



The therapeutic role of emotion regulation and coping strategies during a stand-alone DBT Skills training program for alcohol use disorder and concurrent substance use disorders



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HIGHLIGHTS

- 108 individuals with AUD and concurrent SUDs were included.
- A 3-month DBT-ST as stand-alone outpatient program were carried out.
- Emotional dysregulation, coping strategies and severity of SUDs were assessed.
- The improvement in emotional dysregulation predicted changes in severity of SUDs.
- Coping strategies were mediators of changes in severity of AUD and concurrent SUDs.

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ABSTRACT

Clinical trials on Dialectical Behavior Therapy Skills Training (DBT-ST) as a stand-alone intervention for alcohol use disorder (AUD) showed promising outcomes. Improvements in difficulties with emotion regulation (DER) played a mediating role on abstinence maintenance. However, the effect of DER, together with specific coping strategies, have not been considered yet in the treatment of clinical features associated to AUD and concurrent substance use disorders (CO-SUDs). The current study aims at investigating changes in the number of consecutive days of abstinence (CDA), severity of AUD and CO-SUDs (Shorter PROMIS Questionnaire; SPQ alcohol, prescription, illicit drugs subscale), DER (Difficulties in Emotion Regulation Scale; DERS) and coping strategies (DBT Way of Coping Checklist; DBT-WCCL) during a 3-month DBT-ST program for the treatment of AUD and CO-SUDs. Furthermore, four independent multiple parallel mediational models were estimated considering scores of CDA/SPQ, DERS and DBT-WCCL dimensions as dependent, independent and mediators variables respectively. One-hundred eight individuals with a primary diagnosis of AUD were consecutively admitted. The results showed significant and moderate to large improvements in CDA, severity of AUD, CO-SUDs and DER. The analyses detected significant improvements in the use of DBT Skills. The changes in DER predicted decreases in SPQ scores. The changes in DBT-WCCL scores were mediators of the previous relationships, considering SPQ alcohol and prescription drugs subscales. These findings support the implementation of DBT-ST as a stand-alone intervention for the treatment of AUD and CO-SUDs. DER together with coping strategies are relevant therapeutic mechanisms in the treatment of clinical features related to SUDs.

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1. Introduction

1.1. The adaptation of Dialectical Behavior Therapy for the treatment of substance use disorders

Dialectical Behavior Therapy (DBT) is an evidence-based psychological treatment originally developed to reduce suicide attempts and non-suicidal self-injury behaviors (Linehan, 1981). DBT was further adapted to treat Borderline Personality Disorder (BPD) (Linehan, 1993), and several controlled trials demonstrated its efficacy (e.g., Cristea et al., 2017). In addition to the decrease in suicide attempts and self-injury behaviors (DeCou, Comtois, & Landes, 2019), DBT is equally effective in reducing substance-related behaviors among individuals with BPD (e.g., Axelrod, Perepletchikova, Holtzman, & Sinha, 2011; Dimeff, Rizvi, Brown, & Linehan, 2000; Linehan et al., 1999; Linehan et al., 2002). This evidence supported the adaptation of standard DBT to the treatment of individuals with a primary diagnosis of substance use disorders (SUDs) (Azizi, Borjali, & Golzari, 2010; Beckstead, Lambert, DuBose, & Linehan, 2015; Dimeff & Linehan, 2008).

According to the DBT model (Linehan, 1993, 2014), learning and generalization of DBT skills to everyday life is a key aspect of the treatment for helping patients substitute maladaptive (e.g., suicidal self-injury, alcohol and substance use, binge eating) with goal-oriented behaviors (Linehan & Wilks, 2015). Four skills modules — mindfulness, emotional regulation, interpersonal effectiveness, and distress tolerance — were originally developed in order to address specific dysfunctional domains (i.e., emotional, interpersonal, behavioral, cognitive dysregulation; self-dysfunction) at the heart of BPD diagnostic criteria (Linehan, 1993). The teaching of such modules is provided within the DBT Skills Training (DBT-ST), which represents the group part of the therapy. Empirical studies showed that DBT skills are fundamental for the efficacy of standard DBT for BPD. Indeed, the use of DBT skills was involved in the reduction of self-injury behaviors (Neacsiu, Rizvi, & Linehan, 2010) and emotional dysregulation (Perroud, Nicastro, Jermann, & Huguelet, 2012; Stepp, Epler, Jahng, & Trull, 2008). Furthermore, the reinforcement of DBT skills use in natural environments using mobile phone was associated with a decrease in craving for substances among individuals with BPD-SUDs (Rizvi, Dimeff, Skutch, Carroll, & Linehan, 2011).

According to these findings, the DBT-ST has been implemented as a stand-alone intervention for several clinical conditions (Valentine, Bankoff, Poulin, Reidler, & Pantalone, 2015) including Alcohol Use Disorder (AUD) (Cavicchioli et al., 2019; Maffei, Cavicchioli, Movalli, Cavallaro, & Fossati, 2018). Looking at AUD, the aforementioned studies showed low rates of lapse in substance use and drop-out during a 3-month DBT-ST program. When the intervention was fully carried out in outpatient setting there were large improvements in difficulties with emotion regulation (DER) (Cavicchioli, Movalli, Ramella, et al., 2019). Furthermore, the change in DER during treatment was a mediator explaining AUD primary (i.e., duration of abstinence maintenance; Cavicchioli, Movalli, Ramella, et al., 2019; Maffei et al., 2018) and secondary (i.e., experiential avoidance/emotional distress; Cavicchioli, Movalli, Ramella, et al., 2019) treatment outcomes.

1.2. DBT-ST for the treatment of multiple areas of addiction pathology

Most research on the effectiveness of treatments for SUDs focuses on indexes of substance intake as primary outcomes. However, this approach has been called into question, especially when considering a more comprehensive view of the appropriate targets of treatment evaluation, which extends beyond the quantity and frequency of substance use (Tiffany, Friedman, Greenfield, Hasin, & Jackson, 2012). Particularly, the effectiveness of an intervention is based on several indexes related to multiple domains across different areas of addiction pathology (e.g., acute and protracted substance withdrawal, craving, subjective substance effects) and psychological functioning (e.g., stress,

copying, self-efficacy) (Tiffany et al., 2012). Therefore, the research on the implementation of DBT-ST as stand-alone intervention for SUDs should consider other relevant clinical aspects in addition to abstinence maintenance.

Lefever (1988) proposed a comprehensive clinical operationalization identifying the core domains of addiction. The author identified seven areas describing the severity of addictive behaviors: (i) *pre-occupation* (e.g., looking forward to using); (ii) *use alone* (e.g., using alone feels comfortable; being ashamed about substance use); (iii) *use for effect* (e.g., rewarding effects); (iv) *use as a medicine* (e.g., relaxing, stimulating, suppressant); (v) *protection of supply*, (vi) *using more than planned*, and (vii) *increased tolerance*. Even though there are no studies that have empirically tested the validity of this clinical model, different theoretical perspectives have provided an indirect support for Lefever's dimensions. Specifically, the operationalization of the *pre-occupation* dimension is highly consistent with empirical data on the meta-cognitive model of craving (i.e., desire thinking; Caselli & Spada, 2015). The *use alone* aspect captures the relationship between shame-proneness and the severity of alcohol and drugs use (e.g., Dearing, Stuewig, & Tangney, 2005; Wiechelt, 2007). The area concerning the *use for rewarding effects* overlaps with the neurobiological model of addictive behaviors, called "the reward deficiency syndrome" (e.g., Blum et al., 2000). The *use as a medicine* characteristic of addictive behaviors is supported by different theoretical perspectives confirming the link between problematic emotional states and substance use (e.g., Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Suh, Ruffins, Robins, Albanese, & Khantzian, 2008). Ultimately, *using more than planned* and *increased tolerance* are effectively explained by the neurobiological model of addiction proposed by Koob and Volkow (2016).

