month} = 295.5$  ( $p = .92$ ) and  $U_{2-month} = 301.0$  ( $p = .85$ ),  $U_{3-month} = 283.5$  ( $p = .51$ ) and  $U_{4-month} = 309.0$  ( $p = .94$ ).

**Reliable change in reasons for living.** Norms have not been established for the RFL. As such, five studies that used the RFL with clinical samples (Ellis & Lamis, 2007; Hirsch & Ellis, 1996; Lizardi et. al, 2007; Malone et. al, 2000; Osman et. al, 1993) and five studies with non-clinical samples (Dean & Range, 1996; Ellis & Lamis, 2007; Hirsch & Ellis, 1996; Morrison & Downey, 2000; Range & Antonelli, 1990) were consulted. Means presented for the clinical samples ranged from 4.19 to 4.55 ( $SD$  range 0.57 – 1.07), resulting in an overall clinical mean of 3.29 ( $SD = 0.96$ ). For the non-clinical sample, means reported ranged from 2.89 to 3.93 ( $SD$

range 0.67 – 1.32), yielding an overall non-clinical mean of 4.38 ( $SD = 0.93$ ). Cutoff  $c$  was computed between the two overlapping distributions, resulting in a cutoff of 3.84 for the RFL.

The RCI was computed using the Cronbach's alpha reported in a psychometric study ( $\alpha = 0.89$ ; Osman, Gifford, Jones, Lickiss, Osman, & Wenzel, 1993) and standard deviation present at baseline ( $SD = 0.95$ ). Reliable change was established as a change score greater than 0.87. Participants showing reliable change greater than 0.87 from baseline on the RFL were classified as “recovered” if they scored above 3.84, or otherwise as “improved”. A classification of “deteriorated/no change” was assigned where reliable change has not occurred.

As Table 18 shows, approximately 20% of participants in the iDBT condition were classified as improved or recovered at both  $T_1$  and  $T_2$  during mid and post-treatment, as compared to 11.5% of participants on the waitlist. For the iDBT group, reliable change and recovery rates showed some increase through the post-treatment follow-up phases, with 33.3% of iDBT participants maintaining recovery at the final  $T_4$  assessment phase. The WL group showed a similar slight upward trend in reliable change rates, albeit at lower proportions from pre- (11.1%) to mid- (15.3%) and post-treatment (19.2%). However, nonparametric tests indicated no significant between-condition differences in change classification at any of the assessment phases,  $U_{1-month} = 281.0$  ( $p = .32$ ) and  $U_{2-month} = 261.5$  ( $p = .27$ ),  $U_{3-month} = 269.5$  ( $p = .25$ ) and  $U_{4-month} = 260.0$  ( $p = .19$ ).

**Reliable change in depression.** For the PHQ-9, a cutoff  $c$  between a non-clinical sample ( $M = 3.3$ ;  $SD = 3.8$ ; Kroenke, Spitzer, & Williams, 2001) and a depressed sample ( $M = 17.3$ ,  $SD = 5.0$ ; McMillan, Gilbody, & Richards, 2010) was computed to be 9.34. The Cronbach's  $\alpha$  published in the original psychometric study ( $\alpha = 0.86$ ;  $n = 3000$ ; Kroenke, Spitzer, & Williams, 2001), along with the standard deviation observed at baseline ( $SD = 0.60$ ), were used to compute an RCI. The threshold for reliable change was established at 6.08. At  $T_x$ , of all participants showing reliable change from baseline exceeding 6.08 on the PHQ-9, those who scored below

9.34 were classified as “recovered”, and those with higher scores were classified as “improved”. A classification of “deteriorated/no change” was assigned where reliable change has not occurred.

As reported in Table 18, the proportion of iDBT participants classified as recovered showed a modest increase from 8.3% at mid-treatment ( $T_1$ ) to 13.6% at post-treatment ( $T_2$ ), but was maintained at approximately 10% in the WL group. By the end of the 4-month follow-up, 34.8% of iDBT participants remained recovered, along with an additional 8.7% maintaining improvement. WL participants, on the other hand, showed greater recovery at the  $T_3$  mid-treatment phase (30.8%) than at post-treatment (13.0%). Proportion of participants showing reliable change (i.e. improved or recovered) was comparable across conditions at all except the  $T_3$  assessment phase, with 34.6% WL participants showing reliable change at mid-treatment compared to 25.0% iDBT participants at follow-up. Nonparametric tests, however, indicated no significant between-condition differences in change classification at any of the assessment phases,  $U_{1-month} = 309.5$  ( $p = .94$ ) and  $U_{2-month} = 306.0$  ( $p = .96$ ),  $U_{3-month} = 276.0$  ( $p = .38$ ) and  $U_{4-month} = 239.5$  ( $p = .54$ ).

### **Acceptability Analyses (Tables 19-22)**

Prior to starting treatment, participants were assessed on their expectancies of outcome using the expectancies questionnaire. On average, participants believed iDBT-ST was fairly logical ( $M = 5.33$ ,  $SD = 1.97$ ). Participants believed that iDBT-ST would be neither successful nor unsuccessful in reducing thoughts of suicide ( $M = 4.75$ ,  $SD = 2.13$ ) or problematic drinking ( $M = 4.49$ ,  $SD = 2.23$ ). Similarly, participants were only slightly confident in recommending iDBT-ST to a friend who is experiencing thoughts of suicide ( $M = 4.80$ ,  $SD = 2.33$ ) or problematic drinking ( $M = 4.80$ ,  $SD = 2.34$ ). Finally, when asked how much improvements in both suicidal thoughts and problematic drinking will occur as a result of iDBT-ST, participants

answered with an average of 43% and 45% respectively. See Table 19 for a summary of the expectancies questionnaire.

After each session, participants were asked to evaluate the perceived usefulness of each session on a 0-5 point scale. Collapsed over the entire 8 sessions, the average usefulness rating was 3.91 ( $SD = 0.17$ ). The participants rated session 4 as the most useful, 4.09  $SD=0.90$ , followed by session 3  $M = 4.08$  ( $SD=1.23$ ; the sessions targeting addiction). Sessions 1 and 2, which both target mindfulness, were rated as least useful ( $M = 3.69$ ,  $SD = 1.18$ ;  $M = 3.69$ ,  $SD = 1.14$ ). In addition, participants were assessed on the urge to quit over each session. Collapsed over all 8 sessions, the mean urge to quit was 1.79 ( $SD = 1.05$ ), indicating that on average, the bulk of users endorsed a low urge to quit. See table 20 for a breakdown of usefulness and urges to quit by session.

With regard to therapeutic alliance, 16 participants filled out a survey for individuals who completed all 8 sessions. The survey assessed factors such as usefulness and satisfaction with treatment. On average, participants rated the entire treatment package as useful ( $M = 7.71$ ,  $SD = 1.92$ ). The overall satisfaction score was also relatively high ( $M = 80.79$ ,  $SD = 17.96$ ), indicating participants were generally satisfied with the treatment they received. Participants were also assessed on domains of therapeutic alliance using the CALIPAS. The average CALIPAS overall score was 5.15 ( $SD = 0.86$ ), indicating that the participants endorsed a moderate level of therapeutic alliance to the intervention program. See Table 21 for a summary of acceptability outcomes.

Finally, a series of analyses were conducted examining the amount of time spent on each session, attempt status, and completion status as another proxy for acceptability. Collapsed across all sessions, the average amount of time spent on each session was 46 minutes ( $SD = 39:23$ ). Participants, on average, spent the most amount of time on session 6 ( $M = 01:03$ ,  $SD = 41:50$ ) and the least amount of time, on average, on session 8 ( $M = 00:36$ ,  $SD = 13:42$ ).

Regarding adherence to treatment procedures, 89.83% of individuals attempted session 1 and 84.47% of participants completed session 1. Session 8 was the least attempted and completed with only 30.51% of participants both attempting and completing the session. On average, there were approximately five less individuals who did not attempt the subsequent sessions ( $SD = 1.86$ ). Of those who attempted each session, 61.65% reported completing the homework ( $SD = 6.95$ ), and of those who completed the homework, 94.30% found the homework to be effective ( $SD = 8.96$ ).

**Clinical utility of Dialectical Drinking.** Of the participants who completed session 3, thus viewing the new DBT skill of “Dialectical Drinking” ( $n = 28$ ), the plurality of participants selected ‘safer and reduced drinking’ as a drinking goal (39.29%). No participant choose ‘no change,’ while ‘safer drinking’ was the least endorsed goal (17.86%). Participants who choose ‘quitting’ had the highest motivation and confidence to enact their goal compared to those who choose ‘reduced drinking,’ providing the lowest motivation and confidence scores. A detailed account of participants’ drinking goals and their motivation and confidence scores are presented on Table 22.

### **Study Safety**

As mentioned above, participants were assessed weekly on the frequency, intensity, and seriousness of suicidal urges. Individuals responding in a manner that would indicate high risk for suicide were contacted by study staff for further assessment. Collapsed across all time points, the participants endorsed experiencing suicidal thoughts less than half the days of the week ( $M = 1.74$ ,  $SD = 0.82$ ), with the first week yielding the greatest frequency ( $M = 2.07$ ,  $SD = 0.92$ ). On average, participants endorsed relatively low urge to die by suicide (Range 1-6,  $M = 2.17$ ,  $SD = 1.23$ ), with week one prompting the highest rankings ( $M = 2.74$ ,  $SD = 1.48$ ). Participants were also asked about their current urge to die by suicide. Collapsed across all weeks, participants reported relatively low current urge to die ( $M = 1.59$ ,  $SD = 0.92$ ), with week

three prompting the highest ratings ( $M = 2.03$ ,  $SD = 1.14$ ). Among individual ratings indicating the presence of suicidal thoughts in the past week ( $n = 253$ ), 26 reports considered their urges to die to be “very serious.”

Throughout the entire study, participants responded to their weekly assessments in such a manner prompting the need for 75 suicide risk assessment calls nested among 35 individuals (Range = 1-8 calls,  $M = 2.14$  calls per individual). Of the individuals needing follow-up calls, 16 were enrolled in the immediate treatment group and 19 were enrolled in the waitlist. While 35 individuals responded in such a way that prompted follow-up from study staff, only 25 successful contacts were made nested among 16 participants. For those who were unable to be contacted by phone, a 50 “caring emails” were sent (see Appendix 1). There were no significant differences in frequency, intensity, or seriousness of suicide between those who answered the phone versus those who received an email.

Among those who responded to the phone calls, the phone calls lasted, on average 6.57 minutes ( $SD = 2.33$ ). The assessor rated participants on their current level of risk based on 17 common risk factors. The mean number of risk factors for the sample was 14.07 ( $SD = 1.56$ ), with the most common risk factor being “serious suicide ideation,” (86.4%). No participant required further follow-up after his or her suicidal assessment.

In order to evaluate the safety of using a waitlist control with a suicidal sample, GEE analyses with a negative binomial distribution were conducted to investigate differences in suicidal severity over time both within and between conditions. Individuals randomized to receive iDBT-ST immediately had an average of 4% weekly reduction of the suicidal frequency and 5% weekly reduction in the intensity of suicidal urges over the 16-week study. In comparison, those randomized to waitlist, experienced a 2% weekly decrease in the frequency of suicidal thoughts and a 1% weekly decrease in the intensity of suicidal urges. While those randomized to the waitlist condition had flatter slopes on average than those randomized to

receive treatment immediately, the sample did not experience an increase in suicide ideation while waiting for treatment. Nonetheless, while individuals were on the waitlist, those randomized to immediate treatment saw significantly faster reductions in intensity of suicidal urges (RR = 0.95,  $p < .05$ ).

## Discussion

The present study examined the feasibility, acceptability, and preliminary efficacy of an Internet-delivered DBT skills training intervention for suicidal individuals who engage in HED to regulate their emotions. This pilot randomized controlled trial sought to establish a proof of concept for conducting a full scale RCT comparing iDBT-ST against a waitlist control condition in a high risk and complex sample. This study was not powered to test hypotheses, but rather to assess methodological feasibility, safety of the intervention with respect to potential adverse events, and to estimate rates of change relative to waitlist.

### Main Outcomes

On average, the sample had significant reductions in suicidal ideation, alcohol use severity, alcohol quantity, and emotion dysregulation over the course of the sixteen-week study. Regarding suicide ideation, while the sample saw an average reduction in suicide ideation scores by more than 5-points from baseline ( $M = 14.86$ ,  $SD = 6.61$ ) to the sixteen-week follow-up assessment ( $M = 9.50$ ,  $SD = 7.39$ ), a relatively small proportion of participants in both conditions fell into the improved and/or recovered categories after treatment. Interestingly, individuals randomized to start treatment immediately showed larger reductions in suicide ideation scores than the waitlist group during their respective treatment periods. Even more surprisingly, there was a significant difference in the rate of change between conditions from baseline to 4-month. This, in consort with the differential within-group effect sizes between conditions, highlights two interesting points. For one, suicide ideation remained relatively stable in those waiting for treatment, which is consistent with previous findings on the stability of suicide ideation (Taylor, Gooding, Wood, Johnson, & Tarrier, 2001; Williams, Crane, Barnhofer, Van Der Does, & Segal, 2006); secondly, waiting for treatment may attenuate potential reductions in suicide ideation from subsequent treatment receipt. Given the resource-heavy prerequisites for successful

dissemination of evidence-based treatments, waiting for treatment is an unfortunate reality (Friedmann, Lemon, Stein, & D'Aunno, 2003; Radnofsky, 2015; Smalley et. al., 2010).