Lefever's (1988) model of addictive behaviors is quantitatively operationalized by the Shorter PROMIS Questionnaire (SPQ; Christo et al., 2003). The SPQ simultaneously assesses 16 addictive behaviors considering the seven core characteristics mentioned above. The SPQ was effectively administered for scopes of research and diagnostic screening, demonstrating its reliability and validity among clinical and nonclinical populations (e.g., Christo et al., 2003; Gilbert, Murphy, & McNally, 2011; Haylett, Stephenson, & Lefever, 2004; MacLaren & Best, 2010; Pallanti, Bernardi, & Quercioli, 2006). In order to extend primary outcomes beyond substance use, SPQ might represent a comprehensive assessment of primary outcomes involved in the treatment of SUDs. The advantages of the SPQ are the multidimensional operationalization of addictive behaviors and the clinical utility of simultaneously evaluating several behaviors which frequently co-occur among different populations (Connor, Gullo, White, & Kelly, 2014).

Tiffany et al. (2012) recommend the inclusion of additional indexes related to intermediate targets of treatment, which are functionally linked to primary outcomes, in order to support the effectiveness of interventions for SUDs. According to DBT model and empirical findings on underlying mechanisms of SUDs, DER and coping strategies should be considered as relevant dimensions associated with core clinical features of such conditions (e.g., Berking et al., 2011; Dolan, Rohsenow, Martin, & Monti, 2013). Therefore, the adaptation of DBT framework for the treatment of SUDs assigns a central role to the use of adaptive skills for avoiding substance use and for reducing related problems in other areas of functioning.

There are functional links between DBT skills module and Lefever's dimensions of addictive behaviors. Specifically, "core" mindfulness skills improve the control of attention, which is a crucial ability for maintaining abstinence, modulating urges and thoughts linked to craving, and reducing vulnerability to the dyscontrol on substance intake (Dimeff & Sayrs, 2012; McMains, Sayrs, Dimeff, & Linehan, 2007). Indeed, Cavicchioli, Movalli, and Maffei (2019) showed that mindfulness dimensions (i.e., self-regulation of attention; non-judgmental attitude) were significant mediators of the relationship between DER and SPQ subscales related to the severity of AUD and benzodiazepines use disorder (BUD). Furthermore, the development of mindful

acceptance attitude is involved in addressing shame and guilt for lapse in substance use and in quickly reestablishing abstinence (Dimeff & Linehan, 2008). Similarly, distress tolerance skills allow to manage intense pain associated with withdrawal symptoms (Dimeff & Sayers, 2012). Consistently, low levels of distress tolerance predicted early relapse in substance use after a rehabilitation program (Daughters, Lejuez, Kahler, Strong, & Brown, 2005). Furthermore, distress tolerance skills reduced depressive symptoms among individuals with SUDs (Bornoalova, Gratz, Daughters, Hunt, & Lejuez, 2012). The emotion regulation module provides a wide array of skills that help clients to identify and reduce the vulnerability to extreme emotions, as well as change the distressing ones. Empirical studies sustained the role of adaptive emotion regulation strategies in preventing substance use within DBT (Axelrod et al., 2011; Cavicchioli, Movalli, & Maffei, 2019; Cavicchioli, Movalli, Ramella, et al., 2019; Maffei et al., 2018) and other cognitive-behavioral approaches (e.g., Berking et al., 2011). The adaptation of DBT for the treatment of SUDs also introduced specific behavioral skills for addressing cues to use substance by considering associative processes linked to craving episodes (Dimeff & Sayers, 2012; McMMain et al., 2007). Ultimately, DBT includes specific skills to improve the community reinforcement for maintaining abstinence, taking into account the necessity to substitute the rewarding effects of substance use with the ones of interpersonal relationships (Dimeff & Sayers, 2012; McMMain et al., 2007).

However, no studies so far have empirically tested whether and to what extent a stand-alone DBT-ST program might address other core clinical aspects of AUD and other SUDs beyond abstinence maintenance. Furthermore, the improvements in DER might be linked to changes in core clinical dimensions of addiction pathology. Ultimately, no studies have tested the DBT clinical hypothesis regarding the therapeutic role of coping strategies in addressing DER and core features of SUDs.

1.3. The present study

The current study aims at investigating pre- posttreatment changes in consecutive days of abstinence (CDA), severity of AUD and concurrent SUDs (CO-SUDs) (i.e., BUD, cannabis and cocaine use disorders), DER, as well as in the use of coping strategies during a stand-alone outpatient DBT-ST program adapted for individuals with a primary diagnosis of AUD. The severity of CO-SUDs was taken into account in the light of the high co-occurrence rates between AUD and other SUDs (Hedden et al., 2010; Stinson et al., 2005), especially cannabis, cocaine, sedative and tranquilizer use disorders (Blanco et al., 2013; Hasin et al., 2016; Moss, Goldstein, Chen, & Yi, 2015; Narvaez et al., 2014). Outcomes for the severity of CO-SUDs were separately analyzed. Specifically, empirical data demonstrated that cannabis and cocaine use disorders tend to coexist in individuals with AUD (Cuffel, 1996), and there is an independent class of individuals with AUD and BUD (Blanco et al., 2013).

The study hypothesized significant pre- posttreatment improvements in CDA, the severity of AUD and CO-SUDs, as well as in DER, in line with the previous results regarding the adaptation of DBT-ST for AUD (Cavicchioli, Movalli, & Maffei, 2019; Cavicchioli, Movalli, Ramella, et al., 2019; Maffei et al., 2018). According to DBT treatment goals (Linehan, 1993, 2014), the study expected a significant increase in the use of DBT skills addressing stressful situations, and a decrease in maladaptive coping strategies. Furthermore, improvements in DER should predict changes in primary outcomes, consistent with the functional relationships between these two dimensions (Cavicchioli, Movalli, & Maffei, 2019). Ultimately, changes in the use of coping strategies, both adaptive and maladaptive, should mediate the relationship between DER and abstinence maintenance with the severity of AUD/CO-SUDs, in line with process-outcome studies on DBT (e.g., Neacsiu, Rizvi, & Linehan, 2010; Rizvi et al., 2011).

Table 1
Clinical characteristics of the sample (N=108).

	N	%	M (SD)
Co-occurrent SUDs	39	36.1	
Cannabis use disorder	11	10.2	
Cocaine use disorder	17	15.7	
Anxiolytic use disorder	27	25.0	
Gambling disorder	1	.9	
Mood disorders	11	10.2	
Anxiety disorders	4	3.7	
Eating disorders	3	2.8	
Personality disorders	57	52.8	
Avoidant PD	5	4.6	1.03 (1.34)
Dependent PD	0	.0	.56 (.88)
Obsessive-compulsive PD	2	1.9	.78 (1.03)
Paranoid PD	0	.0	.28 (.59)
Schizoid PD	0	.0	.05 (.33)
Schizotypal PD	0	.0	.05 (.21)
Histrionic PD	1	.9	.40 (.88)
Narcissistic PD	15	13.9	1.60 (1.99)
Borderline PD	11	10.9	1.26 (1.88)
Antisocial PD	0	.0	.06 (.34)
PD other specified	20	18.5	6.08 (3.40)
Cluster A	0	.0	.38 (.74)
Cluster B	27	25.0	3.32 (2.92)
Cluster C	7	6.5	2.38 (1.93)
ASI medical status			.25 (.27)
ASI employment status			.41 (.32)
ASI alcohol use			.45 (.26)
ASI drugs use			.09 (.11)
ASI legal status			.02 (.09)
ASI family/social status			.25 (.21)
ASI psychiatric status			.23 (.20)

ASI = Addiction Severity Index; PD = Personality Disorder; SUDs = Substance Use Disorders.

2. Material and methods

2.1. Participants

From September 2016 to August 2018, a voluntary sample of 108 individuals with AUD (according to DSM-5 criteria; APA, 2013) was consecutively admitted to San Raffaele Hospital (Milan). The sample was represented by both male (59.3%) and female (40.7%) individuals between the ages of 24 and 75 years (Mean (SD) = 48.43 (9.61)). Educational level was equally distributed (25.3% middle school graduates; 22.9% vocational training; 25.3% high school graduates; 25.3% university degree). Psychotic disorders and severe cognitive impairments were considered as exclusion criteria. Lifetime co-diagnoses of other psychiatric disorders were not exclusion criteria, except when symptomatology showed the disorders in an active phase. Personality disorders co-diagnoses did not prevent patients from being included in the clinical trial. Additional DSM-5 substance-related and addictive behaviors diagnoses did not represent exclusion criteria. No one in the sample met the exclusion criteria. Table 1 shows a detailed description of the comorbid conditions.

2.2. Measures

2.2.1. Addiction severity index (ASI) (Consoli & Bennardo, 2001; Kokkevi & Hartgers, 1995; McLellan et al., 1992)

ASI is a semi-structured interview that yields a multi-dimensional assessment of seven life problem areas: medical, employment, alcohol, drug, legal, family-social, and psychiatric. The interview takes approximately 45 min to complete at baseline evaluation. In the current study, the clinicians administered the Italian version of ASI (Consoli & Bennardo, 2001). The composite score was computed for each domain (for a detailed description of computation procedures, see McGahan, Griffith, Parente, & McLellan, 1986). The ASI was also used in order to

assess CDA in the last month before participants' admission to the program.

2.2.2. Structured clinical interview for DSM-5 personality disorders (SCID-5-PD) (First, Williams, Benjamin, et al., 2016a, 2016b)

The SCID-5-PD is a 119-item semi-structured interview designed to assess the 10 DSM-5 PDs of Clusters A (i.e., Paranoid PD, Schizotypal PD, Schizoid PD), B (Histrionic PD, Narcissistic PD, Borderline PD, and Antisocial PD), and C (Avoidant PD, Dependent PD, Obsessive-Compulsive PD). The SCID-5-PD allows also for Other Specified (i.e., Mixed) PD categorical diagnosis. The SCID-5-PD allows to make a dimensional diagnosis for each of the DSM-5 PDs by summing up the all of the ratings (i.e., "0" = Absent, "1" = Subthreshold, and "2" = Threshold). SCID-5-PD is also provided with a 106-item true/false, self-report questionnaire as a screening tool. The current study administered the Italian version of the SCID-5-PD. This version demonstrated adequate Cohen's *k* for SCID-5-PD dichotomous ratings of presence of clinically significant subthreshold features (median *k* value = .78, SD = .06), as well as for categorical PD diagnoses of SCID-5-PD interview (median *k* value = .89, SD = .11) (Somma et al., 2017).

2.2.3. Continuous days of abstinence during the treatment

Substance use during treatment was certified by at least two random weekly toxicological screenings. Particularly, ethyl glucuronide and the ratio between ethyl glucuronide and creatinine were considered as biomarkers of alcohol intake; the screening can detect alcohol intake reliably for about 4 days after alcohol intake (e.g., Helander, Böttcher, Fehr, Dahmen, & Beck, 2008; Wurst, Kempfer, Seidl, & Alt, 1999). Further, the use of other substances was assessed by the following urinary metabolites: cannabinoids (4–5 weeks detection period; Musshoff & Madea, 2006), cocaine (3 days detection period; Cone, Tsodik, Oyler, & Darwin, 1998; Preston et al., 2002), amphetamines (2 days detection period; Kim, Oyler, Moolchan, Cone, & Huestis, 2004), opioids, and benzodiazepines (2 days detection period; Tenore, 2010). Consecutive days of abstinence were estimated by summing the number of consecutive negative toxicological screenings. A distinction was applied between lapse and relapse when patient showed substance intake during the treatment, according to theoretical considerations on treatment outcomes for AUD (Maisto, Witkiewitz, Moskal, & Wilson, 2016). On the one hand, lapse was defined as any single positive toxicological screening. On the other hand, relapse was defined as more than 3 consecutive positive toxicological screenings (Demirbas, Ilhan, & Dogan, 2012).

2.2.4. Shorter PROMIS questionnaire (SPQ) (Christo et al., 2003)

The SPQ is a 160-item self-report instrument for simultaneous assessment of 16 addictive behaviors — use of alcohol, tobacco, illegal drugs, prescription drugs, gambling, sex, dominant and submissive relationships, shopping, food bingeing, starvation, caffeine, work, exercise, and dominant and submissive compulsive helping. Each of the 16 subscales consists of 10 self-referent statements that respondents endorse on a 6-point Likert scale from 0 (not like me) to 5 (like me). Items reflect seven common characteristics of addictive behaviors in the light of Lefever's (1988) conceptualization, namely preoccupation (e.g., "I have been irritable and impatient if there has been more than ten minutes of conversation at a meal or social function before my host offers me an alcoholic drink"), use alone (e.g., "I have deliberately used drugs before going out for a time if I have felt there might not be the opportunity to use them later), use for effect (e.g. "I have particularly enjoyed getting a really strong effect from recreational drugs"), use as a medicine (e.g., "I have used alcohol as both a comfort and a strength), protection of supply (e.g., "If my prescription medicines supply was being strictly controlled I would hang onto some old tablets even if they were definitely beyond their expiry date), using more than planned (e.g., "I have often drunk significantly more alcohol than I intended to"), and increased capacity or tolerance (e.g., "I have found that my

previous doses of prescription medicines are no longer successful in controlling my symptoms). The subscales of SPQ demonstrated good internal consistency ($.82 \geq \alpha \geq .98$) in the original validation study (Christo et al., 2003) and in further validations among nonclinical subjects ($.82 \geq \alpha \geq .98$) (e.g., MacLaren & Best, 2010), as well as adequate test-retest reliability (mean ICC (SD) = .77 (.16)) (Christo et al., 2003). For the purpose of this study, the analysis included alcohol, prescription, and other drugs subscales. The Italian version of SPQ was administered. The previous subscales of this version showed adequate psychometric properties ($.85 \geq \alpha \geq .96$) among individuals with AUD (Cavicchioli, Movalli, & Maffei, 2019).

2.2.5. Difficulties in Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004)

DERS is a 36-item self-report questionnaire with items rated on a 5-point Likert scale. The DERS consists of six subscales—nonacceptance, goals, impulse, awareness, strategies, and clarity. The higher the total score is, the higher the level of emotional dysregulation. The original version showed good psychometric indexes (DERS total score: $\alpha = .93$; DERS subscales: $\alpha \geq .80$). The Italian version of the DERS was administered; an Italian validation study (Giromini, Velotti, de Campora, Bonalume, & Cesare Zavattini, 2012) showed adequate psychometric properties (DERS total score: $\alpha = .92$; DERS subscales: $.77 \geq \alpha \geq .89$). Similar psychometric properties were found among Italian individuals with AUD (DERS total score: $\alpha = .88$; DERS subscales: $\alpha \geq .70$) (Cavicchioli, Movalli, & Maffei, 2019; Maffei et al., 2018). For the purposes of this study, the analysis included the DERS total score.