Nonetheless, this is one of the only studies to have empirically investigated the use of waitlist with individuals at risk for suicide, and thus provides preliminary evidence about the potential adverse effects of placing suicidal heavy drinkers on long waitlists for treatment.

Alcohol use severity significantly improved over the course of the 16-week study, with individuals who were randomized to receive iDBT-ST immediately scoring an average of nine-points lower than baseline at their last assessment, compared to an average reduction of six points for those who waited for treatment. However, the average score for both conditions at treatment completion was remarkably similar (immediate iDBT-ST: 2-month  $M=16.64$ ; waitlist at 4-month:  $M=16.46$ ), leaving one to wonder what the follow-up effect would be for the waitlist condition. Encouragingly, the average reductions in AUDIT scores mirror other online interventions for alcohol use with similar lengths and treatment components (e.g. Hester, Squires, & Delaney, 2005), suggesting preliminarily that the effectiveness of DBT skills in reducing alcohol severity is comparable to CBT, and maintained in the presence of clinical complexity.

With regard to alcohol quantity and frequency, steep reductions were obtained in both total drinks and number of dangerous drinking days. Furthermore, while this study was not designed to evaluate between group differences, individuals randomized to receive immediate treatment saw significantly faster reductions in total drinks and dangerous drinking days in the first three assessment waves. In fact, over the five assessment waves, those who received immediate treatment reduced their drinking by an average of fourteen drinks per month compared to an average reduction of nine drinks for those who waited before starting treatment. Again, this highlights the waitlist dilemma. Previous researchers have warned about long waiting times for treatment, particularly for individuals presenting with addictive behavior. It is well

known that those who engage in addictive behavior can face greater motivational barriers to stopping or reducing addictive behaviors (e.g. DiClemente, Schlundt, & Gemmell, 2004; Miller, 1985). Initial motivation to change expressed by those seeking treatment may recede during the waiting period, leading subsequently to less favorable outcomes. To this point, the likelihood of treatment seeking substance users actually entering treatment after assessment was nearly 50% (Carr et al., 2008). Another survey on injecting drug users seeking treatment revealed that approximately two thirds did not enter treatment after being placed on a waitlist (Pollini, McCall, Mehta, Vlahov, & Strathdee, 2006). Among those who entered treatment after waiting however, there appears to be no attenuated results (Best, Noble, Ridge, Gossop, Farrell, & Strang, 2002). In this study, only three of those on the waitlist (10.34%) did not enroll in the treatment component, indicating that at least for a sample of individuals with co-occurring emotion dysregulation and suicide ideation, the promise of treatment is worth the wait. Nonetheless, the finding that those who waited for treatment showed slower rates of change even while in treatment requires further investigation to be addressed empirically.

While there was a significant decrease in emotion dysregulation over the course of the study, DERS scores remained relatively stable over each assessment point. In fact, only 4.2% of iDBT-ST and 15.4% of waitlist participants were considered recovered at the end the study. There are three potential explanations for the slow rate of improvement in this sample. For one, an online intervention may not have been potent enough to reinforce the production of new skillful behaviors. In a face-to-face DBT skills intervention for individuals with emotion dysregulation, average DERS scores decreased from 105.27 ( $SD = 14.68$ ) at pre-treatment to 82.73 ( $SD = 19.67$ ) at post-treatment, with a large within person effect size ( $d = 1.29$ ; Neacsiu et al., 2014). For this trial, participants' DERS scores reduced by only about 12 points from pre- to post-treatment, with a medium effect size. Secondly, the dosage of emotion regulation skills received and viewed by participants may have been inadequate. Specifically, the three sessions

allocated for emotion regulation skills were viewed by only half of the participants. To that point, participants in Neacsiu and colleagues' trial (2014) received six weeks of emotion regulation skills, suggesting that improvements in emotion regulation capabilities may occur with sufficient dosing in emotion regulation skills. Finally, individuals recruited and enrolled in this study showed substantial emotion dysregulation. In fact, the sample's average pre-treatment DERS score was approximately two and half times higher than normative samples ( $M = 126.14$ ,  $SD = 26.47$ ), with scores that more closely aligned to suicidal women with BPD (e.g.  $M = 127.15$ ; Wilks, Korslund, Harned, & Linehan, 2015) and individuals with eating disorders ( $M = 126.5$ ; Harrison, Sullivan, Tchanturia, & Treasure, 2010). This provides continued support for the role of emotion dysregulation as a transdiagnostic mechanism in complex behavioral disorders. Taken together, it is likely that more intensive and/or longer treatment is required to target deficits in emotion regulation in a sample of suicidal heavy drinkers.

Given that emotion dysregulation was conceptualized as a potential mechanism through which suicidal thoughts and alcohol use would be reduced, one would expect to observe steep reductions in emotion dysregulation that precede reductions in suicide ideation and alcohol use. However, this study did not evaluate emotion dysregulation as mediator, and these hypotheses remain to be tested in future studies. Nevertheless, considerable reductions in both alcohol use and suicide ideation suggest the involvement of other factors (in addition to emotion dysregulation) that may also account for the improvements observed in key outcomes.

**Potential mechanisms of change.** While this study conceptualized that both suicide and alcohol use would reduce as a function of increasing emotion regulation capabilities, there are other potential mechanisms that warrant further investigation. Specifically, these are: 1) communication of care from a nonjudgmental stance, 2) practicing new behavioral skills in relevant contexts, and 3) increased hopefulness.

*Communication of care from a nonjudgmental stance.* The first of the potential mechanisms relates to participants' experience of being heard, supported, and cared for. When participants first contacted study staff, many were disclosing thoughts of suicide to someone for the very first time (i.e. 58% of accepted participants had never disclosed suicidal thoughts prior to the study). In response to their disclosures, study staff members were warm, compassionate, direct, and nonjudgmental. Enrolled participants also engaged in further communications with study staff through both phone and email. In addition, participants enrolled in active treatment received daily text messages reminding them to practice skills and be mindful. Each of these communications could have been interpreted as a form of care and concern. By having constant and ongoing communication from nonjudgmental staff members, it is possible that the participants became more comfortable discussing their suicidal thoughts and drinking problems, which may have led in turn to an increased awareness of dysfunctional behavioral patterns, and of methods and occasions to seek help.

There are two potential factors at play: for one, participants had consistent communication from study staff, and two, the communication was nonjudgmental and warm. In a noteworthy study, individuals who were discharged from a hospital after a suicide attempt were randomly assigned to either receive a "caring letter" expressing nonjudgmental concern, or no contact (Motto, 1976; Motto & Borstrum, 2001). At two-year follow-up, rates of suicide among those who received the caring letter was half that of the no contact group. This principle (i.e. expressing nonjudgmental care) has been replicated numerous times with similar results (Carter, Clover, Whyte, Dawson, & D'Este, 2005; Carter, Clover, Whyte, Dawson, & D'Este, 2007; Fleischmann, et al., 2008; Litman & Wold, 1976; Vaiva, et al., 2006). Being nonjudgmental highlights another important aspect to reductions in both suicidal ideation and alcohol use. While common guidelines for suicide intervention instruct practitioners to implement nonjudgmental communication (e.g., American Association of Suicidology, 2014; Leenaars, 1994; Thomas &

Leitner, 2005), *nonjudgmentalness* is also particularly important when discussing addictive behavior. Specifically, being nonjudgmental is a clinical style of one of the most widely used interventions for addictive behavior: motivational interviewing (Miller & Rollnick, 1991). Taken together, the shame associated with suicidal thoughts and/or problematic drinking is potentially disarmed when continually communicating with study staff who are caring, compassionate, and nonjudgmental.

***Practicing new behavioral skills in relevant contexts.*** The foundation of behavior therapy is based on the theoretical rationale that clients need to learn new behavior that can help them reach their goals, and that the successful acquisition of new behavior is strengthened when emitted repeatedly and with reinforcement (e.g. Kazdin, 2012). This fundamental aspect of all behavioral therapies have been empirically observed in DBT, with evidence suggesting that reductions in dysfunctional behavior occur due to increases in DBT skills (Neacsiu, Rizvi, & Linehan, 2012). To this end, DBT therapists work in collaboration with their clients to encourage the production of new behavior in daily environments through the use of phone coaching, homework, and the diary card (Linehan, 1993a). In fact, a crucial aspect to behavior therapy in general is homework, which functions to motivate repeated practice of new skillful behavior in relevant contexts (Kazantzis, Deane, Ronan, & L'Abate, 2005). Moreover, studies have shown that face-to-face behavioral interventions obtain better outcomes when delivered in one's home, than in a therapy office (Henggeler et al., 1996; King, Haskell, Taylor, Kraemer, & DeBusk, 1991; Slesnick & Prestopnik, 2004), giving further emphasis to the importance of the context in which new behavior is emitted. Technology-delivered interventions have the prominent benefit of *being* in the client's environment when new skills are acquired, emitted, and reinforced. Recent advances in technological delivered interventions have capitalized on the benefits of technology by prompting users to track behavior, providing "just in time" interventions, and/or offering personalized feedback or assistance (Donker, Petrie, Proudfoot, Clarke, Birch, &

Christensen, 2013; Luxton, McCann, Bush, Mishkind, & Reger, 2011; Price et al., 2014). The intervention in this study offered personalized daily text messages as well as email messages to prompt skill use or remind participants to access the intervention. Furthermore, the intervention was designed specifically to be accessed in a place convenient and comfortable for the participant. Taken together, technological-delivered interventions can facilitate behavioral change in spaces and occasions that may otherwise elude the reach of in-person coaching.

***Increased hopefulness:*** While the absence of hope has been strongly associated with suicidal individuals who engage in problematic drinking (Beck, Weissman, & Kovacs, 1976; Kovacs & Garrison, 1985), the prospect of increasing hope in this population is being bolstered by burgeoning empirical support. Hope has been associated with more frequent health promoting behaviors among those with co-occurring MDD and AUD (e.g. attending self-help groups; Magura, Knight, Vogel, Mahmood, Laudet, & Rosenblum, 2003), and with the efficacy of 12-step programs (Kelly, Stout, Magill, Tonigan, & Pagano, 2010). In addition, CBT has been shown to decrease hopelessness among individuals with moderate suicide ideation, depression, hazardous drinking patterns (Handley et al., 2013). While this intervention did not target hopefulness directly, DBT may be uniquely appropriate for targeting hopelessness among suicidal individuals presenting with multiple complex problems. For example, the mindfulness skills highlight nonjudgmental observing of the present moment (rather than ruminating on the past or worrying about the future), and the emotion regulation skills provide techniques to change dysfunctional thinking patterns (i.e. the future is hopeless), emotions (e.g. sadness), and/or behaviors (e.g. anhedonia). However, beyond the theorized active ingredients in DBT skills training, the simple act of receiving help could have elicited hope for the future. In other words, participating in the study may serve as a behavior to counteract the dysfunctional belief that the future is hopeless.

**Summary.** These prospective treatment mechanisms represent important areas for future research. Evaluating the potential utility of the aforementioned mechanisms can expand our understanding of the reasons for the documented efficacy of DBT in other studies, the results of the present study, and the similarities and differences across applications. Furthermore, in order to inform the design, development, and deployment of effective and potent interventions, these mechanisms should be investigated across diverse populations, with concerted efforts to elucidate the qualitative and quantitative elements among those who engage in harmful drinking and endorse suicidal ideation.

### **Secondary Outcomes**

With respect to the secondary outcomes (e.g. reasons for living, DBT skills use, alcohol related consequences, and depression), all outcomes followed a similar pattern with a significant effect of time and little variability between conditions. There are some interesting findings worth highlighting. For one, individuals on the waitlist saw significant improvements in both depression and alcohol-related problem scores while waiting for treatment. There is some research to suggest that depression tends to remit naturally over time (Grilo et al., 2008; Paykel, 2008). This trend, which has not been seen in a high-risk sample, was observed in the waitlist group as a whole. With regard to alcohol related problems, it was especially interesting to note that reductions in SIP scores did not mirror or correspond with consumption trends. For individuals who received treatment first, alcohol-related consequences remained relatively stable throughout, despite drastic reductions in consumption levels. In fact, once individuals on the waitlist received treatment, their SIP scores dipped below those of the immediate treatment group, despite the waitlist group consuming more alcohol on average. This highlights the importance of contextualizing drinking behavior beyond quantity and frequency. Drinking goals, for instance, may interact with consumption behaviors to influence the felt consequences of drinking as individuals perceive themselves to be maintaining or deviating from endorsed goals.

Interestingly, there were only modest improvements in DBT skills use and reasons for living. For skills use, less than half of the entire sample reached a level of improvement or recovery, while approximately only a third reached similar levels of reasons for living. The apparent stability in skills use deficit may be partially explained by the conservative cutoff criteria for recovery (2.43 out of a maximum score of 3 points) computed in the absence of DSS data from normative samples. Reasons for living, on the other hand, may have roots in one's life course and existential dimensions of crises and meaning-making, which may be less apt to accrue changes in the short-term, and may require more targeted or intensive interventions. More work is needed to understand the ways in which approaches to instilling hope and meaningfulness could be implemented within a technological paradigm.