2.2.6. DBT ways of coping checklist (DBT-WCCL) (Neacsiu, Rizvi, Vitaliano, Lynch, & Linehan, 2010)

The DBT-WCCL is an adaptation of the Revised Ways of Coping Checklist (Vitaliano, Russo, Carr, Maiuro, & Becker, 1985) that includes additional items reflecting DBT skills. The DBT-WCCL is a 59-item self-report instrument measuring the frequency of DBT skills use (38 items) and dysfunctional non-DBT coping strategies (21 items) over the previous month. The questionnaire asked about ways in which the participant has coped with stressful events. All items are rated from 0 to 3 ("never use" to "always use"). DBT Skills use (DSS) and dysfunctional non-DBT coping strategies (DCS) indexes were computed by averaging all items of the subscales respectively (Neacsiu, Rizvi, & Linehan, 2010; Neacsiu, Rizvi, Vitaliano, et al., 2010). In the original validation study, DSS ($.92 \geq \alpha \geq .96$) and DCS ($.87 \geq \alpha \geq .92$) showed excellent internal consistency. Test-retest reliability at 4 months for 119 BPD individuals was acceptable, ($\rho_1 = .71, p < .001$). The internal consistency of DSS subscale was replicated in another clinical sample ($\alpha = .94$) (Stein, Hearon, Beard, Hsu, & Björgvinsson, 2016). The Italian version of the instrument was administered. The Italian adaptation of DBT-WCCL was translated by Roder, Cavarra, Gaj, Visintini, and Maffei (2014) showing good psychometric properties (DSS: $\alpha = .90$; DCS: $\alpha = .83$) in a mixed sample of individuals with personality disorders. In the current sample, DBT-WCCL subscales demonstrated excellent internal consistency values (DSS: $\alpha = .98$; DCS: $\alpha = .93$). According to the hypotheses of the study, the analyses included both DSS and DCS subscales.

2.3. Procedures

This study was consistent with the code of conduct for research in psychology (Associazione Italiana di Psicologia: Codice Etico per la Ricerca in Psicologia, 2015), in line with the ethical principles of the American Psychological Association, 2017. It was approved by the Ethics Committee of San Raffaele Hospital. All participants provided informed consent prior to participation in the study. Before their admission to treatment, two senior psychiatrists conducted a preliminary clinical interview to confirm the diagnosis of AUD and evaluate the presence of other psychiatric disorders. The psychiatrists were chosen

according to their long-standing experience (i.e., 20 years) in the field of addiction treatment, to support the reliability of assessment procedures (Govaerts, Schuwirth, Van der Vleuten, & Muijtjens, 2011). Subsequently, the participants received two clinical psychiatric evaluations within a period of two weeks, which assessed if they could achieve spontaneous abstinence. When the addiction severity did not allow reaching this goal, participants were hospitalized for a 10-day detoxification program before DBT-ST admission ($N = 78$ (72.2%)). At the beginning of the treatment, trained psychologists conducted the Italian version of the Addiction Severity Index (ASI) (Consoli & Bennardo, 2001; Kokkevi & Hartgers, 1995; McLellan et al., 1992). The assessment of DSM-5 PD diagnosis was carried out after a month-long period of detoxification to verify the possible diagnostic biases induced by substances intoxication and abstinence. Self-report assessment instruments were administered at the beginning of treatment (t_0), after one month (t_1), and at the end (t_2) of the intervention. At least two random weekly urine toxicology screening tests were used to validate the abstinence maintenance during the treatment.

2.3.1. DBT-ST program for AUD

This three-month program of skills training had two phases: an intensive phase that consisted of five sessions a week for the first month, and a post-intensive phase (two sessions a week) for the subsequent two months. The total number of sessions was 36. Each session lasted three hours, for a total of 108 hours. The first hour, conducted in a group setting, consisted of a clinical assessment conducted by an expert psychiatrist. Suicidal attempts and ideation, non-suicidal self-injury behaviors, lapse in addictive behaviors and craving episodes, and mood and anxiety symptoms were assessed. Sleep disturbances and possible pharmacological side effects were also investigated. The choice to conduct this assessment in a group setting was based on the opportunity to reduce the risk of shame-based avoidance behaviors frequent in individuals with SUDs (Flores, 2001). Nevertheless, individual clinical management was conducted with each participant twice a month to collect more detailed information and to check for possible difficulties due to the lack of privacy in a group setting. The choice to rule out formal procedures for assessing such behaviors and symptomatology was supported by two reasons: (a) even though clinical evaluation based on valid and reliable instruments is more accurate than clinical judgment, the difference between them is modest (for meta-analytic reviews, see *Ægisdóttir et al., 2006; Grove, Zald, Lebow, Snitz, & Nelson, 2000*), and clinical assessment has achieved adequate levels of predictive power (for overviews, see *Lichtenberg, 1997; Miller, Spengler, & Spengler, 2015; Spengler & Pilipis, 2015*); (b) dialectic, unstructured clinical interactions were chosen to improve motivation and to facilitate the working alliance (e.g., *Finn & Tonsager, 1997; Hilsenroth, Peters, & Ackerman, 2004; Tryon, 1990*)

The last two hours focused on DBT-ST in a closed-group setting, with five to ten participants. A leader and co-leader evenly alternated teaching DBT-ST sessions and reviewing homework on mindfulness, distress tolerance, and emotional regulation skills. Table 2 summarizes the structure and rationale of DBT-ST adapted for AUD treatment (for a detailed description of treatment rationale, see *Maffei et al., 2018*). Specific DBT skills for SUDs were incorporated (*Linehan, 2014; McMain et al., 2007*). Chain and missing link analyses were also used when participants either engaged in ineffective behaviors (e.g., alcohol or substance use lapse) or failed to engage in effective behaviors (e.g., difficulties in skills use). The treatment did not involve the use of diary cards; instead, the participants were asked to complete worksheets and bring them to the DBT-ST review sessions. Treatment non-completion was defined as participants missing four consecutive skills group sessions.

2.4. Statistical analyses

SPSS 22 was used to analyze the data. The paired t -test with a

covariate (baseline level of each variable) (*Hedberg & Ayers, 2015*) was computed to evaluate the change in CDA, SPQ scores, DERS total scores and DBT-WCCL subscales from the beginning to the end of treatment. Cohen's d and its 95% confidence interval (CI) (*Borenstein, Hedges, Higgins, & Rothstein, 2011*) were estimated as effect size measures. Consistent with the hypotheses of the study, multiple parallel mediational models were computed using the PROCESS tool for SPSS (*Hayes, 2017*). Model 4 was considered to conduct the analyses. According to the purposes of the research and previous empirical results (e.g., *Cavicchioli, Movalli, & Maffei, 2019; Neacsu, Rizvi, & Linehan, 2010*), the scores at the end of treatment related to CDA/SPQ subscales, DERS total scores and DBT-WCCL dimensions (i.e., DSS and DCS) were introduced within models as dependent (DV), independent (IV) and parallel mediating variables respectively. The baseline scores of these variables were introduced as covariates in the models. Multicollinearity was tested concurrently considering DERS, DSS, and DCS scores in order to control for possible confounding effects of interrelationships among independent and mediator variables. Criteria proposed by *Bowerman and O'connell (1990), Myers (1990), and Menard (2002)* were used to evaluate the presence of collinearity problems. According to procedures described by *Hayes (2017)*, the mediational analysis included the computation of the following indexes: (a) the direct effect (c') (i.e., IV with estimated DV, controlling for the effect of the mediators); (b) coefficient a (i.e., IV with the estimated mediators); (c) coefficient b (i.e. the mediators with estimated DV, controlling for the IV); (d) indirect effects (ab) (total and for each DBT-WCCL dimensions); and (e) the total effect ($c = c' + \sum ab$). Bias-corrected bootstrap methodology using 1000 independent samples (95% CI) and the Sobel test were applied to estimate the significance of the indirect effect. The bootstrap 95% CI was also computed to evaluate the significance of the direct and total effect. Finally, intention-to-treat analysis (ITT) based on the last observation carried forward was proposed in order to adopt a conservative approach (*Hollis & Campbell, 1999; Montori & Guyatt, 2001*).