### **Feasibility, Safety, & Acceptability**

With respect to feasibility, recruitment and enrollment was on schedule. Despite this, recruitment efforts yielded results that were too overwhelming for study staff. To that point, approximately 400 individuals reached out via phone over three months, resulting in an average of six calls during working hours. Furthermore, when individuals expressed interest, the screening calls lasted approximately 45 minutes. In fact, during peak recruitment periods, there were simply not enough phones or offices to field call from individuals expressing interest. Therefore, in order to control the flow of potential participants to a manageable dose, recruitment mediums were kept relatively narrow (e.g. Craigslist).

Importantly, this study appeared to be safe and the treatment moderately usable. In conducting a study of this nature, comprehensive protocols were developed order to manage the safety of the participants. These protocols were planned with considerable oversight of the study participants and were thus flexible enough to manage a study with this size and severity. Along those lines, a total of 75 suicide risk assessment calls were required by on-call supervisors, yet, only 25 successful contacts were made. Future research is needed to examine other suicide risk

assessment platforms besides telephone, to expand on ways to better serve those who were unreachable.

Another safety consideration was the potential adverse effects of randomizing a high-risk population to a waitlist. When designing the study, the 8-week control waiting period was deemed to be acceptable, given that waiting times are often a reality for individuals seeking assessment and treatment (e.g.  $M = 65.4$  days, Carr et. al, 2008) due resource or staff shortage (Friedmann, Lemon, Stein, & D'Aunno, 2003; Radnofsky, 2015; Smalley et. al., 2010). It should be noted that while waiting for treatment (months 0-2), participants did not experience an average increase in suicide risk over time; however, participants who had access to treatment immediately had significantly faster reductions in suicide severity. Taken in consort, these results suggest preliminarily that those who endorse suicide ideation and heavy drinking should have access to treatment as soon as possible.

Another aspect to feasibility is whether an intervention of this kind would be usable for a high-risk sample. Unfortunately, the population endorsed a large amount of technical and access problems, many of which contributed to a complete cessation of treatment engagement (despite high perceived usefulness). In fact, nearly half the sample endorsed some sort of problem that interfered with their use of the intervention. It should be noted that many of the technical problems were due to a user's outdated browser, slow/older computer, and/or unreliable Internet connection, which might be a function of low income ( $Mnd_{income} < \$25,000/\text{year}$ ). New technological devices and conducive Internet speeds are often considered a luxury, and implementing a web-based treatment, which runs optimally with updated software and fast Internet, is a considerable barrier for those who have inconsistent or limited incomes. Moreover, approximately one third of the sample reported access barriers such a theft, incarceration, or homelessness, which again speaks to a level of instability that could interfere with completing an 8-week intervention delivered over the Internet. In summary, Internet-delivered interventions are

not an implementation panacea, and often come with their own feasibility problems, particularly among individuals with significant income disparity or behavioral instability.

Regarding the acceptability of the intervention, those who continued to use the intervention found it useful and were happy with the contents. Notably, the two sessions that targeted problematic drinking were the most popular while the two sessions that targeted mindfulness were the least popular. To that point, 15 participants dropped out of the treatment after the two mindfulness sessions, and they were unable to benefit from aspects of the treatment that were most acceptable to the rest of the participants. Unfortunately, there was considerable treatment dropout, and as mentioned above, was likely due to technological or accessibility problems rather than inapplicability, disinterest, and/or perceived uselessness. In other words, someone's perceived usefulness of the intervention was not enough to overcome many of the other barriers that overwhelmed nearly half of the participants. To note, treatment dropout tends to be relatively high for online interventions (35%; Melville, Casey, & Kavanagh, 2010), and particularly high for addiction treatment in general (Brorson, Arnevik, Rand-Hendriksen, & Duckert, 2013), so the dropout rate in this study is not an aberration, but rather a regularity.

Before starting the intervention, all participants answered questions related to their beliefs about the credibility of the intervention and their own expectations of improvement. In general, participants indicated only moderate credibility and expectations that the intervention would be successful at reducing their thoughts of suicide and problematic drinking. Interestingly, expectancy and credibility scores tend to be in the high range for individuals about to start therapy targeting mood (Watkins, Baeyens, & Read, 2009) or anxiety disorders (Beard, Weisberg, and Amir, 2011); in comparison, those in treatment for addictive behavior have reported considerably low expectations for treatment (Smelson et al., 2013). It is possible that, regardless of its delivery platform, the potential effectiveness of a behavioral treatment targeted

at reducing dysfunctional behavior may be perceived with skepticism by those for whom such behaviors serve key functions in emotion regulation or distress management.

### **Study Limitations and Strengths**

**Limitations.** There are several limitations that warrant discussion. Principally, while there were a handful of significant differences in the rate of change between conditions, this study was not powered to test for significant between group differences. Furthermore, there were copious analyses conducted and an alpha correction was not applied. Therefore, all significant differences in the rate of change between conditions should be interpreted with a heavy degree of skepticism. More specifically, it is quite likely that the significant results found herein are coincidental, rather than confirming. To that point, the sample was heterogeneous and all outcomes had wide confidence intervals, highlighting the need for replication with a larger sample.

Another limitation was the logistical problems recruiting this high-risk sample. A major aim of this study was to evaluate recruitment efforts from a variety of sources, and because study staff were ill equipped to manage to influx of interest, the population may not have been representative of individuals presenting with suicide ideation and heavy drinking. For example, the use of an in-depth phone interview may have scared away potential participants. An RCT that evaluated a computerized CBT intervention for alcohol use and PTSD utilized a recruitment website as an enrollment tool resulting in substantially more enrolled participants in a short period of time (e.g.  $N = 617$  in 46 days; Brief et al., 2011). For the present study, the recruitment and enrollment strategy may have been too big of a barrier for those not comfortable with speaking to study staff.

Another limitation is the use of a waitlist control for a comparison condition. For one, as the results preliminary indicate above, waiting for treatment may weaken its potential benefits. Waitlist control conditions are often used as a comparison group in order to more closely align

with placebo-controlled medical trials. However, placebos are difficult, if not impossible to imitate in trials of behavioral therapy, and eventual treatment is considered more ethical (Gallin and Ognibene, 2012). It has also been argued that waitlist control groups are not analogous to placebo trials in medicine because the participants are fully aware that they will eventually receive treatment, are consented, contacted, randomized, and monitored. As a result, for mild psychological disorders, those on the waitlist tend to improve without treatment, making waitlist conditions problematic (Ahola, et al., 2016; Furukawa et al., 2014). Indeed, even with screening results indicating substantial psychological distress, those on the waitlist saw significant improvements while waiting for depression, alcohol use, and alcohol related consequences. In addition, in this trial participants in the waitlist were closely monitored and repeatedly contacted throughout the waiting period.

There was considerable dropout from the treatment portion of this study, underlining a setback in overall acceptability and feasibility of iDBT-ST for suicidal and heavy episodic drinkers. While only 11.67% of participants dropped from the study, approximately half of participants dropped out of the treatment. As mentioned previously, many participants experienced a considerable amount of structural and/or logistical barriers that interfered with them fully benefiting from the intervention. For one, the inherent structure of iDBT-ST and other web-based interventions is that participants actively turn on their web-enabled device and physically access the program (which is an accessibility barrier all on its own). Although the majority of the participants in this study did log on and access the intervention at least once, many experienced technology-related problems. Ultimately, the combination of technological issues, lack of willingness to access the program, and behavioral instability may have been too much for this research team to subvert. In essence, iDBT-ST needed to be incredibly acceptable or effective to overcome the barriers that the participants experienced.

A considerable limitation to this study is the intervention platform itself, in that it may have aligned too closely to face-to-face skills training, thus diminishing the advantages of a technological mediated intervention. Schueller and colleagues (2013) have argued that web-based psychotherapy is a *skeuomorphism*, or derivative of face-to-face psychotherapy. For example, consistent with face-to-face CBT, web-based CBT often contain a series of modules that are released once a week, generally over a period of six to eight weeks. In addition, web-based CBT includes almost identical format such as an orientation, didactics, practice, and homework assignment. In designing web-based therapies (and iDBT-ST) in this manner, much of the advantages of technology are stymied, while never being able to be as effective as face-to-face treatment. As mentioned, technology has the capacity to be in the backpack, pocket, or even wrist of a client at all times, thus wielding substantial potential to have individuals to engage in nascent behaviors at key times. However, in keeping with the literature of computerized interventions, iDBT-ST almost perfectly mirrored the in-person skills training format and structure (i.e. mindfulness then homework review followed by new skill teaching followed by practice followed by homework assignment), without any evidence that any part of the DBT skills training format or structure is particularly salient in building new behaviors into the repertoire of the participants. As a result, iDBT-ST was both a watered down imitation of in-person skills training and a technology-mediated behavior change tool.

**Strengths.** Despite these weaknesses, the present study also boasts many important strengths. For one, this is the only RCT that has explicitly evaluated individuals both at risk for suicide and who engage in problematic drinking. While there has been a handful of RCTs that have examined how suicide and substance use disorders (SUD) can be treated concurrently (Esposito-Smythers, Spirito, Kahler, Hunt, & Monti, 2011; Harned, Chapman, Dexter-Mazza, Murray, Comtois, & Linehan, 2008), there remains a gap in the literature for the treatment of suicidal alcoholics. Given the wide-spread acceptance, availability, and subsequent

pervasiveness of alcohol, treatment providers tend to approach heavy drinking slightly differently than drug addiction. Therefore, slight alterations were required to the DBT addiction curriculum, prompting the development of a new DBT skill to target drinking, specifically. The reductions in drinking, in tandem with the overall usefulness ratings in the DBT drinking skill, provide a useful blueprint for future treatment research with this population. In particular, the new drinking skill has already been road tested and can be further applied in other online or mobile applications, or even face-to-face settings, to see if adding the skill to the addiction package augments the treatment of individuals in DBT who present with AUDs.

Another strength to this trial is that no restrictions were placed on severity of suicide ideation and level of drinking. The research on web-based psychotherapy has been criticized for only testing their interventions on clean samples, and excluding individuals at-risk for suicide and addictive behavior (Wilks, Zieve, & Lessing, 2015). Trials of computerized interventions explicitly targeting suicide often include strict in/exclusionary criteria that function to monitor the safety of subjects (Christensen et al., 2013). However, given the aforementioned association between shame and suicide, potential participants may tend to under-report suicidal intent in the screening interview, and be inadvertently excluded from the study as a result. As such, no minimal threshold for suicide ideation was put in place. In keeping the inclusionary criteria broad, this trial was able to evaluate the clinical utility of suicide risk protocols on an ecologically valid population in the context of a web-based intervention, thus potentially broadening the scope of intervention research for high-risk populations.

Third, this is the only RCT that has examined the acceptability, feasibility, and preliminary efficacy of an Internet-delivered DBT skills training program. While a plethora of Internet-delivered/web-based interventions have been developed and evaluated, this is the only RCT to have evaluated the preliminary efficacy of DBT in an online format. DBT was initially developed for individuals presenting with significant behavioral dyscontrol, and this stands as

the first RCT evaluating its web-based counterpart for individuals with strikingly similar clinical presentations. Not only have the DBT risk protocols been road tested on a novel platform; the skills were easily transferable, well received, and showed preliminary efficacy on a high-risk and emotionally dysregulated sample.

The insights gathered from placing high-risk clients on a waitlist for two-months adds a noteworthy strength to this study. This study is one of very few that has randomized high-risk individuals to a waitlist control (e.g. van Spijker et al., 2012, randomized mild to moderate suicidal individuals to a six-week waitlist). As a result, considerable information was gathered about how waiting for treatment effects outcomes. Individuals who received treatment first saw immediate reductions in suicide ideation and drinking severity, while those who waited remained relatively stable until receiving treatment, and showed moderately slower rates of change thereafter. Interestingly, the vast majority of those who were waiting eventually enrolled into treatment, which may indicate that there is a considerable need for effective treatment that can be swiftly delivered.

Finally, this trial garnered a series of useful insights about an understudied population. Specifically, we followed nearly 60 suicidal heavy drinkers over the course of 4-months, assessing them using a series of well-validated measures. While drinking patterns and suicidal onset has been evaluated in epidemiological studies (e.g. Grant and Hasin, 1999), this trial repeatedly assessed all participants on a variety of measures including reasons for living, alcohol related problems, and drinking consequences. This produced a bevy of information that afforded extensive access into treatment effects on individual outcome trajectories, as well as individual or group level effects of the aforementioned variables on suicide ideation and drinking consumption.

### **Future Directions**

The most important extension of this work is a continued focus on high-risk and underserved individuals. This study is only the beginning of a line of research aimed at a more complete understanding of suicidal individuals who drink alcohol to regulate their emotions as well as treatments that can best serve their needs. Importantly, this project was conceived with an explicit intention to evaluate whether a “subsequent full-scale RCT” was warranted. Before designing a future trial with a larger population, considerable alterations to the intervention platform is necessary. Specifically, technological advances should be fully exploited, which could ultimately increase access to treatment, augment face-to-face DBT, and increase knowledge about how DBT works. Along those lines, a reasonable first step is to redesign iDBT-ST to be more portable (e.g. mobile application: mDBT). However, in doing so, the content may need to be shortened and streamlined, which presents a meaningful research question in itself: what part(s) of DBT skills training should be shortened and streamlined? While an ostensibly costly and time-consuming task, technological advances can help answer that question.