3. Results

95.3% of participants ($N=103$) concluded the program. 79.6% of patients ($N= 86$) maintained abstinence during the program. On the contrary, the remaining portion of the sample showed at least a lapse in substance use during treatment. However, no relapse was detected. The mean of consecutive days of abstinence at the end of treatment was 95.62 (SD = 39.38) and the average number of absences was 2.34 (SD = 2.54). Considering the evaluation of collinearity problems, no tolerance value was below .2 ($.63 \leq \text{tolerance} \leq .89$), no variance inflation factor (VIF) values were greater than 10 ($1.12 \leq \text{VIF} \leq 1.60$), and the average VIF was close to 1 (VIF = 1.40). *Figs. 1, 2, 3, and 4* summarize results for mediational models estimated according to the study hypotheses.

3.1. Pre – posttreatment changes in clinical variables

Table 3 summarizes descriptive statistics and paired t -test results for CDA, SPQ subscales, DERS total score and DBT-WCCL dimensions. Specifically, independently of baseline levels, significant and large decreases were detected for CDA ($t_{(107)} = 21.90$; $p < .001$), SPQ alcohol subscale ($t_{(107)} = 5.94$; $p < .001$) and DERS total score ($t_{(107)} = 8.63$; $p < .001$). Furthermore, the analysis showed moderate improvements in SPQ prescription ($t_{(107)} = 4.92$; $p < .001$) and illicit ($t_{(107)} = 4.00$; $p < .001$) drugs subscale, as well as in DBT-WCCL DSS dimension ($t_{(107)} = 4.48$; $p < .001$). On the contrary, no significant differences during the treatment were observed in DBT-WCCL DCS subscale.

3.2. Mediational model for consecutive days of abstinence

The analysis did not highlight total ($c = -.29$, $p = .08$; $R^2 = .02$)

Table 2
Description of DBT-ST program for AUD.

Sessions	Topic	Skills	Function
1-2	Dialectical Abstinence (Dimeff & Linehan, 2008; McMMain et al., 2007)	Leader and co-leader use standard DBT commitment strategies	Preventing “abstinent violation effect” (AVE) (Curry et al., 1987; Larimer & Palmer, 1999; Marlatt & Donovan, 2005)
3-6	The Path to “Clear Mind” (McMMain et al., 2007)	Synthesis of “Clean Mind” and “Addict Mind” Burning Bridges Adaptive Denial Self-Management Strategies	Defining targets: (a) interrupting use of alcohol and other substances, including illicit drugs and legally prescribed drugs taken in a non-prescribed manner; (b) alleviating physical discomfort associated with abstinence and/or withdrawal; (c) diminishing urges, cravings, and temptations to abuse; (d) avoiding opportunities and cues for abuse; (e) reducing behaviors conducive to drug abuse; (f) increasing community reinforcement of healthy behaviors. Developing/reinforcing skills needed to sustain abstinence.
7-18	Mindfulness	Observe Describe Participating Non-Judgmentally One-Mindfully Effectively	Teaching of nonjudgmental observation and description of moment-to-moment emotional experiences, thoughts, and action urges especially related to craving. Improving awareness of triggers and internal reactions of craving, and fostering more skillful behavioral choices (Bowen et al., 2006; Bowen et al., 2009; Witkiewitz, Marlatt, & Walker, 2005). They also represent an emotion regulation skill itself (for a review see: Chambers, Gullone, & Allen, 2009)
19-24	Distress Tolerance	TIP Distraction Pros and Cons Radical Acceptance	Teaching adaptive and effective strategies to tolerate life's unavoidable stresses and pain without turning to drinking or substance use, and facilitate acceptance of the current moment's realities
25-36	Emotion Regulation	Identifying and Describing emotions; Functions of Emotions; PLEASE; Opposite Action; Problem Solving; Build Mastery and Positive Experiences	Understanding of how emotions function, accepting emotional reactions, decreasing vulnerability to negative emotions, increasing positive emotions, and changing specific emotional states by acting opposite to one's current emotion. They involve solving problematic situations that trigger emotions, which often had been modulated by substance use previous to the intervention.

and direct effects ($c' = -.20, p = .30$) of DER on CDA. DSS ($b_1 = 8.35; p = .30; R^2 = .007$) and DCS ($b_2 = -.62; p = .93; R^2 = .00$) scores did not explain the duration of abstinence maintenance.

3.3. Mediation model for the severity of AUD

The analysis showed significant total ($c = .28, p < .001; R^2 = .12$) and direct ($c' = .14, p < .05$) effects of DERS total scores on SPQ alcohol subscale scores. Furthermore, results showed significant indirect effects of coping skills use on the relationship between DER and the severity of AUD. Particularly, the data highlighted a significant total indirect effect ($ab_{total} = .13 [0.05 - .23]; Z = 2.60; p < .05$), and indirect effects of both DSS ($ab_{DSS} = .04 [0.003 - .10]; Z = 2.04; p < .05$) and DCS ($ab_{DCS} = .10 [0.03 - .18]; Z = 2.50; p < .05$) subscales on the relationship between DER and the severity of AUD.

3.4. Mediation model for the severity of benzodiazepines use disorder

Significant total ($c = .14, p < .001; R^2 = .20$) and direct ($c' = .09, p < .01$) effects of DERS total score were replicated for the score of SPQ prescription drugs subscale. Furthermore, a significant total indirect effect of the use coping skills was detected ($ab_{total} = .05 [0.01 - .09]; Z = 2.50, p < .05$), especially for DCS subscale scores ($ab_{DCS} = .01 [0.003 - .03]; Z = 2.50, p < .05$). Even though DSS subscale score predicted the severity of AUD ($b_1 = -.223, p < .05; R^2 = .05$), the analyses did not demonstrate a significant indirect effect of this dimension on the relationship between DER and the severity of AUD ($ab_{DSS} = .01 [-0.005 - .05]; Z = 1.33, p = .16$).