As mentioned, more precision on the mechanisms of action in DBT skills training is needed. Fortunately, determining mediators and moderators of treatment can be examined simultaneously through continued iterations and evaluations of iDBT or mDBT. Machine learning can be leveraged to identify and catalogue aspects of DBT that would work best for particular individuals in different occasions and settings. This could potentially lead to predictions about how an individual is feeling in a given context, or even predict when she is about to engage in dysfunctional (or functional) behavior. Machine learning methods may be able to detect complex combinations of behaviors that would be impossible for a clinician to predict or identify given the limits of face-to-face therapy. Technology can also assist in outcome evaluation. In addition to gathering data from psychometrically validated assessments, behavioral outcomes can be assessed through the use of free sensing techniques from the phone (e.g., GPS, phone activity, human movement, physiology etc.) to quantitatively measure changes

in behavior. For example, reductions in symptoms of anhedonia may be indexed by an increase in frequency of interactions with people or trips out of the house. In turn, free sensing data can be fed into the machine learning algorithm, which can more precisely predict behavior and potentially prompt skill use.

With respect to the potential mechanisms of action that were identified above, future work should seek to identify whether a hypothesized mechanism mediates outcomes, and how to empirically evaluate the utility of the mechanism. For example, if nonjudgmental communication was identified as a partial mediator of outcome, a subsequent research trial could randomize individuals into receiving varying degrees of encouraging text messages. Additionally, by incorporating a simple “like” button, text messages can adapt to individual preferences using machine learning techniques.

Finally, any future work requires a larger sample size. Given the logistical challenges encountered in recruiting only 60 participants, entering the study should be simpler and include a recruitment and enrollment website. Along those lines, given that low barrier to entry may come with low barrier to exit, more work is needed to increase retention. For example, factors that work to keep people motivated in face-to-face therapy can be translated for mobile use (e.g. contingency management to gamification).

### **Summary and Conclusions**

The present study begins a line of research aimed at developing and evaluating technological mediated interventions for high-risk individuals. The ease of recruiting and retaining these individuals provide evidence for the potential to access and understand this underserved population. The findings of significant reductions in all outcomes from an Internet-delivered intervention underscores the promise awaiting continued treatment development in this area. Finally, any future work relies on collaboration from individuals across disciplines, such as

computer science and human computer interaction in order to expand access and increase knowledge in both fields.

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Barrier	Suicidal <sup>a</sup>	AUD <sup>b</sup>
Self-Reliance	26.7	28.9
Financial	11.7	11.3
Thinking behavior would improve	11.5	20.1
Lack of treatment	10.9	5.2
Perception that problem was not severe	8.6	19.3
Perceived Ineffectiveness	8.2	8.4
Don't want to stop the behavior	--	12.6

Table 1. Barriers to treatment for suicidal and AUD individuals

*Note.* <sup>a</sup> From Bruffaerts, et al., 2011. <sup>b</sup> From Cunningham, et al., 1999.

Table 2. Study Eligibility Criteria

Inclusion Criteria:
1. 18 years or older
2. Endorsed suicidal thoughts in the past month <sup>a</sup>
3. Engaged in two episodes of heavy episodic drinking in the past month <sup>b</sup>
4. High emotion dysregulation <sup>c</sup>
5. Has access to a computer and Internet
6. Not in psychotherapy or willing to discontinue psychotherapy
Exclusion Criteria:
1. Not living in the United States
2. Non-English-speaking

*Note.* <sup>a</sup> Positive endorsement of suicide ideation was determined with a <0 on the SBQ-R. <sup>b</sup> Heavy episodic drinking was defined as consuming 4 or more standard alcoholic beverages for women or 5 or more standard alcoholic beverages for men under a 2 hour period. <sup>c</sup> High emotion dysregulation was defined as scoring at or above a 46 on the DERS-16.

Table 3. Participant Demographics at Baseline of All Eligible Participants by Consent Response (N=91)

	Randomized (n=60)			Did not consent (n=31)			Total eligible (N=91)			Test stat <sup>a</sup>	p
	n (%)	M	SD	n (%)	M	SD	n (%)	M	SD		
Age		37.2	11.5		35.7	15.3		36.7	12.8	0.43	0.67
Sex										6.73	0.01
Male	18 (30.5)			18 (58.1)			36 (39.6)				
Female	42 (70.0)			13 (41.9)			55 (60.4)				
Racial background										5.20	0.16 <sup>b</sup>
Caucasian	47 (82.5)			26 (92.9)			73 (85.9)				
African American	8 (13.3)			1 (3.2)			9 (10.6)				
American Indian	0			1 (3.2)			1 (1.2)				
Asian	2 (3.3)			0			2 (2.4)				
Highest education										2.27	0.67 <sup>b</sup>
Some high school	2 (3.5)			2 (6.9)			4 (4.7)				
High school /equivalent	11 (19.3)			5 (17.2)			16 (18.6)				
Some college or training beyond H.S	23 (40.3)			15 (51.7)			38 (44.1)				
College graduate	17 (29.8)			5 (17.2)			22 (24.2)				
Beyond college	4 (7.0)			2 (6.8)			6 (7.0)				
Annual income										1.48	0.72 <sup>b</sup>
< \$10,000	17 (30.9)			11 (42.3)			28 (34.6)				
\$10,000-24,999	23 (41.7)			10 (38.4)			33 (40.7)				
\$25,000-50,000	11 (20.0)			3 (11.5)			14 (17.3)				
≥ \$50,000	4 (7.3)			2 (7.7)			6 (7.4)				
Marital status										3.42	0.09 <sup>b</sup>
Married	10 (17.5)			1 (3.4)			11 (12.8)				
Not married <sup>1</sup>	47 (82.5)			28 (96.6)			75 (87.2)				
Children <sup>2</sup> (y)	24 (43.6)			16 (55.2)			40 (47.6)			1.01	0.31
Number of children		1.05	1.50		1.03	1.21		1.05	1.39	0.07	0.95
Nearby family, ≥50 mi (y)	40 (71.4)			20 (69.0)			60 (70.6)			0.06	0.81

Note. Of the 86 eligible participants who consent to the demographic survey, five declined to disclose annual income, two did not disclose number of children, one did not disclose racial background, and one did not disclose number of family members living nearby. <sup>1</sup> Single, divorced, separated or widowed. <sup>2</sup> Biological children. <sup>3</sup> A t-test is reported to compare mean age and number of children between groups; for remaining comparisons, chi-square values are reported. <sup>b</sup> For 2x2 chi-square comparisons with minimum expected cell count <5, the Fisher's exact test is reported.

Table 4. Clinical Characteristics Assessed at Phone Screen of all Eligible Participants by Consent Response (N=91)

	<u>Randomized</u> (n = 60)			<u>Did not consent</u> (n = 31)			<u>Total Eligible</u> (N = 91)			<i>Test stat<sup>a</sup></i>	<i>p</i>
	%	M	SD	%	M	SD	%	M	SD		
<b>SBQ-R</b>											
Total Score		12.13	2.47		12.74	2.61		12.30	2.52	1.09	0.28
<b>Heavy Drinking</b>											
Every day	21.7			41.9			28.6			7.54	0.12 <sup>b</sup>
5 to 6 days a week	21.7			6.5			16.5				
3 to 4 days a week	30.0			25.8			28.6				
1 to 2 days a week	16.7			22.6			18.7				
2 to 3 days a month	10.0			3.2			7.7				
<b>AUDIT</b>											
Total Score		24.85	8.46		25.23	6.32		25.00	7.76	0.22	0.83
<b>DMQ</b>											
Coping		16.70	2.83		16.35	2.69		16.6	2.77	-0.56	0.58
Social		12.20	4.36		11.94	5.00		12.1	4.56	-0.26	0.79
Enhancement		14.22	4.02		14.10	4.07		14.2	2.77	-0.13	0.89
<b>DERS-16</b>											
Total Score		63.45	8.94		61.94	7.01		62.9	8.33	-0.82	0.41
<b>Mental health treatment</b>											
Past year (% yes)	46.7			45.2			46.2			0.19	0.89
Never (%)	11.7			25.8			16.5			2.97	0.09
<b>Psychiatric hospitalizations</b>											
Lifetime (% yes)	53.3			50.0			52.2			0.09	0.77
<b>Psychotropic medication prescribed</b>											
Past year (% yes)	53.3			45.2			50.6			0.55	0.46

*Note.* <sup>a</sup>A t-test is reported to compare SBQ-R, AUDIT, DERS-16, and DMQ subscale scores across conditions; for remaining comparisons, chi-square values are reported. <sup>b</sup> For chi-square comparisons with minimum expected cell count <5, the Fisher's exact test is reported.

Table 5. Participant Demographics at Baseline by Condition (N=59)<sup>1</sup>

	iDBT-ST ( <i>n</i> = 30)			Waitlist ( <i>n</i> = 29)			Total ITT ( <i>N</i> = 59)			<i>Test Stat</i> <sup>a</sup>	<i>p</i>
	<i>n</i> (%)	M	SD	<i>n</i> (%)	M	SD	<i>N</i> (%)	M	SD		
Age		38.0	11.3		37.4	10.1		38.0	10.4	0.21	0.83
Sex										0.23	0.63
Male	10 (33.3)			8 (27.6)			18 (30.5)				
Female	20 (66.7)			21 (72.4)			41 (69.5)				
Racial background										1.93	0.62 <sup>b</sup>
Caucasian	23 (79.3)			23 (85.2)			46 (82.1)				
African American	4 (13.8)			4 (14.8)			8 (14.3)				
Asian	2 (6.9)			0			2 (3.6)				
Highest education										0.50	0.95 <sup>b</sup>
Some high school	1 (3.4)			1 (3.7)			2 (3.6)				
High school /equivalent	5 (17.2)			5 (18.5)			10 (17.9)				
Some college or training beyond H.S	11 (37.9)			12 (44.4)			23 (41.1)				
College graduate	10 (34.5)			7 (25.9)			17 (30.4)				
Beyond college	2 (6.9)			2 (7.4)			4 (7.1)				
Annual income										0.57	0.93 <sup>b</sup>
< \$10,000	8 (26.7)			8 (32.0)			16 (29.6)				
\$10,000-24,999	12 (41.4)			11 (44.0)			23 (42.6)				
\$25,000-50,000	7 (24.1)			4 (16.0)			11 (20.4)				
≥ \$50,000	2 (6.9)			2 (8.0)			4 (7.4)				
Marital status										11.17	0.01 <sup>b,c</sup>
Married	1 (3.4)			8 (29.6)			9 (16.1)				
Not married <sup>2</sup>	28 (96.6)			19 (70.4)			47 (83.9)				
Children <sup>3</sup> (y)	10 (37.0)			13 (48.1)			23 (42.6)			0.68	0.41
Number of children		1.04	1.72		1.04	1.29		1.05	1.40	.00	1.00
Nearby family, ≥50 mi (y)	19 (67.9)			20 (74.1)			39 (70.9)			0.26	0.61

*Note.* <sup>1</sup> Intend to Treat only. Of 56 participants who agreed to demographics, two declined to disclose income level, and one declined to disclose number of children. <sup>2</sup> Single, divorced, separated or widowed. <sup>3</sup> Biological children. <sup>a</sup> A t-test is reported to compare mean age and number of children between groups; for remaining comparisons, chi-square values are reported. <sup>b</sup> For chi-square comparisons with minimum expected cell count <5, the Fisher's exact test is reported. <sup>c</sup> As a result of the significant difference in the proportion of marital status reported by participants in each condition, this variable was evaluated as a potential confounding factor in all analyses.

Table 6. Clinical Characteristics Assessed at Phone Screen of Randomized Participants by Condition (N = 60)

	iDBT ( <i>n</i> = 31)				Waitlist ( <i>n</i> = 29)				<i>Test stat</i> <sup>a</sup>	<i>p</i>
	<i>n</i>	%	<i>M</i>	<i>SD</i>	<i>n</i>	%	<i>M</i>	<i>SD</i>		
<b>SBQ-R</b>										
Total Score			12.55	2.49			11.74	2.44	1.27	0.21
<b>Heavy Drinking</b>										
Every day		19.4				24.1			2.76	0.62 <sup>b</sup>
5 to 6 days a week		19.4				24.1				
3 to 4 days a week		29.0				31.0				
1 to 2 days a week		16.1				17.2				
2 to 3 days a month		16.1				3.4				
<b>AUDIT</b>										
Total Score			29.93	6.78			25.71	9.82	-0.82	0.42
<b>DMQ</b>										
Coping			16.86	2.98			16.55	2.72	0.43	0.67
Social			12.72	4.69			11.71	4.05	0.89	0.38
Enhancement			14.00	3.97			14.42	4.11	-0.40	0.69
<b>DERS-16</b>										
Total Score			64.66	9.30			62.32	8.59	1.01	0.32
<b>Mental health treatment</b>										
Past year (% yes)		48.4				44.8			0.08	0.78
Never (%)		12.9				10.3			0.95	1.00 <sup>b</sup>
<b>Psychiatric hospitalizations</b>										
Lifetime (% yes)		51.6				55.2			0.08	0.78
<b>Psychotropic medications prescribed</b>										
Past year (% yes)		51.6				55.2			0.08	0.78

*Note.* <sup>a</sup>A t-test is reported to compare SBQ-R, AUDIT, DERS-16, and DMQ subscale scores across conditions; for remaining comparisons, chi-square values are reported. <sup>b</sup> For chi-square comparisons with minimum expected cell count <5, the Fisher's exact test is reported.

Table 7. Drinking reduction techniques and DBT counterpart

Alcohol Reduction Strategy	DBT Skill
<b>Deciding to make a change</b>	
Goal Setting	Dialectical Drinking
Decisional Balance	Dialectical Drinking
Assessment of motivation and interest	Dialectical Drinking
Abstinence violation effect	Dialectical Drinking and Clear Mind
<b>Making a change</b>	
Drink Tracking	Daily diary card
Contingency management	Contingency management & and Burning bridges
Craving management	Burning bridges
Drink refusal strategies	Dialectical Drinking

Table 8. Outline of intervention sessions

Session	DBT module	Skills	Function
1	Mindfulness	<ul style="list-style-type: none"> <li>- Observing</li> <li>- Describing</li> <li>- Participating</li> </ul>	To introduce the foundational skills to develop non-judgmental awareness of the present.
2	Mindfulness	<ul style="list-style-type: none"> <li>- Non-judgmentally</li> <li>- One-mindfully</li> <li>- Effectively</li> </ul>	To teach how to practice mindfulness with skillful effectiveness.
3	Addiction	<ul style="list-style-type: none"> <li>- Dialectical Drinking</li> <li>- Clear Mind</li> </ul>	To help learners find a middle path between oppressive sobriety and unrestrained freedom of drinking, and develop a clear mind.
4	Addiction	<ul style="list-style-type: none"> <li>- Community Reinforcement</li> <li>- Burning Bridges</li> </ul>	To teach strategies to identify relationships and activities that aim to stop or reduce problematic drinking.
5	Emotion Regulation	<ul style="list-style-type: none"> <li>- Naming and Understanding Emotions</li> </ul>	To teach the functions of emotions, and how to describe them.
6	Emotion Regulation	<ul style="list-style-type: none"> <li>- Check the Facts</li> <li>- Opposite Action</li> <li>- Problem Solving</li> </ul>	To teach skills to reduce frequency and quantity of unwanted emotions.
7	Emotion Regulation	<ul style="list-style-type: none"> <li>- Building Mastery</li> <li>- Copy Ahead</li> </ul>	To teach skills to build future resilience against intense emotion.
8	Distress Tolerance	<ul style="list-style-type: none"> <li>- TIP (Temperature of Face, Intense Exercise, Paced Breathing)</li> <li>- Distract</li> </ul>	To teach skills that help weather crises and intense negative emotions.

Table 9. Assessments and Assessment Schedule

Assessment Instrument	Phone Screening	Baseline and Monthly assessment	Weekly Assessments iDBT	Weekly Assessments Waitlist
1. NIAAA Recommended Questions-Revised	X			
2. Suicide Behaviors Questionnaire Revised	X	X		
3. Brief Treatment History Interview	X			
4. Difficulties In Emotion Regulation Scale-16	X			
5. Difficulties In Emotion Regulation Scale		X		
6. Drinking Motives Questionnaire	X	X		
7. Alcohol Use Disorder Identification Test	X	X		
8. Short Inventory Of Problems		X		
9. DBT Ways Of Coping Checklist		X		
10. Scale Of Suicide Ideation		X		
11. University Of Washington Risk Assessment Protocol	X		X	X
12. Weekly Suicide Assessment			X	X
13. Weekly Alcohol Consumption Assessment			X	X
14. Expectancies Questionnaire <sup>a</sup>			X	
15. Client Satisfaction <sup>b</sup> Questionnaire			X	
16. California Therapeutic Alliance Ratings System <sup>b</sup>			X	
17. Weekly Usefulness Ratings			X	

*Note.* <sup>a</sup> Measure was given before the start of session 1. <sup>b</sup> Measure was given before start of session 8.

Table 10. Primary Outcomes Assessed at Baseline of Randomized Participants by Drop Status

	Non-Drops			Study Dropouts ( $N = 6^a$ )			Total Randomized			<i>t</i>	<i>p</i>
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>		
<b>AUDIT</b>											
Total Score	53	22.60	7.39	6	21.00	15.65	59	22.44	8.39	0.25	0.81
<b>Drinks consumed in past 30 days</b>											
Total drinks	52	128.59	86.93	6	143.00	119.20	58	130.09	89.60	-0.37	0.71
<b>BSI</b>											
Total score	53	14.33	7.84	6	11.37	5.98	59	14.03	7.68	0.89	0.38
<b>DERS</b>											
Total Score	53	126.93	24.61	6	119.17	42.03	59	26.47	26.47	0.44	0.67

*Note.* <sup>a</sup> One participant did not fill out any monthly assessments, and their data is not included in this table.

Table 11. Randomization Algorithm Investigation

	iDBT-ST	Waitlist	Total	$\chi^2$	p
Biological Sex (Female) <sup>a</sup>	21	21	42	0.16	.69
Suicide Ideation (High) <sup>b</sup>	30	29	59	0.95	.33
Alcohol Use Severity (High) <sup>c</sup>	27	25	52	0.01	.92

*Note.* <sup>a</sup>For transgender clients, biological sex was assessed by sex assigned at birth. <sup>b</sup>High suicide ideation defined at SBQ-R score > 7. <sup>c</sup>High alcohol use severity defined as AUDIT score > 15.

Table 12. Recruitment Mediums and Effectiveness

	Screened		Invited		Enrolled		Retained	
	N	%	n	%	n	%	n	%
Craigslist	257	64.6	82	90.1	54	90.0	46	95.8
Reddit	3	0.8	3	3.3	2	3.3	2	4.2
Referral	8	2.0	5	5.5	3	5.0	3	6.3
Unknown/Other	128	32.2	1	1.1	1	1.7	1	2.1
Total	398		91		60		48	

*Note.* Based on information obtained during the phone screening interview.

Table 13. Means and standard deviations over time between condition

		iDBT			Waitlist		
		n	M	SD	n	M	SD
AUDIT	Baseline	30	22.83	9.24	29	22.03	7.54
	1-month	24	17.38	7.78	26	21.21	10.17
	2-month	22	16.64	7.32	28	19.71	10.18
	3-month	24	16.59	9.31	26	16.15	9.41
	4-month	24	13.62	8.86	25	16.46	8.77
SSI	Baseline	30	13.54	7.52	29	14.53	7.95
	1-month	24	9.59	7.09	26	13.14	7.93
	2-month	22	8.67	6.80	28	12.48	8.37
	3-month	24	7.38	7.34	26	11.23	9.14
	4-month	24	5.45	6.62	26	9.59	8.99
DERS (Total)	Baseline	30	123.93	26.40	29	128.44	26.82
	1-month	24	117.13	22.33	26	133.45	28.14
	2-month	22	113.27	25.34	28	126.72	34.07
	3-month	24	113.78	26.95	26	124.99	26.76
	4-month	22	109.18	26.11	26	114.35	29.37
RFL mean	Baseline	30	3.01	1.01	29	3.12	0.90
	1-month	24	3.45	0.94	26	3.19	0.99
	2-month	22	3.46	0.99	28	3.25	0.94
	3-month	24	3.67	0.84	26	3.35	1.04
	4-month	24	3.64	0.90	26	3.38	1.01
DBTWC Mean DBT skills use	Baseline	30	1.47	0.65	29	1.39	0.54
	1-month	23	1.77	0.52	26	1.50	0.64
	2-month	22	1.74	0.57	28	1.45	0.58
	3-month	24	1.81	0.48	26	1.70	0.59
	4-month	24	1.91	0.49	26	1.68	0.56
SIP	Baseline	30	22.81	12.05	29	24.83	10.78
	1-month	24	20.03	11.12	26	23.55	12.96
	2-month	22	16.97	10.47	28	19.86	12.52
	3-month	24	17.96	10.68	26	17.46	13.78
	4-month	24	17.79	10.09	26	14.77	12.23
PHQ-9	Baseline	30	17.50	6.11	29	19.13	5.58
	1-month	24	13.67	6.17	26	19.08	6.21
	2-month	22	12.13	5.99	28	16.05	7.45
	3-month	24	13.69	7.31	26	14.08	8.70
	4-month	24	12.13	6.45	26	13.27	6.81

Table 14. Drinking outcomes between conditions and over time

	iDBT-ST			Waitlist		
	Total Number of drinks M (SD)	Unsafe Drinking Days M (SD)	Safe Drinking weeks M (SD)	Total Number of Drinks M (SD)	Unsafe Drinking Days M (SD)	Safe Drinking weeks M (SD)
Month-0	132.20 (100.44)	12.13 (10.31)	0.17 (.51)	127.82 (78.11)	12.75 (10.02)	0.33 (0.97)
Month-1	83.19 (65.76)	6.17 (6.22)	0.20 (.42)	132.65 (92.53)	12.08 (9.54)	0.25 (0.77)
Month-2	74.24 (76.71)	5.14 (6.99)	0.43 (1.13)	117.22 (98.66)	10.96 (10.03)	0.79 (1.43)
Month-3	65.96 (77.43)	4.96 (6.66)	1.40 (1.51)	106.44 (98.42)	10.56 (10.86)	1.00 (1.73)
Month-4	61.84 (60.80)	5.09 (6.99)	1.10 (1.20)	82.60 (90.24)	8.56 (11.26)	1.53 (1.80)

Table 15. Slope estimates between condition for normally distributed outcomes

Outcome	iDBT-ST				Waitlist			
	Phase	Slope Estimate	S.E.	p	Phase	Slope Estimate	S.E.	p
AUDIT	<b>TX</b>	<b>-3.21</b>	<b>1.02</b>	<b>.002</b>	RBL	-1.16	0.66	.080
	FU	-1.53	0.69	.026	TX	-1.65	0.88	.062
DERS	<b>TX</b>	<b>-5.40</b>	<b>2.73</b>	<b>.048</b>	RBL	-0.83	1.99	.677
	FU	-2.04	3.24	.528	<b>TX</b>	<b>-6.13</b>	<b>2.94</b>	<b>.037</b>
RFL	<b>TX</b>	<b>0.23</b>	<b>0.12</b>	<b>.046</b>	RBL	0.07	0.05	.207
	FU	0.02	0.07	.745	TX	0.07	0.05	.181
SIP	<b>TX</b>	<b>-2.91</b>	<b>1.39</b>	<b>.036</b>	<b>RBL</b>	<b>-2.48</b>	<b>0.89</b>	<b>.006</b>
	FU	0.88	1.02	.387	<b>TX</b>	<b>-2.26</b>	<b>1.10</b>	<b>.039</b>
DBT-WCCL	TX	0.15	0.09	.095	RBL	0.03	0.04	.466
	FU	0.06	0.05	.241	TX	0.11	0.06	.078
PHQ-9	<b>TX</b>	<b>-2.74</b>	<b>0.84</b>	<b>.001</b>	<b>RBL</b>	<b>-1.53</b>	<b>0.47</b>	<b>.001</b>
	FU	0.12	0.65	.855	TX	-1.37	0.79	.092

Table 16. Time by condition effects for each normally distributed outcome from 0-2 month and 0-4 month

Measure	Parameter	0-2 month				0-4 month			
		Beta	SE	95% CI	p	Beta	SE	95% CI	p
AUDIT	Time	-1.15	0.66	-2.45-0.17	.08	-1.61	0.42	-2.44- -0.78	<.001
	Condition	0.05	2.22	-4.30-4.39	.98	-0.88	2.22	-5.24-3.49	.69
	Time*Condition	-2.05	1.12	-4.43-0.33	.09	-0.37	0.68	-1.70-0.95	.58
DERS	Time	-0.83	1.99	-4.73-3.07	.67	-3.57	1.40	-6.32- -0.82	.01
	Condition	-6.71	6.90	-20.20-6.77	.33	-10.33	7.18	-24.41-3.75	.15
	Time*Condition	-4.57	3.38	-11.20-2.05	.18	0.20	1.92	-3.57-3.96	.92
RFL	Time	0.07	0.05	-0.03-0.18	.18	0.07	0.03	0.003-0.13	.04
	Condition	-0.12	0.23	-0.57-0.33	.59	-0.04	0.23	-0.48-0.41	.87
	Contact	-0.53	0.22	-0.97- -0.10	.02	-0.52	0.23	-0.98- -0.07	.02
	Time*Condition	0.18	0.13	-0.08-0.42	.19	0.06	0.07	-0.07-0.19	.36
SIP	Time	-2.48	0.90	-4.24- -0.72	.006	-2.50	0.60	-3.68- -1.33	<.001
	Condition	-2.36	2.88	-8.01-3.30	.41	-3.60	2.84	-9.16-1.96	.21
	Time*Condition	-0.43	1.65	-3.62-2.81	.79	1.39	0.79	-0.17-2.95	.08
DSS	Time	0.03	0.04	-0.05-0.11	.47	0.08	0.03	0.015-0.014	.02
	Condition	0.10	0.15	-0.20-0.39	.52	0.16	0.14	-0.11-0.43	.25
	Time*Condition	0.11	0.10	-0.08-0.30	.24	0.01	0.04	-0.07-0.10	.78
PHQ-9	Time	-1.53	0.47	-2.45- -0.62	.001	-1.64	0.35	-2.32- -0.96	<.001
	Condition	-2.40	1.36	-5.06-0.25	.08	-3.45	1.44	-6.27- -0.64	.02
	Time*Condition	-1.21	0.96	-3.09-0.67	.21	0.55	0.52	-0.48-1.57	.30