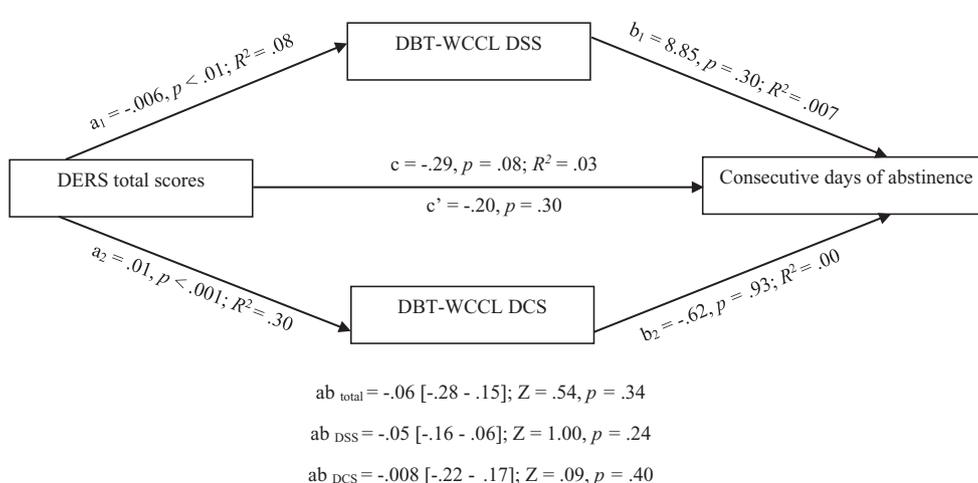


Fig. 1. Mediation model for consecutive days of abstinence.

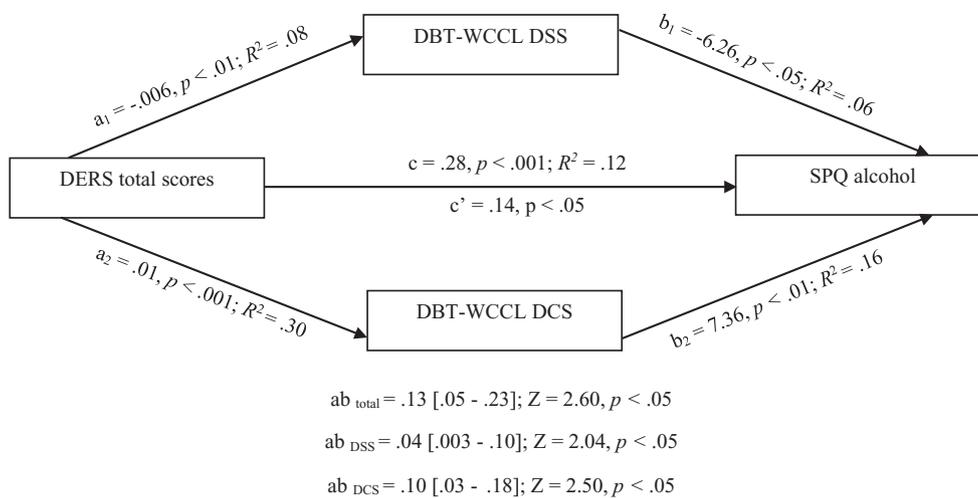


Fig. 2. Mediation model for the severity of alcohol use disorder.

3.5. Mediation model for the severity of cocaine and cannabis use disorders

The results showed significant total ($c = .15, p < .001; R^2 = .17$) and direct ($c' = .12, p < .01$) effects of DERS total scores on SPQ illicit drugs scores. On the contrary, the analyses detected no indirect effects of coping skills use on the previous relationship.

4. Discussion

This study sought to examine primary and secondary treatment outcomes of a stand-alone outpatient DBT program for AUD. Particularly, the research focused on changes in CDA, severity of SUDs, DER, and use of coping strategies. Furthermore, the relationships between DER, substance use and severity of SUDs during treatment were investigated according to previous studies (for a review see: Wilcox, Pommy, & Adinoff, 2016). Ultimately, this study tested the mediating role of the use of coping strategies (i.e., DBT skills, maladaptive strategies) on the associations between DER and relevant clinical features of SUDs in line with DBT clinical principles (Linehan, 1993, 2014).

First of all, the significant improvements observed during treatment in CDA and severity of AUD/CO-SUDs, which were independent of baseline levels, replicated and extended the evidence supporting the implementation of DBT-ST as stand-alone intervention for individuals with AUD (Cavicchioli, Movalli, Ramella, et al., 2019; Maffei et al., 2018). Secondly, the large decrease in DER from the beginning to the

end of treatment replicated the results of previous clinical trials (Cavicchioli, Movalli, Ramella, et al., 2019; Maffei et al., 2018). The key role of DER in the treatment of AUD and CO-SUDs (Cavicchioli, Movalli, Ramella, et al., 2019; Maffei et al., 2018) were also confirmed by the associations between changes in DER and improvements in severity of SUDs. This result is consistent with clinical views assuming and demonstrating that DER should be considered as a core dimension involved in the treatment of SUDs (e.g., Berking et al., 2011; Kober & Bolling, 2014). Accordingly, several empirical studies showed that negative mood and emotions are the most prominent factors determining craving and relapses (e.g., Gamble et al., 2010; Sinha, 2012). Furthermore, DER were involved in predicting the severity of AUD and BUD (Cavicchioli, Movalli, & Maffei, 2019). Therefore, the decrease in DER during the DBT-ST might impact on several clinical features characterizing SUDs. Unexpectedly, the analyses showed a modest, albeit nonsignificant, association between changes in DER and CDA, in contrast with previous trials (Cavicchioli, Movalli, Ramella, et al., 2019; Maffei et al., 2018). This result might be related to several clinical and methodological issues. The current sample showed better baseline levels of DER and CDA compared to the previous ones. This could affect the relationship between DER and abstinence maintenance. Indeed, the initial protracted abstinence might impact on emotional vulnerability induced by substance intoxication and withdrawal syndrome (e.g., Koob, 2011). Therefore, this could reduce the effect of DER on abstinence maintenance. Furthermore, the current study and previous ones differ in the way DER and CDA scores were introduced in the

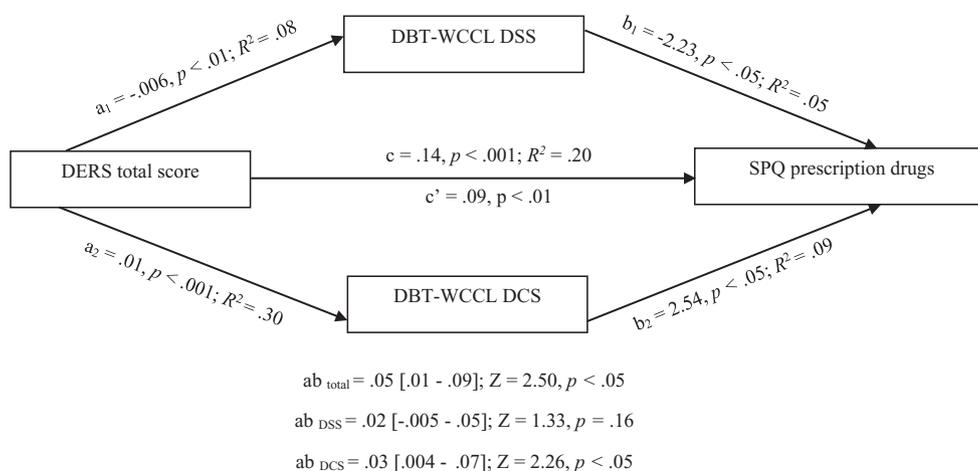


Fig. 3. Mediation model for the severity of benzodiazepines use disorder.