Note. Bold indicates  $p < .05$

Table 17. Estimated Slopes for Zero Inflated Outcomes for Intent-to-Treat Participants (N=59)

Scale	Months 0-2			Months 0-4		
	Wald $\chi^2$	RR	p	Wald $\chi^2$	RR	p
<b>SSI total score</b>						
Time	3.30	0.92	.07	6.34	0.92	.01
Condition	0.09	0.96	.76	0.07	0.96	.80
Condition * Time	2.55	0.86	.11	5.02	0.86	.03
<b>Total Drinks</b>						
Time	0.56	0.96	.46	6.15	0.90	.01
Condition	0.08	0.95	.78	0.90	0.84	.34
Condition * Time	4.77	0.77	.03	1.51	0.92	.22
<b>Dangerous drinking days</b>						
Time	2.58	0.92	.11	4.73	0.91	.03
Condition	0.08	0.94	.78	0.28	0.90	.60
Condition * Time	7.16	0.72	.01	3.11	0.87	.08
<b>Safe Drinking weeks</b>						
Time	2.39	1.49	.12	8.57	1.39	.003
Condition	0.82	0.46	.36	1.08	0.50	.29
Condition * Time	1.26	0.96	.96	0.57	0.82	.45

*Note.* RR = Risk ratios; bold indicates  $p < .05$

Table 18. Clinically Significant Change for Primary and Secondary Outcomes by Condition

	iDBT-ST				Waitlist				U <sup>a</sup>	p	
	Valid n	No change/ deteriorated N (%)	Improved N (%)	Recovered N (%)	Valid n	No change/ deteriorated N (%)	Improved N (%)	Recovered N (%)			
BSI	1-month	24	20 (83.3%)	3 (12.5)	1 (4.2)	26	24 (92.3)	0	2 (7.7)	287.0	0.29
	2-month	22	17 (77.3)	2 (9.1)	3 (13.6)	28	23 (82.1)	3 (10.7)	2 (7.1)	290.5	0.62
	3-month	24	14 (58.3)	4 (16.7)	6 (25.0)	26	18 (69.2)	4 (15.4)	4 (15.4)	274.0	0.39
	4-month	24	15 (62.5)	2 (8.3)	7 (29.2)	26	19 (73.1)	2 (7.7)	5 (19.2)	277.0	0.41
AUDIT	1-month	24	20 (83.3)	3 (12.5)	1 (4.2)	26	24 (92.3)	2 (7.7)	0	283.0	0.32
	2-month	22	15 (68.2)	5 (22.7)	2 (9.1)	28	25 (89.3)	2 (7.1)	1 (3.6)	243.5	0.07
	3-month	24	16 (66.7)	5 (20.8)	3 (12.5)	26	20 (76.9)	2 (7.7)	4 (15.4)	287.0	0.54
	4-month	24	12 (50.0)	6 (25.0)	6 (25.0)	26	19 (73.1)	5 (19.2)	2 (7.7)	231.0	0.07
DERS	1-month	24	21 (87.5)	3 (12.5)	0	26	26 (100)	0	0	273.0	0.07
	2-month	22	16 (72.7)	5 (22.7)	1 (4.5)	28	24 (85.7)	3 (10.7)	1 (3.6)	269.0	0.27
	3-month	24	17 (70.8)	6 (25.0)	1 (4.2)	26	23 (88.5)	3 (11.5)	0	255.5	0.11
	4-month	24	18 (75.0)	5 (20.8)	1 (4.2)	26	19 (73.1)	3 (11.5)	4 (15.4)	297.5	0.71
SIP	1-month	24	22 (91.7)	1 (4.2)	1 (4.2)	26	25 (96.2)	1 (3.8)	0	297.5	0.49
	2-month	22	19 (79.2)	3 (13.6)	2 (9.1)	28	21 (75.0)	6 (21.4)	1 (3.6)	305.5	0.95
	3-month	24	19 (79.2)	3 (12.5)	2 (8.3)	26	20 (76.9)	1 (3.8)	5 (19.2)	298.5	0.72
	4-month	24	19 (79.2)	3 (12.5)	2 (8.3)	26	16 (61.5)	4 (15.4)	6 (23.1)	252.0	0.15
DSS	1-month	23	18 (78.3)	4 (17.4)	1 (4.3)	26	20 (76.9)	5 (19.2)	1 (3.8)	295.5	0.92
	2-month	22	17 (77.3)	4 (18.2)	1 (4.5)	28	22 (78.6)	6 (21.4)	0	301.0	0.85
	3-month	24	15 (62.5)	6 (25.0)	3 (12.5)	26	18 (69.2)	7 (26.9)	1 (3.8)	283.5	0.51
	4-month	24	16 (66.7)	6 (25.0)	2 (8.3)	26	17 (65.4)	7 (26.9)	2 (7.7)	309.0	0.94
RFL	1-month	24	19 (79.2)	2 (8.3)	3 (12.5)	26	23 (88.5)	2 (7.7)	1 (3.8)	281.0	0.35
	2-month	22	17 (77.3)	1 (4.5)	4 (18.2)	27	24 (88.9)	1 (3.7)	2 (7.4)	261.5	0.27
	3-month	24	17 (70.8)	2 (8.3)	5 (20.8)	26	22 (84.6)	1 (3.8)	3 (11.5)	269.5	0.25
	4-month	24	16 (66.7)	0	8 (33.3)	26	21 (80.8)	2 (7.7)	3 (11.5)	260.0	0.19
PHQ	1-month	24	19 (79.2)	3 (12.5)	2 (8.3)	26	21 (80.8)	2 (7.7)	3 (11.5)	309.5	0.94
	2-month	22	15 (68.2)	4 (18.2)	3 (13.6)	28	19 (67.9)	6 (21.4)	3 (10.7)	306.0	0.96
	3-month	24	18 (75.0)	2 (8.3)	4 (16.7)	26	17 (65.4)	1 (3.8)	8 (30.8)	276.0	0.38
	4-month	23	13 (56.5)	2 (8.7)	8 (34.8)	23	13 (56.5)	7 (30.4)	3 (13.0)	239.5	0.54

Note. <sup>a</sup> Mann-Whitney U analyses were carried out to compare between conditions the proportion of participants who remained unchanged, and who showed improvement or recovery at 1-month, 2-months, 3-months, and 4-months.

Table 19. Pre-treatment Credibility/Expectancy Ratings by Condition

	Overall ( <i>N</i> = 54)		iDBT ( <i>n</i> = 28)		Waitlist ( <i>n</i> = 26)		t	p	
	M	SD	M	SD	M	SD			
<b>Credibility</b>									
Total	4.80	1.89	4.63	1.93	4.99	1.86	-0.69	0.49	
Problematic drinking	4.82	1.90	4.71	1.97	4.93	1.87	-0.42	0.67	
Thoughts of Suicide	4.93	1.82	4.77	1.84	5.11	1.81	-0.69	0.50	
<b>Expectancy of Improvement</b>									
Total (%)	43.1	2.75	40.6	2.76	45.4	2.77	0.64	0.53	
Problematic Drinking (%)	43.5	3.04	40.4	3.09	46.4	3.01	0.73	0.47	
Thoughts of Suicide (%)	49.4	2.66	40.8	2.70	44.3	2.66	0.48	0.63	

Table 20. Number and percentages of individuals attempting sessions and endorsing homework completion

Session number	Attempted <i>N</i> (%)	Completed <i>N</i> (%)	Completed homework <i>N</i> (%) <sup>a</sup>	Rated homework as effective <i>N</i> (%) <sup>b</sup>
Session 1	53 (89.83)	50 (84.47)	--	--
Session 2	44 (74.58)	37 (69.71)	26 (59.09)	25 (96.15)
Session 3	38 (64.41)	29 (49.15)	21 (55.26)	17 (77.27)
Session 4	35 (59.32)	25 (42.37)	19 (54.29)	19 (100)
Session 5	28 (47.46)	23 (38.98)	16 (57.14)	16 (100)
Session 6	26 (49.15)	23 (38.98)	17 (65.38)	17 (100)
Session 7	22 (37.29)	19 (32.20)	15 (68.18)	13 (86.67)
Session 8	18 (30.51)	18 (30.51)	13 (72.22)	13 (100)

*Note.* <sup>a</sup> Denominator is number of people who attempted session; <sup>b</sup> Denominator is number of people who completed homework

Table 21. Average perceived usefulness ratings and urges to quit by session

Session number	N	Perceived Usefulness M (SD) <sup>a</sup>	Urge to Quit M (SD) <sup>a</sup>
Session 1	45	3.69 (1.18)	1.78 (1.06)
Session 2	32	3.69 (1.14)	1.92 (1.34)
Session 3	26	4.08 (1.23)	1.97 (1.49)
Session 4	23	4.09 (0.90)	1.97 (1.56)
Session 5	20	4.00 (1.21)	2.00 (1.50)
Session 6	21	4.00 (1.18)	1.80 (1.54)
Session 7	17	3.76 (1.03)	1.42 (1.44)
Session 8	17	3.94 (1.20)	1.50 (1.00)

*Note.* <sup>a</sup> Scale is from 0 (low) to 5 (high).

Table 22. End of treatment satisfaction, usefulness, and alliance

Measure	M	SD
Overall usefulness of treatment <sup>a</sup>	7.71	1.92
Client Satisfaction total score <sup>b</sup>	80.79	17.96
CALPAS overall score <sup>c</sup>	5.15	0.86
CALPAS patient working capacity	4.83	0.82
CALPAS Patient commitment	5.07	0.89
CALPAS Working strategy consensus	5.15	1.09
CALPAS Therapist understanding and commitment	5.64	0.87

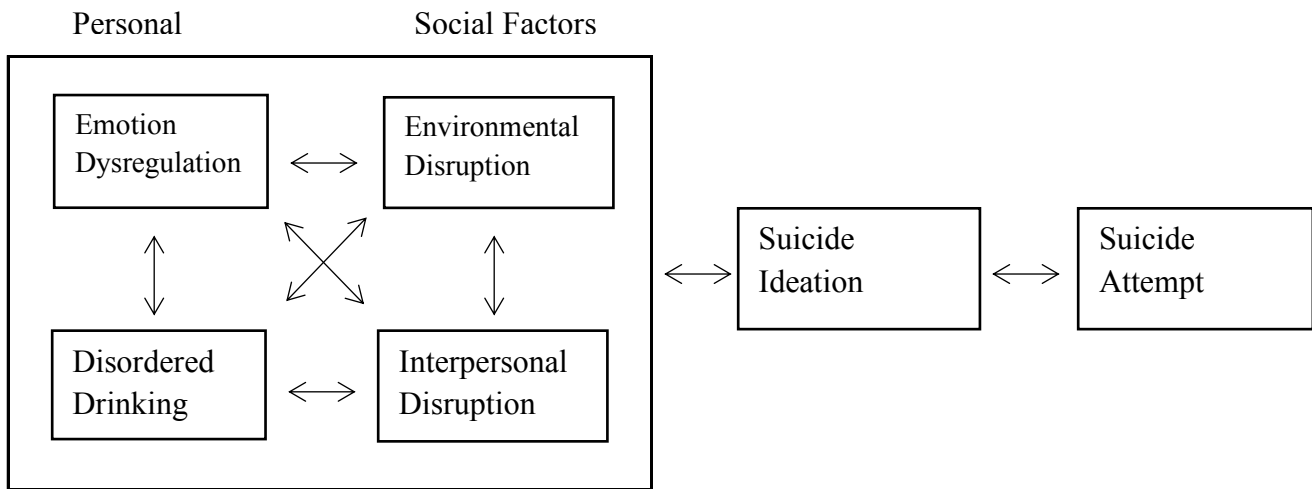
*Note.* <sup>a</sup>Overall usefulness is rated on a scale of 0 (not at all useful) to 10 (extremely useful). <sup>b</sup>Client Satisfaction score ranges from 1 (not satisfied) to 100 (totally satisfied). <sup>c</sup>CALPAS mean ratings range from 1 (not at all) to 7 (very much so).