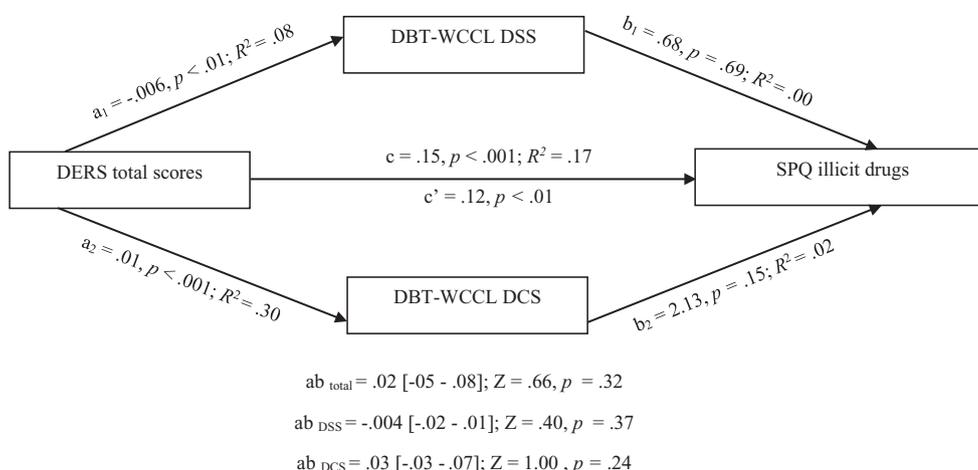


Fig. 4. Mediation model for the severity of cocaine and cannabis use disorders.

mediational models. Particularly, the first open trial and replication study evaluated the relationship between change scores of DERS and CDA. The different mathematical approach might explain the non-significant result discussed above. Indeed, the analysis replicated significant total and direct effects of changes in DER on the duration of abstinence maintenance ($c = -.36; p < .01$; $c' = -.34; p < .01$), conducting a mediational model using change scores. Ultimately, the absence of a significant relationship between DERS scores and abstinence maintenance could be related to the sample size, which was smaller than prior studies (i.e., Cavicchioli, Movalli, Ramella, et al., 2019; $N = 171$; Maffei et al., 2018; $N = 244$). This aspect dampens the power of the statistical test. Despite this partial incongruence regarding abstinence maintenance, DER are relevant clinical targets in the treatment of SUDs in the light of their implications in core features of addiction pathology.

In line with DBT clinical assumptions and other DBT clinical trials (Neacsiu, Rizvi, & Linehan, 2010; Neacsiu, Rizvi, Vitaliano, et al., 2010; Neacsiu, Eberle, Kramer, Wiesmann, & Linehan, 2014), participants reported a significant increase in the use of DBT Skills from the beginning to the end of treatment. Furthermore, this increase was related to the improvement of severity of AUD and concurrent BUD, but not to cannabis and cocaine use disorders and abstinence maintenance. On the contrary, no significant changes in the use of maladaptive coping skills were detected during treatment. Nonetheless, DBT-WCCL DCS dimension predicted the severity of AUD and BUD.

With regard to AUD, both adaptive and maladaptive coping strategies were significant, albeit partial, mediators of the relationship between DER and severity of such condition. This result is fully line with empirical findings on emotion-focused and avoidant coping strategies, which represent significant protective and risk factors for alcohol abuse respectively (e.g., Feil & Hasking, 2008; Hasking, Lyvers, & Carlopio, 2011; Walker & Stephens, 2014). This evidence suggests that the

improvement of adaptive cognitive and behavioral skills (e.g., mindfulness, distress tolerance and emotion regulation strategies), and the decrease of dysfunctional coping strategies could be considered therapeutic mechanisms in addressing core clinical features of AUD. This finding is in line with both the DBT model (Dimeff & Linehan, 2008; Dimeff & Sayrs, 2012; McMains et al., 2007) and other third-wave cognitive treatments for SUDs (e.g., mindfulness-based relapse prevention, acceptance and commitment therapy) (Brewer, Bowen, Smith, Marlatt, & Potenza, 2010; Hayes & Levin, 2012; Witkiewitz, Lustyk, & Bowen, 2013). Nevertheless, the partial mediating role of coping strategies supports the implication of other mechanisms involved in explaining the association between DER and AUD. For instance, long-term biological alterations of emotional systems induced by alcohol intoxication and withdrawal syndrome might sustain the link between emotional dysregulation and clinical manifestations of AUD (e.g., craving, difficulties in refrain alcohol intake) (Heilig, Egli, Crabbe, & Becker, 2010). Furthermore, the typical impairments in neuro-cognitive of AUD (Stavro, Pelletier, & Potvin, 2013) might be involved in explaining both DER and the severity of AUD (Kober & Bolling, 2014). Ultimately, personality traits linked to impulsivity (i.e., negative urgency and lack of planning), which are significantly associated to AUD (Coskunpinar, Dir, & Cyders, 2013), might play a role in the link between DER and clinical features of this condition. The considerations regarding the therapeutic role of coping strategies can be extended to the severity of concurrent BUD, although only the use of maladaptive strategies represents a significant partial mediator. The mediating role of DBT-WCCL DCS subscale on SPQ prescription drug scores might support the conclusion that individuals with AUD misuse benzodiazepines as a maladaptive form of emotion regulation (Cavicchioli, Movalli, & Maffei, 2019). However, the significant direct effect of DER suggests that additional processes could be involved in the relationship between DER and the severity of BUD, as previously discussed for AUD.

Table 3

Descriptive statistics and pre- posttreatment comparisons (ITT $N = 108$).

	Beginning of treatment M (SD)	End of treatment M (SD)	$t_{(107)}$	d (95% CI)
CDA	21.80 (25.15)	95.62 (39.38)	21.90***	2.15 (1.80 – 2.50)
SPQ alcohol	25.09 (14.17)	10.77 (14.71)	5.94***	-.99 (-1.23 – -.75)
SPQ prescription drugs	9.88 (10.16)	5.53 (8.88)	4.92***	-.42 (-.56 – -.27)
SPQ illicit drugs	7.99 (11.78)	3.54 (9.13)	4.00***	-.36 (-.55 – -.18)
DERS total score	99.74 (24.16)	75.11 (20.90)	8.63***	-1.08 (-1.34 – -.81)
DBT-WCCL DSS	1.63 (.50)	1.83 (.47)	4.48***	.43 (.23 – .62)
DBT-WCCL DCS	1.32 (.74)	1.33 (.59)	.34	.01 (-.23 – .20)

CDA = Consecutive Days of Abstinence; DBT-WCCL DSS = DBT ways of coping checklist DBT Skills Use; DBT-WCCL DCS = DBT ways of coping checklist dysfunctional non-DBT coping strategies; DERS = Difficulties with Emotion Regulation Scale; ITT = Intention-to-Treat; SPQ = Shorter Promis Questionnaire.

*** $p < .001$

Particularly, the misuse of benzodiazepines might reflect high levels of experiential avoidance, as observed in other clinical settings (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996). The concurrent maladaptive use of benzodiazepines as a form of emotion regulation could be also related to the dimension of anxiety sensitivity, as shown in other populations of SUDs (e.g., Hearon et al., 2011; McHugh et al., 2017). In line with DBT principles, these empirical findings suggest that the substitution of maladaptive coping strategies with adaptive cognitive and behavioral skills might be a relevant therapeutic mechanism involved in the relationship between DER and AUD with concurrent BUD. Nevertheless, other risk factors, both biological and psychological, should be considered in the treatment of AUD and concurrent SUDs. This conclusion is particularly relevant for concurrent cannabis and cocaine substance use disorders. Indeed, the use of adaptive and maladaptive coping strategies did not predict the scores of SPQ illicit drugs subscale. Contrary to AUD and BUD, the link between DER and severity of these SUDs could be associated to a dysregulation of reward systems (Koob & Volkow, 2016) and different dimensions of impulsivity, such as positive urgency (e.g., Zapsolski, Cyders, & Smith, 2009), sensation seeking (Ball, Carroll, & Rounsaville, 1994), as well as neuro-cognitive processes involved in self-regulation (Moreno-López et al., 2012; Verdejo-García, Rivas-Pérez, Vilar-López, & Pérez-García, 2007).