Table 23. Drinking goals and motivation

Drinking Goals	N	Motivation M (SD) <sup>a</sup>	Confidence M (SD) <sup>a</sup>
Quitting	6	7.33 (3.14)	7.00 (3.03)
Safer Drinking	5	7.00 (3.14)	4.33 (2.89)
Reduced Drinking	8	5.00 (2.00)	5.00 (1.51)
Safer and Reduced Drinking	11	7.09 (1.76)	6.91 (1.51)
Total	28	6.40 (2.36)	5.93 (2.33)

*Note.* <sup>a</sup> Motivation and Confidence scores range from 1 (not very motivated/confidant) to 9 (very motivated/confidence)

Figure 1. The theoretical relationship between alcohol and suicide



*Note.* Model adapted from Yoshimasu et al., 2008

Figure 2. Dialectical Drinking diagram

## Dialectical Drinking

Oppressive Sobriety

Unrestrained Freedom



Figure 3. Study Timeline

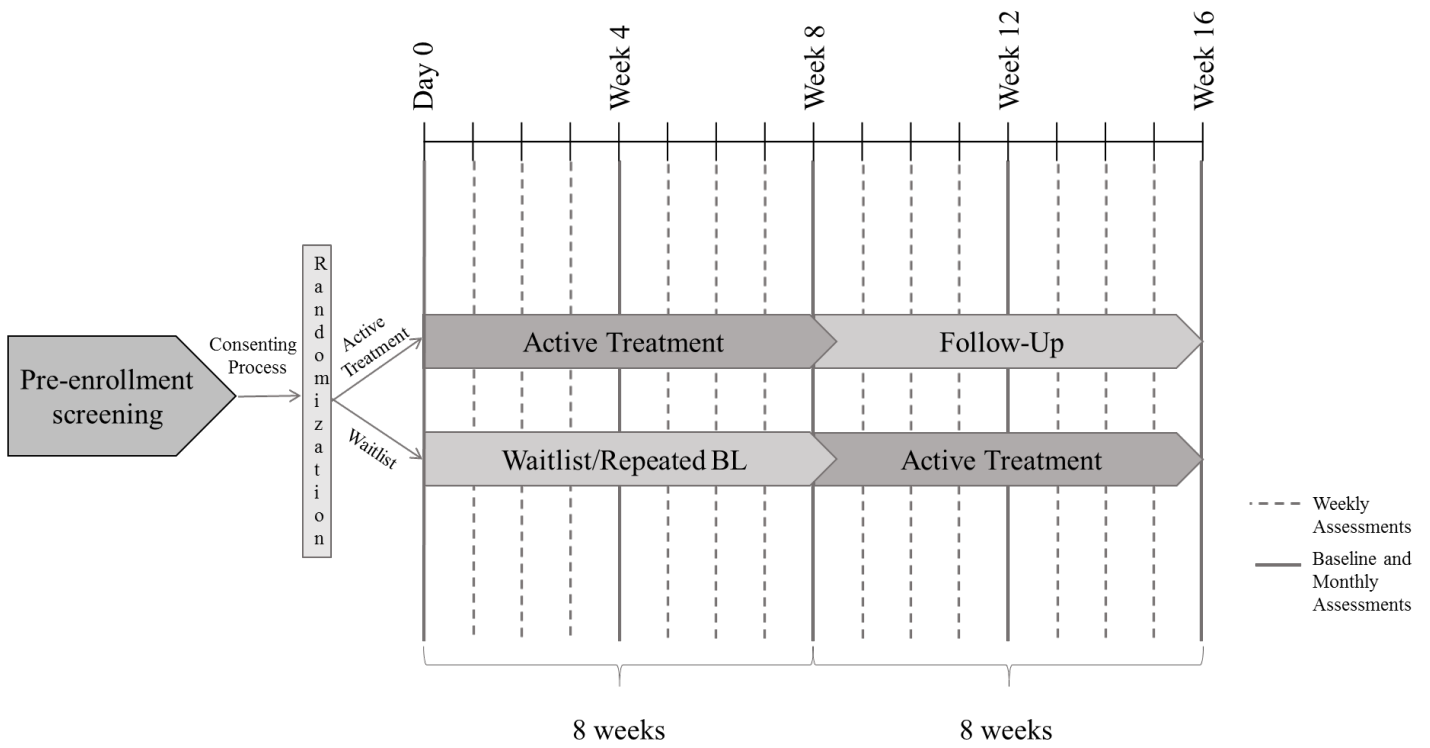


Figure 4. Consort Diagram

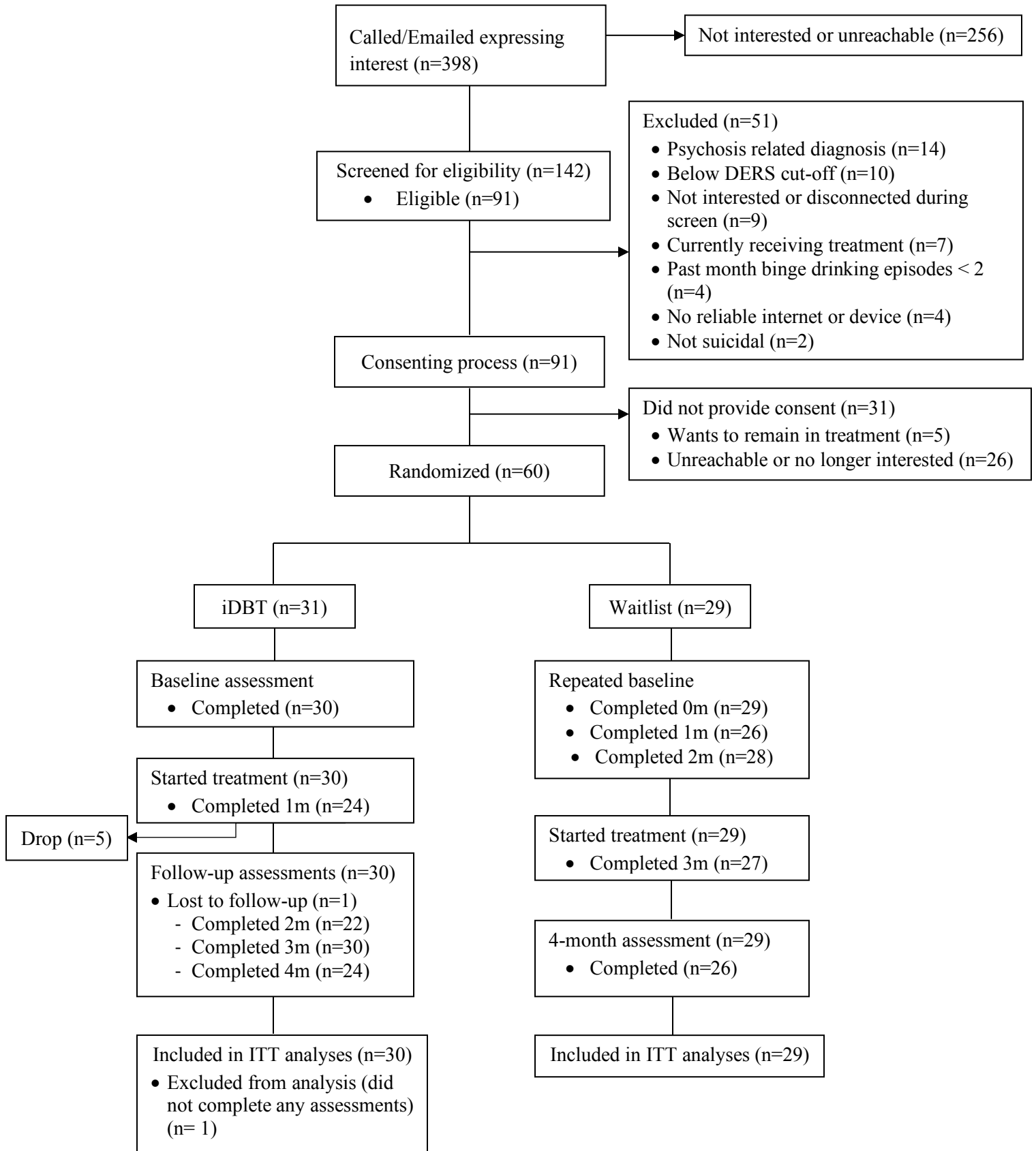


Figure 5. Mean suicide ideation scores by condition over time

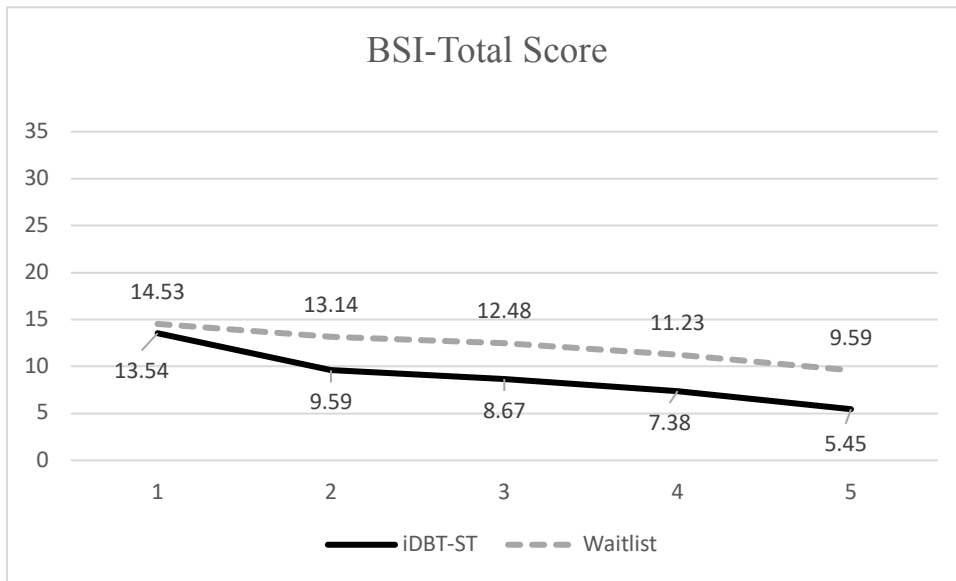


Figure 6. Mean alcohol use severity scores by condition over time

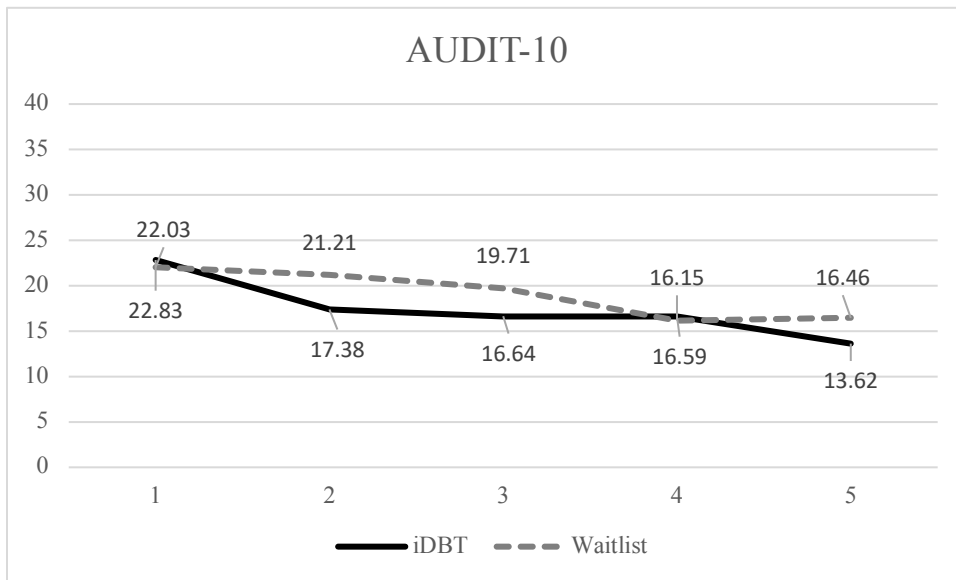


Figure 7. Mean total number of drinks by condition over time

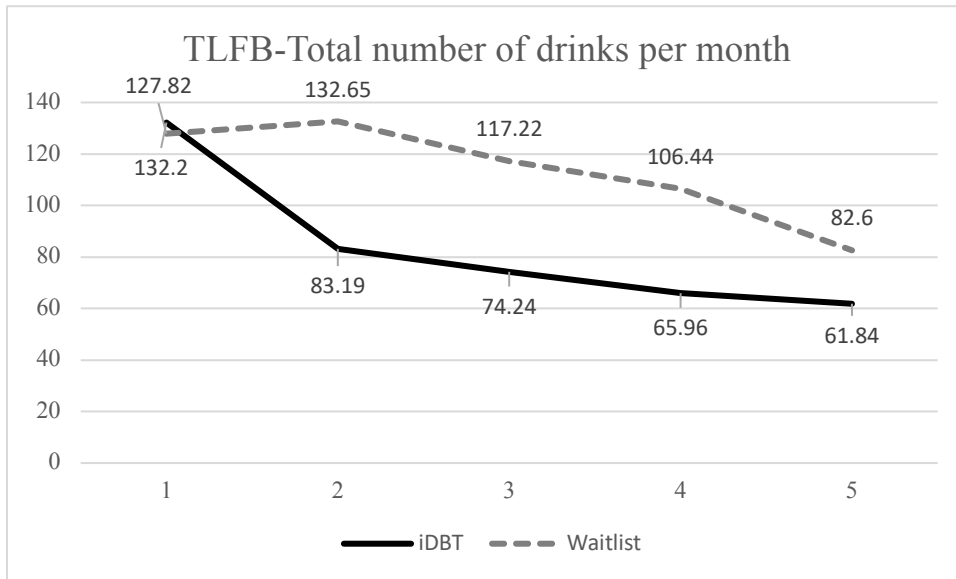


Figure 8. Mean number of dangerous drinking days by condition over time

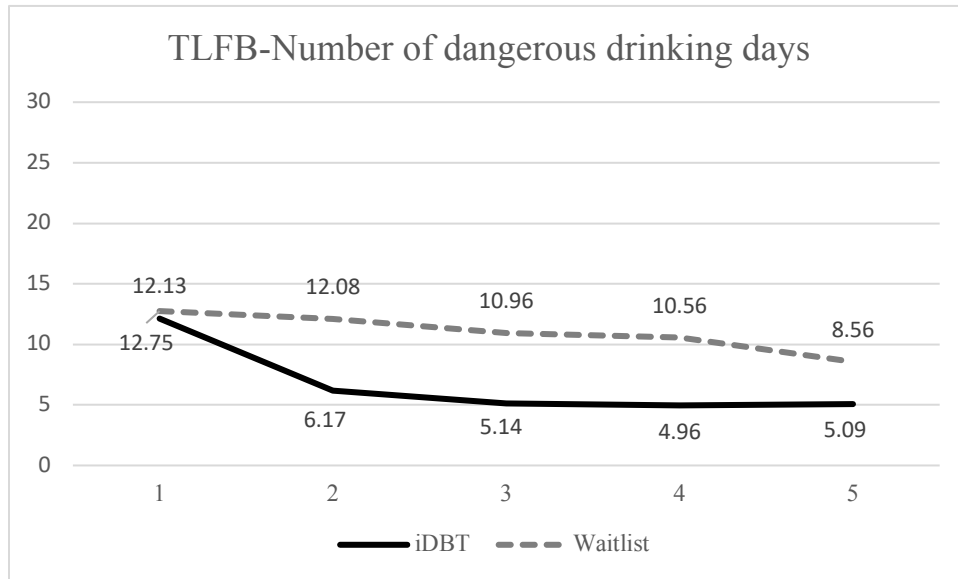


Figure 9. Mean number of safe drinking weeks by condition over time

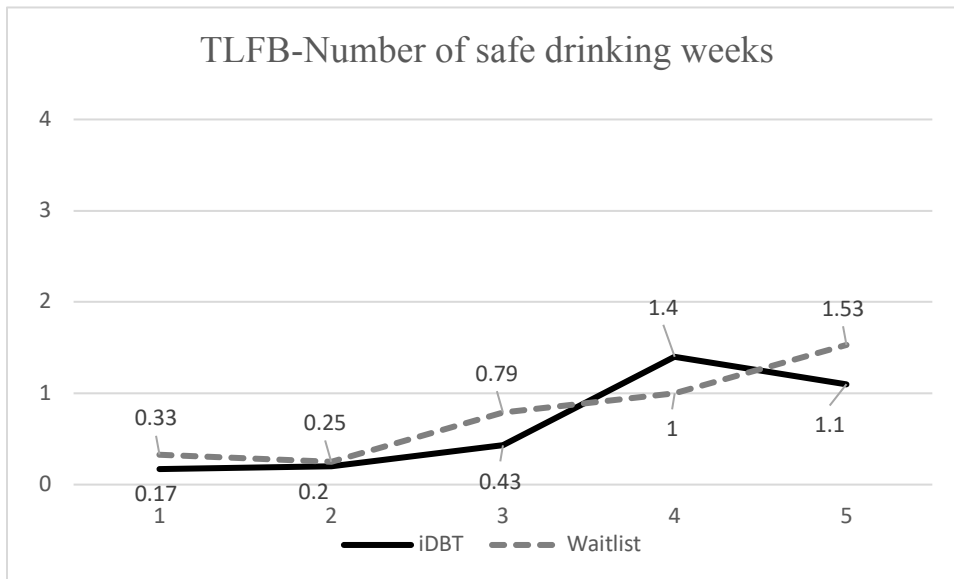


Figure 10. Mean emotion dysregulation scores by condition over time

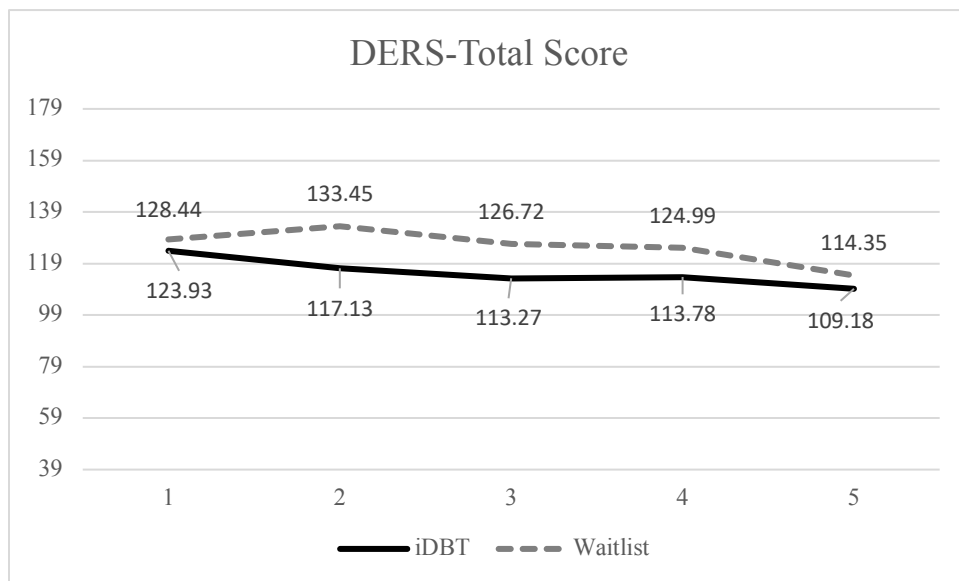


Figure 11. Mean reasons for living scores by condition over time

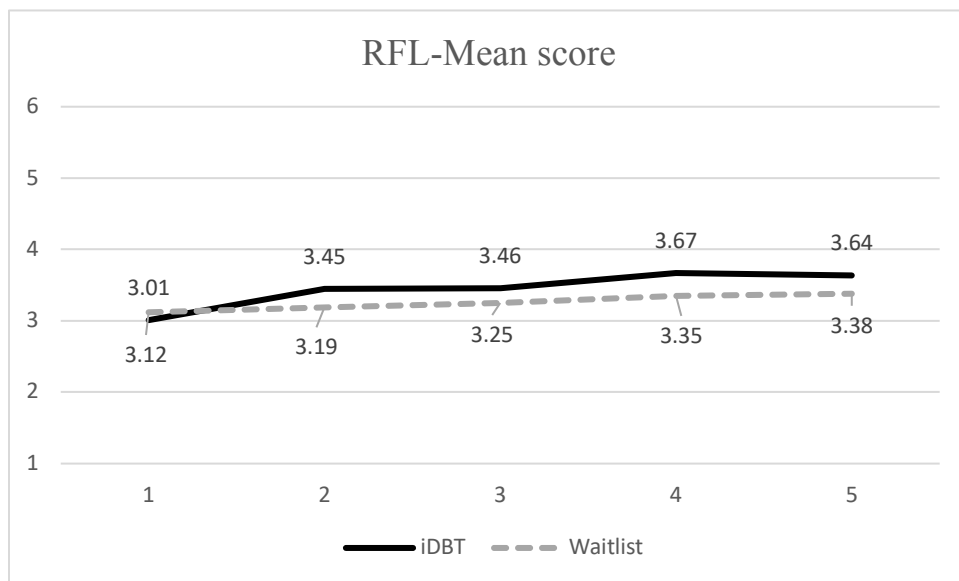


Figure 12. Mean alcohol related problems score by condition over time

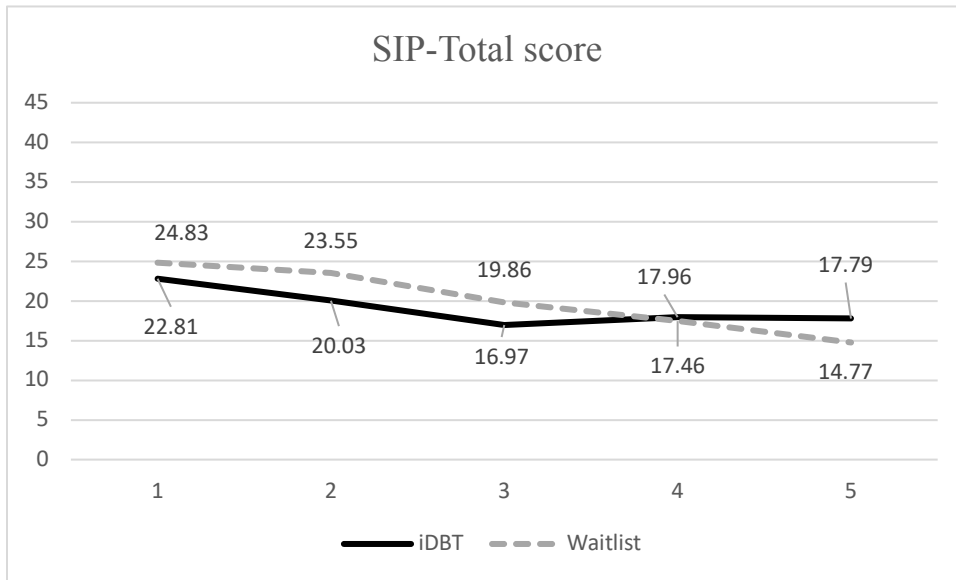


Figure 13. Mean DBT skills use score by condition over time

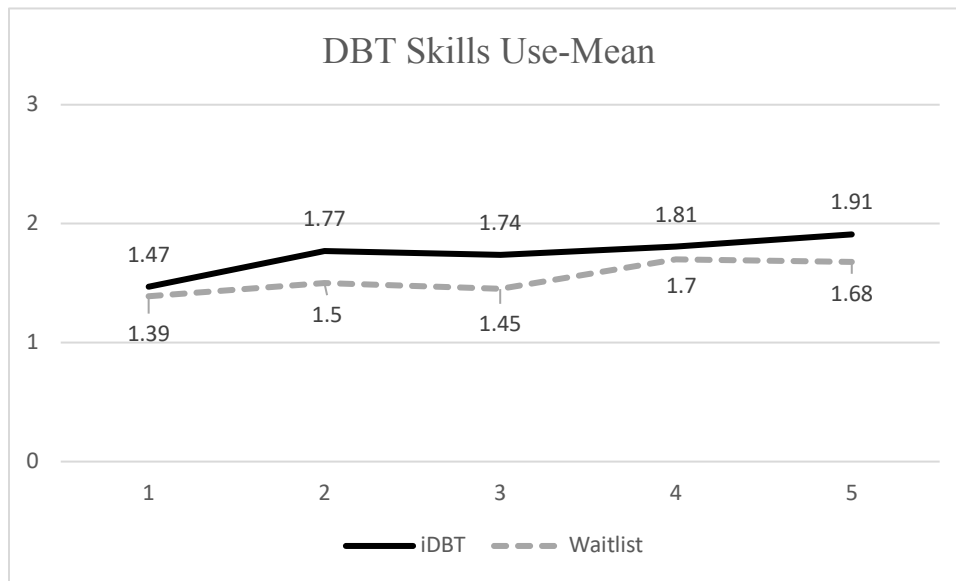
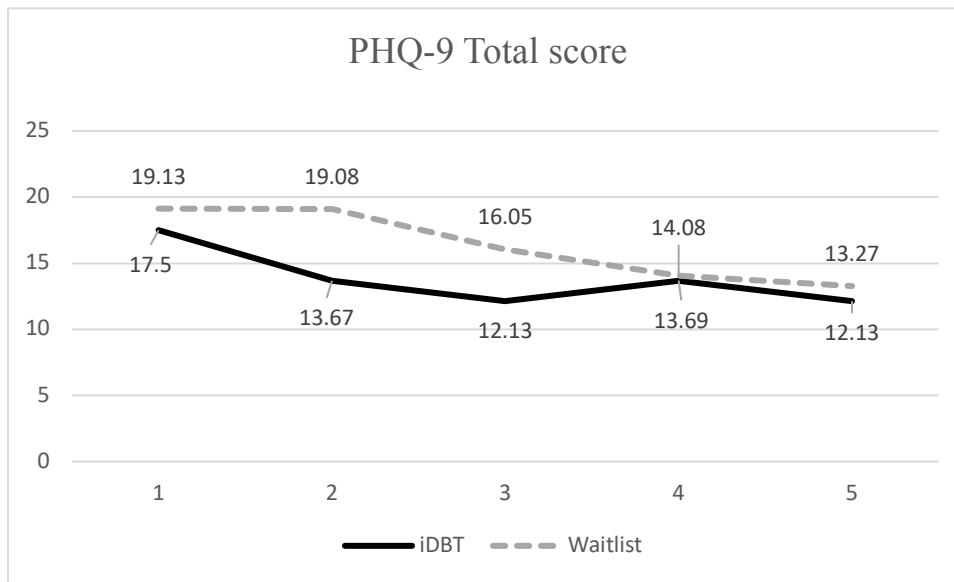


Figure 14. Mean depression scores by condition over time



Appendix 1. Caring email sent to those unreachable by phone

Dear \_\_\_\_\_ ,

Hope you're doing ok! Below are some resources if you need anyone to talk to, are in a crisis, or if you would like to reach out.

National Suicide Prevention Lifeline: 1-800-273-8255

Website with chat option:

<http://www.suicidepreventionlifeline.org/>

Crisis numbers by County and State:

<http://www.suicide.org/suicide-hotlines.html>

<http://www.sprc.org/states>

Crisis text line

<http://www.crisistextline.org/>

Best,  
Chelsey  
The OASIS Team