The empirical evidence regarding primary and secondary treatment outcomes supports the implementation of DBT-ST as stand-alone outpatient program for AUD and CO-SUDs. The improvement in DER is a core clinical target of the treatment for AUD and CO-SUDs. Moreover, the changes in coping strategies should be considered a significant, albeit partial, therapeutic process for the treatment of clinical features of AUD and concurrent BUD. On the contrary, coping strategies were not involved in addressing the link between DER and the severity of cannabis and cocaine use disorders. Therefore, future studies should consider additional therapeutic mechanisms of DBT beyond the use of coping strategies, such as the improvement of the acceptance attitude towards experiences and top-down neural regulation induced by regular mindfulness practice (e.g., Tang, Tang, & Posner, 2016; Witkiewitz et al., 2013).

Despite the evidence in favor of the implementation of DBT-ST as a valid outpatient program for AUD and CO-SUDs some limitations must be discussed. As in the previous trials, the primary limitation was the absence of control conditions, in particular other evidence-based interventions for SUDs. Overall, the improvements cannot be attributed entirely to the effects of DBT-ST. Further randomized controlled trials should be carried out comparing the current outcomes of DBT-ST with other stand-alone pharmacological treatments for AUD (i.e., disulfiram, oral and injectable naltrexone, acamprosate, and nalmefene) (O'Malley and O'Connor 2011; Mann et al. 2013). These trials should focus on the relationship between DER and severity of clinical features of SUDs. Furthermore, DER could be treated with traditional CBT and other acceptance-based behavioral treatments (e.g., Acceptance and Commitment Therapy; Berking et al., 2011; Gratz, Weiss, & Tull, 2015), using similar behavioral and cognitive strategies (Brown, Gaudiano, & Miller, 2011; Hofmann & Asmundson, 2008). Therefore, future clinical trials are needed to clarify common and unique therapeutic processes associated with DBT-ST, especially comparing such program with other evidence-based psychological treatments (e.g., CBT, ACT) developed from different principles of DBT.

Additional limitations concern assessment procedures. The use of self-reported measures, especially the ones on the use of specific coping strategies, might have partially influenced the results of the study. Clinical interviews should be included in the assessment of adaptive and maladaptive emotional regulation processes (e.g., Emotion Regulation Interview; Werner, Goldin, Ball, Heimberg, & Gross, 2011) and other cognitive-behavioral strategies, such as mindfulness (e.g., Ng, Chow, Lau, & Wang, 2017) and problem-solving skills (Royer, Cisero, & Carlo, 1993). Improvements in behavioral skills might be evaluated by means of neuro-cognitive tasks, which are frequently administered to

individuals with SUDs (Verdejo-García, Lawrence, & Clark, 2008), such as the Stroop task (Stroop, 1935), the Go/No-Go Task (Donders, 1969; Luce, 1986), the Delay Discounting Task (Richards, Zhang, Mitchell, & De Wit, 1999), and the Iowa Gambling Task (Bechara, Damasio, Damasio, & Anderson, 1994). The absence of a systematic assessment of psychiatric symptoms did not allow to explore the relationship between these symptoms and lapse in substance use (for a review see: Bradizza, Stasiewicz, & Paas, 2006). Therefore, reliable self-report instruments (e.g., DSM-5 Cross Cutting Symptoms; Narrow et al., 2013) and clinical interviews (e.g., Structured Clinical Interview for DSM-5; First, Williams, Karg, & Spitzer, 2015) should be administered in future process-outcome studies.

In addition, the completion rate of the current replication study was significantly higher than previous DBT-ST trials for AUD (Cavicchioli, Movalli, & Maffei, 2019; Cavicchioli, Movalli, Ramella, et al., 2019; Maffei et al., 2018) and other interventions for SUDs (for a meta-analysis see: Brorson, Arnevik, Rand-Hendriksen, & Duckert, 2013). This result could reflect a progressive improvement of the skills trainers' expertise, as suggested in the first replication study (Cavicchioli, Movalli, Ramella, et al., 2019). Considering comparable lapse rates across trials, this improvement could result in more effective use of specific dialectic and commitment strategies which were included to prevent the abstinence violation effect (Curry, Marlatt, & Gordon, 1987). This clinical phenomenon is indirectly linked to drop-out by increasing the likelihood of relapse (Marlatt & Donovan, 2005). An alternative explanation of the high completion rate is related to the severity of AUD, which was less severe compared to previous DBT-ST studies (Cavicchioli, Movalli, & Maffei, 2019; Cavicchioli, Movalli, Ramella, et al., 2019; Maffei et al., 2018). According to other empirical studies (e.g., Ahmadi et al., 2009; McKellar, Kelly, Harris, & Moos, 2006), this severity of SUDs significantly impacts on treatment retention. Ultimately, the voluntary admission of participants might also affect the high completion rate of the study. For instance, voluntary admission could lead to higher levels of readiness for change at baseline, which are involved in successful completion of treatment for SUDs (e.g., DiClemente, 1999; DiClemente, Schlundt, & Gemmell, 2004). Furthermore, the voluntary admission of participants could be a confounding factor, especially considering the promising primary (i.e., abstinence maintenance) and secondary (i.e., DER) treatment outcomes. As a result, studies on non-voluntary samples (e.g., incarcerated individuals with AUD) are recommended to replicate the current results. Further replication studies should be carried out among individuals with other primary SUDs (e.g., cocaine, heroin, and cannabis use disorders) in order to confirm the key therapeutic role of DER. Moreover, the low rates of mood and anxiety disorders compared to other studies (e.g., Quello, Brady, & Sonne, 2005; Vorspan, Mehtelli, Dupuy, Bloch, & Lépine, 2015) limits the generalizability of findings. Therefore, the clinical role of DER and DBT skills in addressing relevant features of SUDs should be examined in more representative samples. The absence of follow-up evaluations is an additional limitation of this study. No conclusions can be drawn on the effects of DBT-ST on primary and secondary treatment outcomes after the end of the program. In addition, the question on the temporal stability of improvements and functional relationships of the current study remains unsettled. Hence, follow-up studies should be carried out in order to address these limitations. Ultimately, the current DBT-ST program is difficult to extend to other clinical settings (e.g., ambulatory interventions) because of the number, the length and the frequency of therapeutic sessions. Therefore, future replication studies should carry out a program with a lower frequency (e.g., one or two sessions a week) and length of therapeutic sessions (e.g., 2 hours per sessions), according to standard DBT model (Linehan, 1993, 2014).

In conclusion, this study confirmed the key role of DER within the DBT-ST as stand-alone intervention for the treatment of AUD and CO-SUDs. Furthermore, the increase in the use of DBT skills and the decrease in maladaptive coping strategies should be considered relevant

therapeutic mechanisms in the treatment of SUDs. Nevertheless, future studies should investigate additional processes involved in explaining the relationship between DER and SUDs. Future controlled trials are recommended to clarify unique and common therapeutic effects comparing DBT-ST with other third-wave cognitive interventions or standard CBT. Follow-up studies are needed to demonstrate the temporal stability of primary and secondary outcomes, as well as to investigate the role of DER, DBT skills and maladaptive coping strategies in long-term relapse prevention.

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